



Software Process Improvement Case Study



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Overview - *Cunav Technologies* is a software systems development and consulting company, which provides IT resources and solutions to customers operating in a variety of application areas. As we are continually involved in the development of specialised software systems on behalf of our clients, an ability to elicit precise system requirements from our customers obviously has a significant impact on our business.

Specifically, we saw that **improving our requirement analysis process** would improve our ability to manage customer expectations and to deliver systems with significantly reduced need for rework. As a result of our SPIRE project, a requirement analysis process was developed and training in requirements elicitation provided for Cunav consultants.

The initiative was very successful, as evidenced by improvements in several key areas of our development process. The amount of rework and number of requirements related bugs have both fallen and the accuracy of our time and budget estimates has improved. Most importantly, we are in a position to understand the needs of our customers and deliver top quality systems on time and within budget.

The most important thing learned is that software processes are fundamental to the smooth running and success of a growing company such as Cunav. Software requirements in particular are critical elements of any system and having an efficient, consistent and cost effective means of handling these is of paramount importance.

<p>Making Software Smarter™</p>  <p>TECHNOLOGIES</p>	<p>Cunav, from the Gaelic Cunamh (pronounced coo-nav) meaning help or assistance</p>
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The Cunav Technologies Crew pictured at IonaWorld in Boston, March '98
 Back: Malachi Briody - Consulting Manager, John McEvoy - R&D Manager,
 Front: Canice Lambe - CEO



The Organisation and its Environment

Cunav Technologies is a fast growing Irish software company, which provides expert help to customers having a variety of IT needs. Established in 1994, we have developed a substantial consulting business with corporate clients both in Ireland and in the U.S., with an annual turnover of IR£1 million and a staff of approximately 20 people.

Our customers needs range from specific personnel and technical requirements for existing projects, to the full systems development required to solve key customer problems. The services which Cunav provide reflect this.

Firstly, our consultants, with their wide-ranging technical skills and experience with database systems, Internet technologies and distributed systems, can address specific customer shortages in these areas.

Secondly, we provide solutions - a bespoke development service creating new systems, which solve key complex business problems for our customers. These problems are as diverse as loan application processing for financial services, automatic protocol configuration for telecommunications equipment and streamlining of manufacturing control processes for the brewing industry.

To each of these problems, with their inherently complex underlying logic, Cunav brings a fresh solution approach. This consists of incisive problem analysis, innovative designs and expert development of systems, which capture complex business rules in a form which the customer can easily understand and manage.



Starting Point

Given the nature of our business, it is critical that, as consultants, we understand exactly what our customers require on a given project. While our current software processes were undoubtedly strong in areas such as problem resolution and software design details, we were aware of some deficiencies.

With the help of our project Mentor – Fran O’Hara of Insight Consulting- we assessed and reviewed our organisational and project level processes for Software Development.

In particular, a review of previous project post-mortems had shown that a lack of proper software requirement analysis has caused problems in the past. These included difficulties with managing customer expectations on some projects and excessive amounts of rework due to misunderstanding of initial requirements.

We decided that improving our requirement analysis process would help us to address such problems but also, because of its fundamental nature, would yield benefits across many areas of our operations.

Initial Status

To more clearly identify specific areas of weakness, three representative Cunav employees were assessed against a SPICE scale.

SPICE: Software Process Improvement and Capability dEtermination.

This framework is used to evaluate various components of an organisation’s software development process. For each component, a capability rating is determined and the relevance of the component is assessed, given particular organisations specific business needs.

In our case, our business needs were, critically, that we should meet real customer needs and improve project estimates and visibility with the customer. Moreover, this should occur in the context of meeting functionality and quality requirements within appropriate time and budgetary constraints.

The outcome of our assessment showed that software requirements analysis was a key process with high relevance to most of our business needs. However, the capability scores achieved for requirements analysis on each of the employee interviews were consistently low. A score of 0.7 was obtained, where ratings below 1 imply that the process is not implemented, or fails to achieve its defined process outcomes.

It was also found, in both cases, that while some planning for system performance and quality was undertaken, no standard process definition was applied and a suitable infrastructure for requirement analysis was not available.

On the positive side, an evaluation of staff attitudes showed that the attitude to software process improvement was, in general, very positive, with an organisational score of 7.87.

Goals

The primary objective of this improvement project, therefore, was to improve Cunav’s software requirement analysis, capture and management. Specifically:

- The amount of rework on a project would decrease by at least 20%. Rework is defined as functionality that must be re-implemented because what is delivered is not what the customer desired.
- Accuracy of both time and budgetary estimates for a project would increase by at least 20%.
- The number of requirements related bugs should decrease by at least 20%. A requirement related bug occurs when the code has been developed in a non-modular ad-hoc manner. This happens when requirements are not suitably grouped and structured and change requests are implemented without examining the impact on already coded areas of the system. Better gathering and management of requirements should reduce the number of requirements related bugs.
- The level of effort required to support customer queries should decrease by at least 20% because the customer better understands exactly what we are providing.
- Likewise, the level of system maintenance should decrease by at least 20%.

The Improvement Project

Overall Approach

We decided that the overall approach to improving our requirement analysis process should be one of investigation, followed by experimentation and refinement. Specifically:

- We would conduct an initial investigation into various approaches to the capture and management of software requirements. From this, we would choose an approach tailored to the different types of software projects that Cunav undertakes. This would be done with the help of an external consultant, with expertise in the implementation of various requirement



processes. Pat Fehin was chosen as our external consultant.

- Once a candidate process was selected and documented, appropriate training would be provided to enable Cunav employees to become aware of, and familiar with, the new Cunav Software Requirements Methodology (SRM).
- Critically, we would start to test the new SRM by implementing the process on a number of software projects. Depending on business demands, two or three projects would be chosen, with any relevant successes and/or failures on these projects being used to feed back into the process definition.
- In order to be able to quantify the relative success or failure of the new process, a set of metrics would be chosen which would best reflect our objectives for improvement. These metrics would first be applied to a control project - one on which we use our existing methods for requirement analysis.
- Thereafter, the metrics would be applied to the projects where the new requirement process had been carried out.

Tools and Methodologies

Starting out, we had determined that the SRM to be developed should concern itself with two primary areas relating to software requirement analysis. Requirements Elicitation and Requirements Management.

A number of potential techniques and methods relating to these two areas would be considered as part of the new SRM. Specifically:

Requirements Elicitation –Tools and Methods

- Techniques for planning customer meetings and identifying the different types of user.
- Interviews conducted at the customer's workplace to determine the real customer requirements and how they hope to use the planned system - this would include exploration interviewing with individual users, as well as user group sessions.
- Prototypes described on paper to give the customer a concrete idea of how their requirements might look.
- Rapid software prototyping to achieve the same objective as above.
- Benchmarking surveys to determine an acceptable level of some required attribute (performance, quality, etc.) of a product that may subsequently be improved.
- Story boarding and walkthroughs of usage scenarios to help derive software requirements.

Requirements Management -Tools and Methods

- Methods and templates for specification and prioritisation of requirements.
- Methods for evaluation of requirements.
- QFD (Quality Function Deployment), as an example of a specific method which allows requirements to be prioritised.
- Identifying procedures to deal with change requests (bugs) and feature requests (enhancements).
- Software requirements review procedures to get agreement on requirements with the customer.

Metrics

The metrics chosen to determine relative success or failure of our new SRM should closely reflect our objectives for improvement. Our candidate list of metrics is given below:

Process Improvement Metrics

- The time spent on rework undertaken during the software project development.
- Time spent vs. time estimated.
- Budget spend vs. budget estimated.
- The number of requirements related bugs found during development.

Cultural and Human Factors

Finally, it was of the utmost importance that certain cultural and human factors should be taken into account in the planning and execution of the new SRM. Principally:

- It was critical that staff members from all levels be involved at all stages of the improvement project. In this way, a methodology that would be both practical and meaningful to all parties could be developed.
- Management commitment would be essential. Authorisation and support from the top of the company would give the project a high profile and ensure that its importance was felt throughout the organisation.
- At a practical level, it was important that a relatively small number of meaningful metrics be chosen. This would ensure that the metrics would not be a burden on the developers and analysts who must track them.



Results

Having chosen a candidate requirements process, we used three projects as a test bed for the new methodology. The process was applied to one internal and one external development project, while an additional external project was used as a control.

The metrics gathered from each of these projects showed that, in terms of percentage increase or decrease, most of our specific target objectives were met.

For example, a decrease of 90% in the amount of rework required was observed. Increases of 17% and 48% in the accuracy of time and budget estimates for Pilots 1 and 2 respectively were observed. We concluded from this that time and budget statistics are heavily influenced by other factors such as development environments, testing strategies etc.

In addition, we noticed that the "softer" and less easily quantifiable aspects of system development had also improved. These included smoother project flow, better client relations and greater ease of development and maintenance. Moreover, the general consensus within the company was that the techniques, templates and guidelines developed, as part of the improvement project would prove indispensable on future projects and will be used for a long time to come.

Perhaps it is appropriate that the most telling indicator of the success of our project comes from a customer. A telecommunications company was our customer on the external pilot project, they said that "they were both impressed and surprised with how well the demonstrator (Mike) matched their expectations, particularly given the fact that they had never met Mike in person to relay their requirements to him directly."

Lessons Learned

First and foremost, we learned that requirement-gathering techniques needed to be tailored to our specific needs. Techniques derived from experience on large corporate projects may be excellent in theory but their application was not always relevant to the nature of Cunav's business. Quite a bit of work was required to tweak the processes to a size and nature suitable for Cunav. In retrospect, we should have used Pat Fehin's (our external consultant) expertise more in helping to do this.

In any project external factors such as the project nature, customer, consultant, size and difficulty will influence the metrics measured. These "environmental" factors are difficult to quantify.

Plans for the Future

Cunav is delighted with the results of the pilot projects and plans to rollout the methodologies developed to the entire company. Half-day workshops will be used to train the consultants and heighten awareness.

Software Requirements Gathering and Management are only two aspects of a Software Process. Cunav Technologies has a software lifecycle already in place and templates for technical specifications, test plans and coding standards exist.

However, these are not consolidated and the profile and usage of them in the company is not as widespread as we would like. In the coming months we will be focusing our attention on renewing the usage of these standards.

Risk Management is also an area in which we are both inexperienced and somewhat lax, an investigation and implementation plan for this process is already in place. Finally we as a company are committed to quality software processes and believe they will help in delivering software that is Better, Faster and more Cost Effective.

Table with 2 columns: Acknowledgements and SPIRE Partner contacts. Acknowledgements includes CSE Ltd., Dublin, Cunav Technologies, and Fran O'Hara. Partner contacts lists Centre for Software Engineering, Enoteam, IVF, Austrian Research Centers - Seibersdorf, and Software Industry Federation with their respective contact details.