

# Adept – A Software Process Appraisal Method for Small to Medium-sized Irish Software Development Organisations

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## Abstract

In this paper we describe the appraisal method that was developed by Lero (the Irish Software Engineering Research Centre) and Dundalk Institute of Technology (DkIT) to assess software processes within small to medium-sized Irish software organisations that have little or no experience of software process improvement (SPI) programmes. We developed a method, called Adept, through investigating the key factors that contribute to an effective software assessment method, reflecting the desires of Irish SMEs in terms of providing a “manageable” approach to SPI and through expanding upon the EPA method [1] to fulfil these objectives.

## Keywords

Assessment method, Small to Medium-sized Enterprises (SMEs), Software Process Improvement (SPI)

## 1 Introduction

This Adept assessment method was developed as a result of a meeting between researchers from Dundalk Institute of Technology (DkIT), Lero – the Irish Software Engineering Research Centre, and Enterprise Ireland (the economic development agency for indigenous Irish companies) in relation to how a culture of SPI could be instilled into small to medium sized Irish software development organisations. Among other initiatives, it was decided that for individual companies who were interested in SPI, it would be important to initially understand the current state of software practice within these companies. Therefore, an assessment method had to be developed that could diagnose any weaknesses in a company’s software process. This diagnosis would then form the starting point from which to base a path for continuous SPI that will make the company more effective in fulfilling their business goals.

The remainder of the paper is structured as follows. Section 2 investigates the important characteristics of effective lightweight assessment methods, and section 3 lists the requirements for the Adept

method. Section 4 describes the Adept method in detail, while section 5 discusses the benefits of the Adept method. Finally, section 6 contains our conclusion.

## ***2 Investigation into existing lightweight software process assessment methods***

In order to provide guidance to our development of an assessment method that would be suitable for the Irish software industry we looked at some preliminary results from the Irish market [2] and performed a literature review of software process assessment methods used within other regions. We discovered that such assessment methods are generally based upon one of two process models: (i) ISO/IEC 15504 [3] and (ii) CMMI<sup>®</sup> [4]. There have been many attempts to develop light-weight process assessment methods for each of these models. For example, RAPID [5], SPINI [6], FAME [7], TOPS [8], and MARES [9] are all based on the ISO/15504/5 reference model. With regard to the CMMI<sup>®</sup>, EPA [1] is an example of an ARC class-C compliant method.

Anacleto et al. [10] have considered process assessment methods for small software companies. They provide criteria for comparing assessment methods and have compared the ISO/IEC 15504 based methods mentioned above. In this paper, we compare the CMMI<sup>®</sup> class-C compliant EPA method against the other assessment methods using criteria from the Anacleto et al. [10] comparison framework, discussing particular features which are applicable for Adept.

The criteria Anacleto et al. [10] uses to compare assessment methods is as follows:

1. *Low cost* - The EPA, RAPID, SPINI, TOPS and MARES assessment methods all try to minimise the cost of performing an assessment and these are consistent with the preliminary findings in [2]. In order to encourage adoption within the Irish software SMEs it will be important to minimise the cost of performing the Adept method.
2. *Detailed description of the assessment process* - The EPA, SPINI, TOPS and MARES assessment methods all provide a detailed description of the assessment process. Similarly, the Adept method will provide a description of the assessment process.
3. *Guidance for process selection* - The RAPID assessment method does not provide any information in relation to process selection as it pre-defines eight mandatory process areas. The MARES assessment method plans to provide guidance for process selection in the future. However, both the SPINI and EPA assessment methods currently provide guidance for process assessments. The Adept method will enable companies to select assessment within software process areas deemed to provide the most benefit to their business goals. Therefore the Adept method will contain optional process areas so guidance will be provided in relation to process selection.
4. *Detailed definition of the assessment model* - The EPA, RAPID, SPINI, TOPS and MARES methods each provide a detailed definition of the assessment model. The Adept method will provide definitions of both the CMMI<sup>®</sup> and ISO/IEC: 15504 models.
5. *Support for identification of risks and improvement suggestions* - Most of the assessment methods (EPA, SPINI, FAME and TOPS) provide support for the identification of risks and improvement suggestions, with this feature currently being developed in the MARES method. This will be provided within the Adept method.
6. *Support for high-level process modelling* - Only one of the assessment methods (FAME) provides this feature with another (MARES) currently developing this feature. This will not be provided within the Adept method.
7. *Conformity with ISO/IEC 15504* - The assessment methods (RAPID, SPINI, FAME, TOPS and MARES) are conformant with ISO/IEC 15504 whereas the EPA method is compliant with the ARC 1.1 for a CMMI<sup>®</sup> class-C method. The Adept method will conform with both the ISO/IEC 15504 and CMMI<sup>®</sup> models.
8. *No specific software engineering knowledge required from companies' representatives* - Unlike FAME and TOPS, four of the assessment methods we investigated (EPA, RAPID, SPINI and

MARES) do not require assessment participants to have specific knowledge of the assessment model. In order to encourage participation (particularly in SMEs) within the Irish software industry it will be vital to minimise the overhead on the company engaging in the appraisal. Therefore, the Adept method may be performed within an organisation without the assessment participants from the company having to undergo training on the assessment model.

9. *Tool support* - Tool support for the assessment methods we investigated appears to vary with the SPINI and FAME having tools to assist with data collection, analysis and rating. Tool support is currently being developed for the MARES method. However, the RAPID and TOPS assessment methods do not include tool support and therefore depend upon paper forms. The EPA method provides tool support but also relies upon paper forms so that both assessors may compare data when preparing the findings report. The Adept method will provide tool support similar to that adopted within the EPA method.
10. *Public availability* - Only two of the assessment methods (TOPS and MARES) are publicly available. There is no current requirement for the Adept method to be made public.

### **3 Requirements for the Adept assessment method**

From investigating other assessment methods and based upon the experiences gained by one of the researchers when involved both in the development and usage of the EPA method within SMEs in Northern Ireland, the Adept method was designed to adhere to 8 of the 10 criteria outlined by Anacleto et al. [10], the exceptions being, 6. *Support for high-level process modelling* and 10. *Public availability*.

However, Enterprise Ireland (representing the Irish SMEs), requested that Adept take the following factors into account:

- Improvement is more important than certification and a rating is not required;
- The amount of preparation time required by the company for the assessment should be minimal;
- The assessment should be performed over a short period of time;
- The assessment method should enable companies to select assessment in process areas that are most relevant to their business goals;
- Whilst the assessment will be based upon both the CMMI<sup>®</sup> and ISO/IEC 15504 models the SPI models should be invisible to the SMEs that are being assessed.

### **4 The Adept method**

The Adept method development was based largely on the structure of the EPA method that was adopted in Northern Ireland [1], but with the following differences:

- Adept does not highlight either CMMI<sup>®</sup> or the ISO/IEC:15504 SPI models. It refers to general SPI, thus focusing on improvement rather than certification.
- Adept enables the development of a SPI path, based upon a company's business goals, from the findings report that is produced as a result of the assessment.
- Adept includes a stage that involves revisiting the company after a period of 3 months and re-assesses the company's SPI path.
- Stage 1 (Develop Appraisal Schedule) and stage 3 (Conduct site Briefing) of the EPA method are both covered in stage 1 of the Adept method but require only half the time to perform.

## 4.1 Selecting an SPI model

The main aim of the Adept method is to encourage SPI improvement based upon the generic SPI principles that are shared by both CMMI<sup>®</sup> and ISO/IEC:15504. To progress the Adept method we had to decide whether to:

- Develop a completely new model that would contain new process areas based upon input from both the CMMI<sup>®</sup> and the ISO/IEC:15504 models;
- Base the Adept method upon relevant process areas from the CMMI<sup>®</sup> model and include input from the ISO/IEC:15504 model
- Base the Adept method upon relevant process areas from the ISO/IEC:15504 model and include input from the CMMI<sup>®</sup> model

As the development team had more experience of the CMMI<sup>®</sup> model, option (b) was preferred to option (c). Additionally, option (a) was ruled out due to the effort that would be involved in developing both a new assessment model and an assessment method. Therefore the Adept method consists of an assessment component for each CMMI<sup>®</sup> process area that is deemed applicable for Irish SMEs. However, even though each assessment component adopts a CMMI<sup>®</sup> process area name, it will provide equal coverage of both the CMMI<sup>®</sup> and ISO/IEC 15504 models by containing questions that relate to ISO/IEC 15504 in addition to questions based upon the CMMI<sup>®</sup> model.

## 4.2 What Process Areas should the Adept Method Assess?

The next important key decision in the development of the Adept method was to decide what process areas are most applicable to the Irish software SMEs. The process areas included in Adept are based on the previous involvement in the EPA method development and usage, and upon the results of previous research performed by DkIT and Lero in relation to software processes with Irish SMEs [2,12,13]. Based upon this information we then sequentially (by taking a CMMI<sup>®</sup> staged model maturity level grouping of process areas at a time) investigated the potential benefits to software SMEs of each of process areas within the CMMI<sup>®</sup> model.

### 4.2.1 *What CMMI maturity level 2 processes should be included?*

Upon investigation, six of the seven process areas associated with maturity level 2 of the CMMI<sup>®</sup> model were selected as they constitute the engineering management basis of an organisation and the foundation upon which an efficient software company is based. We omitted the seventh CMMI<sup>®</sup> process area at maturity level 2 (Supplier Agreement Management) as previous research indicated that it would not be as beneficial to SMEs in Ireland as other process areas [11]. Furthermore, omitting one process area ensures that we avoid situations where a company might attempt to claim some form of maturity level 2 compliance in the event that no issues or weaknesses were discovered in the process areas appraised. As stated previously, the Adept method will not attempt to provide any form of rating. The Adept method includes assessment components for each of the following process areas at CMMI<sup>®</sup> maturity level 2: Requirements Management, Configuration Management, Project Planning, Project Monitoring & Control, Measurement & Analysis and Process & Product Quality Assurance.

### 4.2.2 *What CMMI maturity level 3 processes should be included?*

Upon investigation of the CMMI<sup>®</sup> maturity level 3 process areas, six of the fourteen process areas were deemed applicable for Irish software SMEs. Therefore, an assessment component was included in the Adept method for each of these process areas. These CMMI<sup>®</sup> maturity level 3 process areas are: Risk Management, Technical Solution, Verification, Validation, Requirements Development and Product Integration.

#### 4.2.3 Should any CMMI maturity level 4 & 5 processes be included?

The process areas listed at CMMI<sup>®</sup> maturity levels 4 and 5 would be of less benefit to companies that have little or no experience in SPI and therefore an assessment component was not required within the Adept method for any of the process areas at these levels.

In summary, the Adept method will enable an assessment to be performed in 12 process areas.

### 4.3 Should assessment in certain process areas be given priority?

While all 12 process areas may be assessed using the Adept method, four will be mandatory - Requirements Management, Configuration Management, Project Planning, Project Monitoring & Control. These process areas are critical to the success of any software development company. The choice of mandatory process areas was based upon the overlap of three factors. Firstly, priority was given to the process areas that are deemed to be the foundation of the CMMI<sup>®</sup> model. Secondly, priority was assigned to the process areas in which SMEs would gain most benefit [11]. Thirdly, research in Ireland has shown that specific processes are seen as important by software SME managers [2, 12, 13].

### 4.4 How many process areas should be assessed within a single Adept appraisal?

In an attempt to reduce the cost and time associated with the assessment, on-site interviewing should be restricted to one day. It was therefore decided that an Adept assessment would be limited to six process areas as this is as many as can reasonably be covered within one day [11]. Therefore, in addition to being assessed in the four mandatory process areas, companies will also be able to choose two of the other process areas discussed in Section 4.2. Based upon previous research into the applicability of process areas to software SMEs [11], companies will be advised against selecting either the Measurement & Analysis or Process & Product Quality Assurance process areas unless these process areas are directly linked to their business goals.

### 4.5 The Stages of the Adept Method

The Adept method is divided into eight stages. The appraisal team consists of two assessors who conduct the appraisal between them.

Stage 1 (*Develop Appraisal Schedule and Receive Site Briefing*) is a preliminary meeting between the appraisal team and the software company wishing to undergo an SPI assessment. This stage consists of two parts. The first part involves establishing the logistics, selecting the most applicable process areas and determining the schedule of the appraisal. The second part is used by the appraised organisation to explain elements of the company structures to the appraisal team, who learn a little about the company's history, the company's business objectives and about the types of ongoing projects, along with the lifecycle stage that each project has reached. This meeting involves 2 assessors and at least one representative from the company. This meeting lasts approximately two hours. Therefore 4 person-hours of assessor time and at least 2 person-hours of company time are normally required for this stage.

During stage 2 (*Conduct Overview Briefing*) the lead assessor provides an overview of the method for members of the appraised organisation who will be involved in subsequent stages. This session is used to remove any concerns that individuals may have and to establish codes of conduct and confidentiality. This overview session involves 2 assessors and on average 7 company staff (the number of company staff involved depends upon the size of the company). The overview normally lasts 1 hour. Therefore 2 person-hours of assessor time and 7 person-hours of company time are normally required for this stage.

Stage 3 (*Analyse Software Documentation*) provides a brief insight into project documentation. Normally the following documents will be requested: a typical project plan, a typical project progress report, a typical approved requirements statement and any documentation relating to the company policy on configuration management. The primary source of data for the Adept method is through a series of process area interviews conducted during stage 4. The brief consideration of some sample documents during stage 3 is used mainly to craft further questions for stage 4. This stage will involve 2 assessors and usually 1 member of personnel from the appraised organisation. Typically, this stage will involve the company member dedicating 1 hour to retrieving the requested documents. The 2 assessors performing the appraisal will then each analyse this data for approximately 3 hours. Therefore 6 person-hours of assessor time and 1 person-hour of company time are normally required for this stage.

The main part of the Adept method is stage 4 (*Conduct Process Area Interviews*). In this stage key staff members from the appraised organisation are interviewed. There are 6 interviews. Each interview is scheduled to last approximately 1 hour. However based upon the experiences with the EPA in Northern Ireland, interviews for the process areas of project planning and project monitoring and control typically require 1.5 hours, therefore 7 hours is required to complete the 6 process area interviews. Each interview involves two assessors, and at least one representative from the company (on average 3 staff are involved) is present for each process area interview. Therefore 14 person-hours of assessor time and on average 21 person-hours of company time are normally required for this stage. The schedule of the process area interviews should be carefully designed to follow the natural sequence of the software development lifecycle. This will assist the assessors in painting an accurate profile of the software development practices adopted by a company and responses from process areas' interviewees earlier in the day may be cross-referenced in later interviews (without specifying names or project details as all interview data is treated with the strictest confidence). During each of the process area interviews, one of the assessors invokes responses from the interviewees using a combination of pre-defined and follow-up questions while the other assessor makes notes. The lead assessor will use an Excel based tool which enables them to make an initial judgement about the responses by judging them against a discrete set of values – Red (not practiced), Amber (partially practiced), Yellow (largely practiced) and Green (fully practiced). In this way, the opinions of the questioner and not just the note-taker will also be recorded for subsequent review.

Stage 5 (*Generate Appraisal Results and Create the Findings Report*) is very much a collaborative exercise between the two assessors. The findings report will consist of a list of strengths, issues and suggested actions for each of the process areas evaluated. Global observations covering all process areas are also covered and the initial judgements recorded in the Excel tool are revised. The findings report is then developed through a review of the interview notes and the scores produced by the Adept tool for each of the 6 assessed process areas. The appraisers produce the findings report by sequentially reviewing the data obtained for each of the process areas and documenting an agreed set of strengths, issues and suggested actions. The findings report takes the format of a Microsoft PowerPoint presentation that lists a set of strengths, issues and suggested actions for each of the process areas, plus a list of global observations that affected all process areas. This stage involves 2 assessors collaborating together for six hours. Therefore a total 12 person-hours of assessor time is required for both these stages.

Stage 6 (*Deliver the Findings Report*) involves presenting the findings report to the staff in the appraised organisation who participated in the interviews. This presentation involves the assessors and typically 7 company staff (this depends upon the number of the appraisal participants). The briefing normally lasts 1 hour. Therefore 2 person-hours of assessor time and 7 person-hours of company time are required for this stage.

Stage 7 (*Develop a SPI Path with the Company*) involves collaborating with staff from the appraised company to develop a roadmap that will provide guidance to the appraised company in relation to practices that will provide the greatest benefit in terms of the company's business goals. The basis for this roadmap is the Software Process Matrix [14] developed for use in small software development companies. The Software Process Matrix enables companies to base their software process improvement roadmap on: (a) their business goals; (b) maximising their return on investment; and (c) providing 'quick implementations'. This should encourage management and staff to institutionalise the SPI effort. This stage involves 2 assessors and one member of the appraised organisation working together for 4 hours, requiring 8 person-hours of assessor time and 4 person-hours of company time.

Stage 8 (*Re-assess the SPI Path and Produce a Final Report*) involves revisiting the appraised company approximately 3 months after the completion of stage 7 and reviewing progress against the SPI path that was developed in stage 7. The outcome of this stage will be an updated SPI path and a final report detailing the progress that has been accomplished along with additional recommendations. This stage will involve the 2 assessors and one member of the appraised organisation working together for 3 hours. Additionally the 2 assessors will dedicate a further 2 hours to producing a final report in relation to the assessment. Therefore 10 person-hours of assessor time and 6 person-hours of company time will normally be required for this stage. This stage is important as it provides feedback and assistance to the appraised company after a period of time. This stage also assists in compiling research material in terms of SPI experiences.

Overall, the Adept method requires approximately 58 person-hours of assessor time and 48 person-hours of the appraised organisation's time. Ideally stages 1 to 7 of the appraisal process are completed over two elapsed weeks, with stage 8 happening approximately 3 months later.

## **5 Benefits of the Adept method**

The Irish software industry contains many software SMEs driven by entrepreneurs and often lacking a quality culture. Research [2,15] has shown that software companies are often not aware of SPI models or initiatives. In such an environment it is very difficult for software organisations to appreciate the global importance of having effective software processes. Part of the problem is one of education where software development managers fail to understand how to improve their business and further fail to appreciate their company's technical performance with regard to international standards. To combat this requires an appropriate approach that will facilitate education and begin to engage software managers in a quality agenda. The application of the Adept method will help raise the level of SPI education within the appraised organisations. Also, the high-level findings report and the detailed SPI path will provide a road map for SPI within each appraised organisation. Additionally, as the Adept method requires only 6 person-days of internal staff time, this should prove attractive to SMEs from the standpoint of costs and impact upon staff working time. This is important as the primary objective of the Adept method is to stimulate process improvement programmes.

## **6 Conclusions**

The Adept method has been developed to assess software processes within Irish software SMEs based upon information that has been obtained from four different sources: (a) by reflecting upon the effectiveness of the EPA method to assess software processes in SMEs within Northern Ireland; (b) through investigating the characteristics of other lightweight assessment methods; (c) from the outcome of a meeting between researchers from DkIT, Lero and Enterprise Ireland that discussed how a culture of SPI could be instilled into Irish software SMEs; and (d) through research that has been performed by Lero and DkIT in relation to Irish software SMEs. The Adept method is designed as a lightweight assessment model to be used within organisations that have very little experience of SPI. The method relies heavily on information obtained from interviewing company personnel and performs limited cross-referencing checks (due to the limited time available for data collection and analysis). As a result, this approach depends on the willingness of the company to engage in SPI. It is therefore important that senior management within the company encourage their employees to answer interview questions in a truthful and helpful manner so that the resultant findings report will provide an accurate reflection of the company's strengths and weaknesses within each of the appraised process areas. The findings report will contain a list of recommendations. Based on these, each company must then collaborate with the assessors to prioritise these recommendations into an action plan based upon their business goals and aspirations.

We are currently planning to perform a series of software process assessments in Irish SMEs organisations using the Adept method.

## 7 Acknowledgements

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## 9 Author CVs

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### Dr. Ita Richardson

Dr. Ita Richardson is a senior lecturer in the Department of Computer Science and Information Systems at the University of Limerick where she lectures to undergraduate and postgraduate students. Her main research interests are in Software Process Improvement with a specific focus on small to medium sized enterprises and on Global Software Development. She is a project leader on the GSD for SMEs project, which is funded by Science Foundation Ireland and operates within Lero – the Irish Software Engineering Research Centre. Her research involves qualitative research with companies, and some of her post-graduate students are in full-time employment with software development companies. She is also a researcher on the B4-STEP Principal Investigator project.

### Mr. Gerry Coleman

Mr. Gerry Coleman is a member of the Computing and Maths Department at Dundalk Institute of Technology (DKIT) where he specialises in teaching Software Engineering and Project Management. He is also Director of the Software Technology Research Centre (SToRC) at DKIT and a member of the Irish Software Engineering Research Centre. His research involves examining the development and evolution of software processes in small software development companies. He is a researcher on the GSD for SMEs project, which is funded by Science Foundation Ireland and affiliated to Lero – the Irish Software Engineering Research Centre. He is also researching the use and deployment of agile development methodologies in software SMEs as part of the SPACE project, funded by Co-operation Ireland.