

# Early Stage Adoption of ISO/IEC 29110 Software Project Management Practices: A Case Study

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**Abstract.** The ISO/IEC 29110 standard has at its core a Management and Engineering Guide [1] which are targeted at very small entities (enterprises, organizations, departments or projects) having up to 25 people [2], to assist them unlock the potential benefits of using standards which are specifically designed to address their needs. This paper discusses the role and structure of Project Management in the ISO/IEC 29110 standard and the design and development of project management support documentation. In particular this paper describes a case study of an early adopter of ISO/IEC 29110 project management practices and their experiences with implementing these in an industrial context.

**Keywords:** VSE, ISO/IEC 29110, ISO, Standards, Project Management

## 1 Introduction

Projects are the cornerstone of all business activities in small and very small companies. Firms must complete various projects to achieve their financial goals and obtain information. Business owners and managers have only one attempt executing a project successfully. Hence, the process must be carefully thought out and planned. In their study into why software projects fail [3] 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

Administering software development is usually achieved through the introduction of a software project management process. However, implementing software project management controls in very small software companies is a major challenge. This paper introduces the project management practices in the newly published ISO/IEC 29110 [1] standard Software Process Lifecycles for Very Small Entities. The following sections discuss the role of project management in general, the structure of ISO/IEC standard and its project management practices. Finally the paper focuses on the design and development of project management support documentation and their associated usage in early trials of ISO/IEC 29110.

## 2 ISO/IEC 29110 Standard

The ISO/IEC 29110 standard “Lifecycle profiles for Very Small Entities” [1] is aimed at addressing the issues identified above and addresses the specific needs of VSEs [4, 5, 6] and to tackle the issues of poor standards adoption by small companies [7, 8, 9]. The approach [2] used to develop ISO/IEC 29110 started with the pre-existing international standard ISO/IEC 12207 dedicated to software process lifecycles. The overall approach consisted of three steps: (1) Selecting ISO/IEC 12207 process subset applicable to VSEs of up to 25 employees; (2) Tailor the subset to fit VSE needs; and (3) Develop guidelines for VSEs.

The basic requirements of a software development process are that it should fit the needs of the project and aid project success [10]. And this need should be informed by the situational context where in the project must operate and therefore, the most suitable software development process is contingent on the context [11]. The core situational characteristic of the entities targeted by ISO/IEC 29110 is size, however there are other aspects and characteristics of VSEs that may affect profile preparation or selection, such as: Business Models (commercial, contracting, in-house development, etc.); Situational factors (such as criticality, uncertainty environment, etc.); and Risk Levels. Creating one profile for each possible combination of values of the various dimensions introduced above would result in an unmanageable set of profiles. Accordingly VSE’s profiles are grouped in such a way as to be applicable to more than one category. Table 1 illustrates a Profile Group which contains three profiles (labeled A, B and C) that are mapped to nine combinations of business models and situational factors.

**Table 1.** Allocating VSE characteristics to profile groups

<b>Business Models</b>	<b>Profile Situational Factors</b>		
	<b>Critical</b>	<b>User Uncertainty</b>	<b>Environment Change</b>
<i>Contract</i>	<i>Profile A</i>	<i>Profile A</i>	<i>Profile A</i>
<i>In-House</i>	<i>Profile C</i>	<i>Profile B</i>	<i>Profile A</i>
<i>Commercial</i>	<i>Profile B</i>	<i>Profile A</i>	<i>Profile A</i>

Profile Groups are a collection of profiles which are related either by composition of processes (i.e. activities, tasks), or by capability level, or both. The “Generic” profile group has been defined [6] as applicable to a vast majority of VSEs that do not develop critical software and have typical situational factors. This profile group does not imply any specific application domain, however, it is envisaged that in the future new domain-specific sub-profiles may be developed in the future. Table 2 illustrates this profile group as a collection of four profiles, providing a progressive approach to satisfying the requirements of profile group.

**Table 2.** Graduated profile of the Generic profile group

<b>Generic Profile Group</b>	

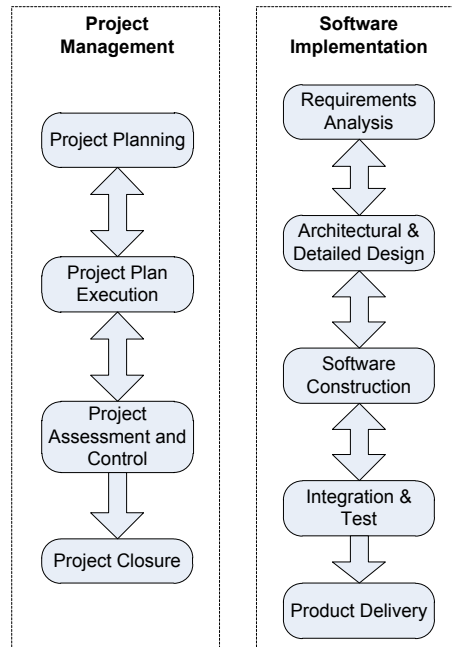
Entry	Basic	Intermediate	Advanced

To date the Basic Profile [1] has been published, the purpose of which is to define a software development and project management guide for performing one project at a time.

## 2.1 Engineering and management guide

At the core of this standard is a Management and Engineering Guide (ISO/IEC 29110-5) [1] focusing on *Project Management* and *Software Implementation* as illustrated in figure 1. The purpose of the *Project Management* process is to establish and carry out in a systematic way the tasks of a software implementation project, which complies with the project's objectives in terms of quality, time and cost. *Project Management* generates a *Project Plan* to direct the software project. During the execution of the project *Change Requests* may cause revisions to the *Project Plan*. The project is the subject of *Project Assessment and Control* during the lifetimes of the project until the *Software Implementation* is complete and *Project Closure* occurs. Software Implementation (SI) produces a specified software system implemented as a software product or service. This process starts with the establishment of *Software Requirements*, after which *Architectural and Detailed Design* are produced. Software is the *Constructed* and verified using *Integration and Test* procedures. The final staged being *product delivery* to the customer.

Within ISO/IEC 29110, the purpose of the Project Management process is to establish and carry out in a systematic way the Tasks of the software implementation project, which allows complying with the project's Objectives in the expected quality, time and costs. It is intended to be used by the VSE to establish processes to implement any development approach or methodology including, e.g., agile, evolutionary, incremental, test driven development, etc. based on the VSE organization or project needs.



**Fig 1.** ISO/IEC 29110 Basic profile Process Diagrams

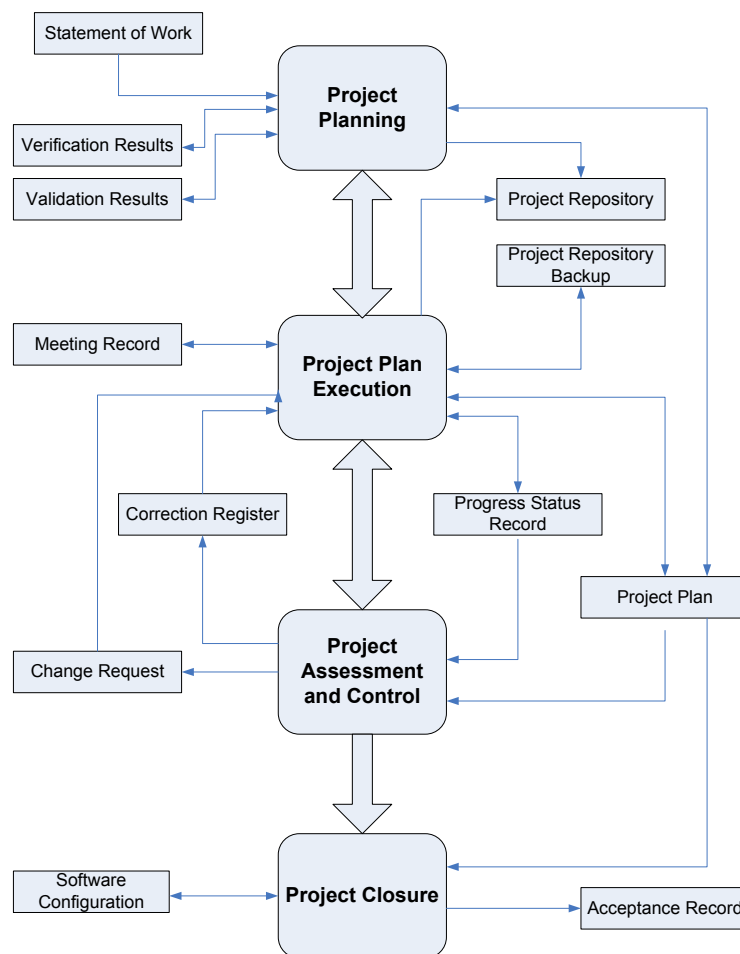
## 2.2 ISO/IEC 2910 Project Management Objectives Practices

Figure 2 shows the flow of information between the Project Management Process activities of the Basic profile including the most relevant work products and their relationship.

The objectives of the ISO/IEC 29110-5-1-2 Project Management Process are:

- The *Project Plan* for the execution of the project is developed according to the *Statement of Work* and reviewed and accepted by the *Customer* and the *Tasks and Resources* necessary to complete the work are sized and estimated.
- Progress of the project is monitored against the *Project Plan* and recorded in the *Progress Status Record*. Corrections to remediate problems and deviations from the plan are taken when project targets are not achieved. Closure of the project is performed to get the *Customer* acceptance documented in the *Acceptance Record*.
- The *Change Requests* are addressed through their reception and analysis. Changes to software requirements are evaluated for cost, schedule and technical impact.
- Review meetings with the *Work Team* and the *Customer* are held and agreements are registered and tracked.
- Risks are identified as they develop and during the conduct of the project.

- A software *Version Control Strategy* is developed, where items of *Software Configuration* are identified, defined and baselined, and releases of the items are controlled and made available to the *Customer* and *Work Team*.
- *Software Quality Assurance* is performed to provide assurance that work products and processes comply with the *Project Plan* and *Requirements Specification*.



**Fig 2.** Overview of ISO/IEC 29110 Project Management Practices

The four activities of the Project Management Process of ISO/IEC 29110-5-1-2 are:

- **Project Planning** - The primary objective of this process is to produce and communicate effective and workable project plans. This process determines the scope of the project management and technical activities, identifies process outputs, project tasks and deliverables, establishes schedules for

project task conduct, including achievement criteria, and required resources to accomplish project tasks”.

- **Project Plan Execution** - To implement the actual work tasks of the project in accordance with the project plan. Ideally when the project plan has been agreed and communicated to all team members, work of the development of the product, which is the subject of the project, should commence.
- **Project Assessment and Control** - purpose is to determine the status of the project and ensure that the project performs according to plans and schedules, within projected budgets and it satisfies technical objectives. This process includes redirecting the project activities, as appropriate, to correct identified deviations and variations from other project management or technical processes. Redirection may include re-planning as appropriate.
- **Project Closure** - typically involves releasing the final deliverables to the customer, handing over project documentation to the business, terminating supplier contracts, releasing project resources and communicating project closure to all stakeholders. Often a final step is to undertake a Post Implementation Review (post-mortem) to identify the level of project success and note any lessons learned for future projects.

### 2.3 Deployment and Implementation Assistance

In order to assist with the deployment of ISO/IEC 29110 and to provide guidance on the actual implementation of ISO/IEC 29110-5 in VSEs a series of *Deployment Packages* and *Implementation Guides* have been developed to define guidelines and explain in more detail the processes defined in the ISO/IEC 29110 profiles [12].

A set of *Deployment Packages* (DP) (which are freely available from [13]) are a set of artifacts developed to facilitate the implementation of a set of practices, of the selected framework, in a VSE. A DP is not a process reference model (i.e. it is not prescriptive). The elements of a typical DP are: description of processes, activities, tasks, roles and products, template, checklist, example, reference and mapping to standards and models, and a list of tools. Packages are designed such that a VSE can implement its content, without having to implement the complete framework at the same time. The table of content of the project management deployment package is illustrated in figure 3.

In addition a series of *Implementation Guides* have been developed to help implement a specific process supported by a tool and are freely available from [13]. To date a small number of implementation guides have been developed. These include:

- Version Control with CVS
- Version Control with SVN
- Project Management with GForge
- Issue tracking with GForge
- Software Process Improvement with OpenOffice Calc.

1. Technical description
Importance of project management
Project management success and failure
2. Definitions (generic and specific definitions)
3. Relationships with ISO/IEC 29110
Project management process
Tasks and roles
4. Detailed description
Roles, products and artifacts
5. Templates
WBS, Project status template, etc.
6. Examples
Project management lifecycle practices, etc.
7. Checklists
Project plan review checklist, etc.
8. Tools
9. Reference to other standards and models
ISO 9000, ISO/IEC 12207 and CMMI for Development
10. References
11. Deployment package evaluation form

**Fig. 3.** Table of Content of a Project Management deployment package.

### **3 The Case Study**

To date a series of pilot projects have been completed in several countries utilizing some of the deployment packages developed [14]. For example in France, a pilot study [15] was conducted with a 14-people VSE that builds and sells counting systems about the frequenting of natural spaces and public sites. In this section we describe the adoption of ISO/IEC 29110 Project Management practices by an Irish based VSE.

#### **3.1 Case Study Company**

An Irish based VSE, henceforth referred to using the pseudonym ‘Emerald Island Software’ expressed an interest in the adoption of ISO/IEC 29110 Project Management. Emerald Island Software has been in existence for 8 years and employs 9 people, 8 of which are involved directly in software development. Their primary

market is financial services and insurance market sectors, where they have a single software product line and undertake bespoke software development for a variety of private clients. The CEO (and founder) of the company approached the researcher as part of an Irish governmental sponsored publicity launch of ISO/IEC 29110 and expressed an interest in exploring the potential benefits from partial or full standards practice adoption. After an initial series of briefing meetings with the CEO, CTO and two project manager in the company, where the ISO/IEC 29110 standard was presented and explained, the company agreed to adopt ISO/IEC 2910 Project Management practices as an initial starting point for exploring the potential of full practice adoption of ISO/IEC 29110.

The company already had an informal project management practices which varied depending on the specific project. Tools such as Microsoft Excel were generally used for project planning and scheduling purposes with 2 large whiteboards in the office used for open tracking of tasks and task allocation. The company used a modified waterfall approach to development, with some use of agile story cards as part of the requirements gathering phase. However, no formal project management practices were common to all projects and project managers were allowed significant amounts of discretion in managing projects under their control. However the company founders (who are the CTO and CEO) were becoming increasingly concerned about slippage on recent projects and issues of project velocity due to recent staff changes and a new project manager hire. The primary motivation for exploring ISO/IEC 29110 Project Management practices was to bring some visibility and certainty to projects control. Accordingly 2 pilot projects were launched within the company.

### 3.2 Pilot Projects

Emerald Island Software agreed to implement all ISO/IEC 29110 Project Management Practices (as outlined above) for 2 new bespoke projects being undertaken. The first project (project Alpha) was 4 months in duration and was a totally new software package for an existing client delivering assistance with customer profiling in a financial institution. The second project (project Beta) was a 3-month project to add additional functionality to an existing bespoke package to a different existing financial institution client. Table 3 illustrates some basic project information.

**Table 3.** Projects Alpha and Beta

	<b>Project Alpha</b>	<b>Project Beta</b>
Duration	4 months	3 months
Team	3 developers and project manager	2 developers and project manager
Client	Existing financial institution	Existing financial institution
Project risk	Medium	Low
Project type	New bespoke	Maintenance (new functionality) existing system

The pilot project was initiated by the researcher facilitates a series of round table 'Town Hall' style meetings where the role and purpose of ISO/IEC 29110 Project



Management practices was explored in detail and discussions had on how the gap between existing practices and the tasks in ISO/IEC 29110. A 'standards champion' was appointed from the experienced staff and with assistance from the researcher he formulated a project management process guide for the company based on the published Project Management Deployment Package [16], which included the implemented of all the mandated lifecycle practices for the four ISO/IEC 29110 Project Management Practices. This process guide was subject to review and enhancing by the researcher and was subject to further review and change at two further open 'town hall' style meetings within the VSE. The final outcome of this was a completed project management process guide for which Emerald Island Software would use to manage projects Alpha and Beta. For reasons of pre-agreed confidentiality none of the contents of the process guide can be disclosed in this paper.

### 3.3 Post-Mortem Interviews

A series of post-mortem interviews were conducted at the end of projects Alpha and Beta. These interviews were unstructured open interviews [17] and involved the project manager for each project. In addition the CEO and CTO were interviewed regarding both projects. The interviews lasted 2 hours in duration and were audio recorded and transcribed. The Grounded Theory [18] coding mechanisms was used to analyze interview data. Due to pre-agreed confidentiality reasons none of the empirical data collected regarding these pilot projects can be discussed in this paper.

Overall the experience of adoption ISO/IEC 29110 project management practices was regarded as a positive one by the company, with few reservations. The primary reservation – in particular as expressed by management – was the significant amount of time and resources consumed during the creation of the internal project management process guide. An interview extract illustrating this point from the CEO was *"Is they [ISO] want us [VSEs in general] to adopt standards then they should make it easier for us... they should give us complete how to guides and not just a list of task criteria... its too long and too difficult to create all these processes "*. Furthermore company management noted the lack of requirement from the market in general and their customer in relation to the need to have or follow a recognized standard. Examples of interviewee opinion illustrating these would be: *"In a company of our size they [standards] would not necessarily add value... we would only need more sophisticated process if we were a larger company"* and *"Our developers are busy with coding, we don't have resources to do that [standards compliance]"*. Furthermore as noted by one project manager there customer base did not require standards, saying, *"we had never had a problem selling our stuff or not selling our stuff because we don't follow an ISO standard"*.

By contrast interviews with project managers were generally supportive, however both questioned the need to change from existing practices, indicating, *"Nothing was really that wrong"* and *"we didn't really need to be this heavyweight in changing the way we work"*.

In order to understand more about the needs of VSEs in general regarding lifecycle standards, we asked all of the interviewees what criteria they considered important in a software lifecycle standard and for project management aspects in particular. The main criteria elicited were:

- Align with current development process style and working style
- Provide detailed guidelines and assistances
- Provide clear templates and example documentation
- Provision of mentorship and detailed guidance on how to actually apply practices in every day working situations
- Align with company existing business and development process.
- Align with others specific software technical standard and process.

## 6 Discussion

As ISO/IEC 29110 is an emerging standard there is much work yet to be completed. The main remaining work item is to finalize the development of the remaining three profiles: (a) Entry – a six person-months effort project or a start-up VSEs; (b) Intermediate - Management of more than one project and (c) Advanced - business management and portfolio management practices. In addition the development of additional Profile Groups for other domains such as critical software, game industry, scientific software development are being studied

Recently, working group 24 was mandated to develop a standard for VSEs developing systems. A system may include material, computer programs, firmware and technical documentation. The new standard for VSEs will use ISO/IEC 15288 System life cycle processes standard [19] as the main framework. The objective of the working group is to develop a systems engineering basic profile which will match the software engineering basic profile. The working group will use the actual project management process of the software basic profile as the baseline to modify or add new tasks required by systems engineers. As an example, since most systems have material components, the project manager of a VSE must decide if the material components will be developed and built internally or subcontracted. This 'make or buy' task was not a task of the software project management process, it will therefore be added to the systems basic profile [20].

**Acknowledgments:** This work is supported, in part, by Science Foundation Ireland grant 03/CE2/I303\_1 to Lero, the Irish Software Engineering Research Centre ([www.lero.ie](http://www.lero.ie)).

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