White Paper

Dynamic Requirements Management for Iterative/Incremental Development

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Overview

With the dynamic nature of today's modern software and systems development practices, it is no longer possible to gather a complete set of requirements specifications upfront and set them in stone for the duration of the entire project. A far superior approach, which more accurately reflects the development process, is to allow requirements specifications to evolve as the development project progresses. However, this has created a seemingly unsolvable paradox – *How can projects accommodate myriad requirements changes without spiraling out of control and still meet cost, quality, and time-to-market objectives?*

This white paper takes a look at how to solve this paradox and introduces the concept of *Dynamic* Requirements Management.

Introduction

In today's fast-paced world, getting systems delivered to the market at the right time with the right functionally is critical to business success. Systems and software development teams need to employ development processes that show results quickly, but without compromising quality or adherence to customer requirements. Technology improvements, business legislation, industry standards, and a multitude of other external influences – together with an ever more demanding customer – mean that development projects not only have to result in systems that can be enhanced easily after deployment, but are also responsive to change during development. The luxury of 'freezing requirements' after an extensive phase of capturing them can no longer be afforded. Many organizations have already adapted their systems and software development processes to allow for changes in requirements as the project progresses. These development processes no longer follow the 'big-bang' approach, but rather a more evolutionary approach where deliveries are broken down into increments, or iterations, in order to produce faster results and enable early user validation. This approach allows for change, but minimizes its impact.

Recent industry analyst reports have highlighted effective requirements management as critical to successful systems and software development projects. When asked by Standish Group why projects succeed, 50% of respondents attributed successful projects to reasons related to requirements management [Chaos03] – see Figure 1.
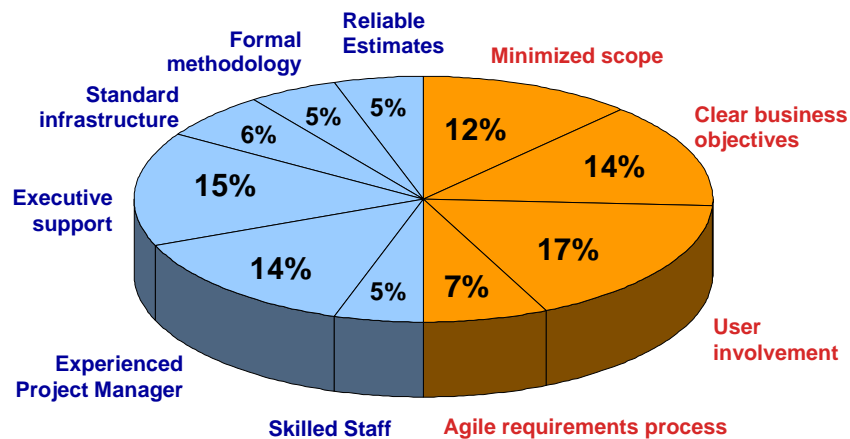
Figure 1. Reasons why projects succeed [Chaos03]

In contrast, the META Group recently discovered that approximately 60-70% of IT project failures result from poor requirements gathering, analysis, and management [Meta-Mar03].

Thus, the importance of requirements management is established. However, the perception exists that requirements management and supporting tools are too formal, restrictive, and inflexible. Indeed, Thomas Murphy of the META Group, states *"…and*

although development processes have evolved to become more iterative and collaborative, traditional tools still work in a waterfall (or functional separation) style. This creates breaks in the development process, leading to reduced customer satisfaction because requirements are ineffectively captured and communicated." [Meta-Apr03].

What if the benefits of the Requirements Management discipline (capturing and tracing requirements and controlling project scope) could be utilized in an Iterative/Incremental development process? What if requirements management could become, for the first time ever, *dynamic?*

Effective requirements management

The most successful projects are those that satisfy the user. While this may seem like an obvious statement, how can user satisfaction be ensured? The fact is, it cannot without a solid requirements process. A lack of requirements management can cause 'gold plating', where a product has more functionality than initially agreed. If the scope of a project does 'creep' in this way, the result can be a product that does not meet the customer's needs, or has resulted in additional, unnecessary expense.

A requirements management solution offers the chance to define from the outset what needs to be done and why, as well as communicate any changes that occur to this initial definition during the project. Requirements management enables the effective collaboration of the project team by recording every step of development. And it provides validation – the ability to trace all stages of a project and prove that the final product meets all requirements.

In order to be effective, requirements management must enable users to:

- **Communicate:** Gather and analyze different types of requirements

- **Collaborate:** Link and trace interdependent requirements and other project artifacts (designs, tests, etc.) throughout the project

- **Validate:** Control project scope and cost by validating that team members are always working against defined requirements

Improving the requirements management process is also an essential part of improving the quality of the overall development process. Organizations aiming to meet the Software Engineering Institute's (SEI) Capability Maturity Model (CMM) Levels 2 and beyond must have a requirements management process. Those aiming at Levels 4 and 5 require comprehensive traceability throughout the project lifecycle in order to be able to fully understand the effort and cost of requirement changes.

This level of traceability support can only be achieved using a dedicated requirements management tool. Otherwise a considerable bespoke development effort would be required [Meta-Apr03].

Requirements management for incremental / iterative development

Traditionally, formal requirements management has been used to try to get all user requirements captured up-front, and all subsequently derived requirements, designs, and tests traced back to the user requirements in order to demonstrate compliance. This style of requirements management fits well with the 'capture, analyze, design, develop, test, and deploy everything in one delivery' approach of so-called 'waterfall' methods. However, the idea of getting all the user requirements completely understood, well-defined, and 'set in stone' before any development starts is simply unrealistic. Users change their minds, their business rules change, and technology continues to develop throughout the course of a project. In addition, system architects, designers, developers, and testers may not understand the user (and derived requirements) right the first time. And following a 'waterfall' approach (Fig. 2), the user may not discover the misunderstanding until the complete system is delivered, making it very difficult and expensive to correct.
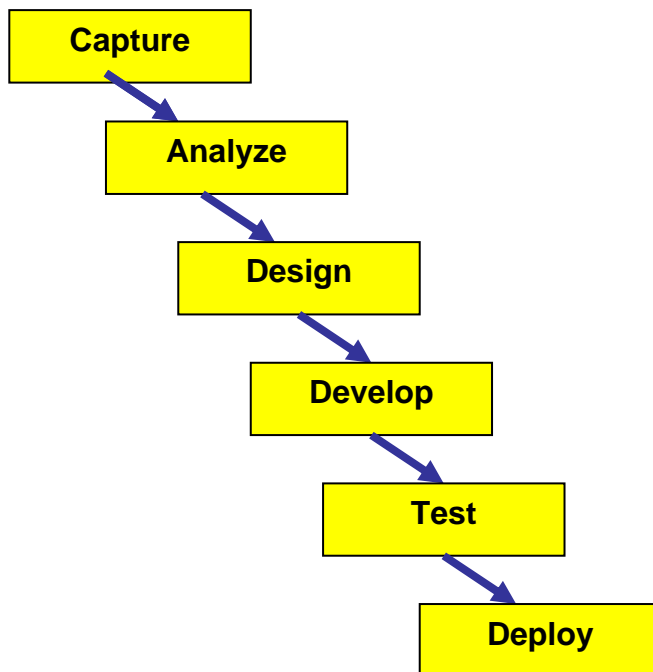
Figure 2. - 'Waterfall' development

An Iterative/Incremental development approach (Fig. 3 below) accepts that change will happen, and, in fact, builds in a 'feedback loop'. Thus, when an increment is delivered, user findings are fed back, and changes to the requirements for the next increment are made, if appropriate.
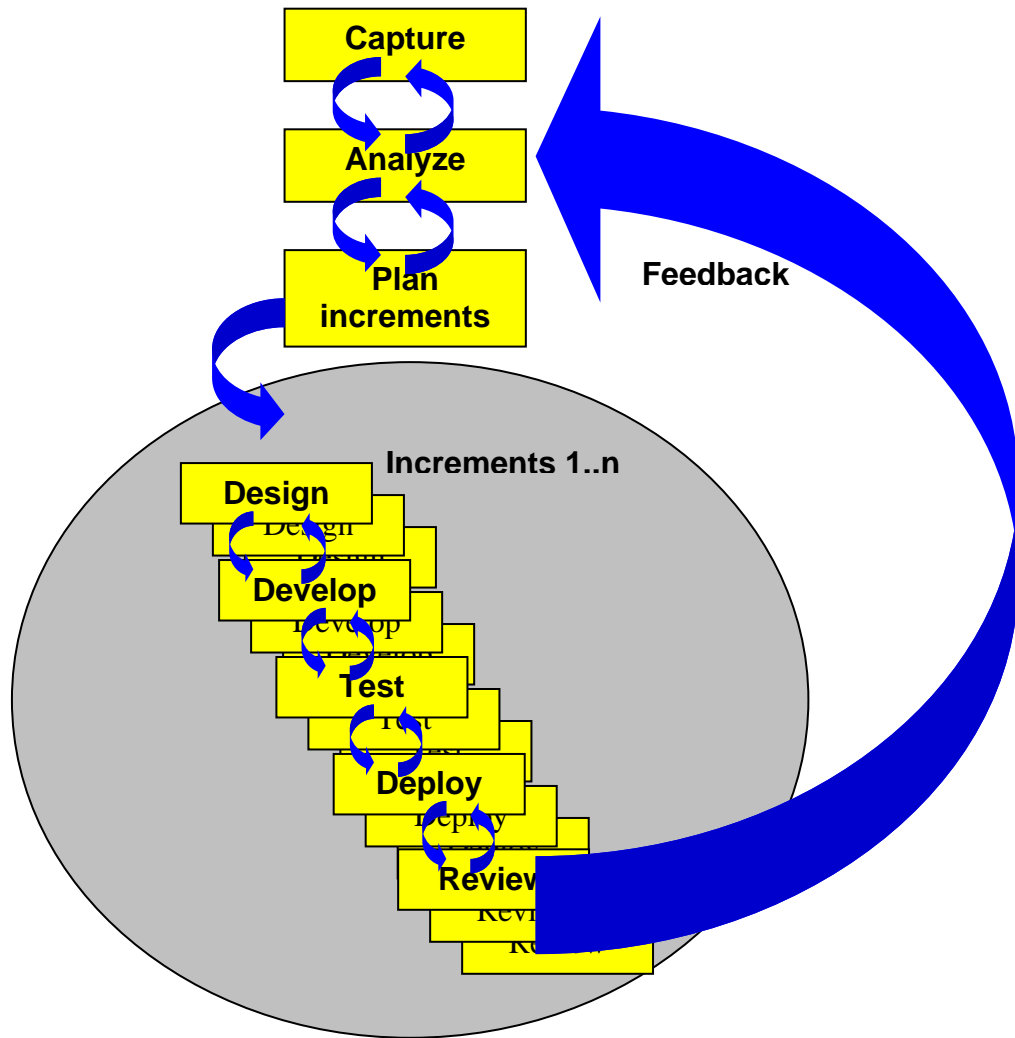
Figure 3.   – An example of an Iterative/Incremental development process

With the Iterative/Incremental approach accepting that change will happen, the benefits of continuous feedback can be realized without losing control of project scope, quality, cost, and timescales by:

- Ensuring that teams work on a particular increment at different stages of the lifecycle, and are able to determine the correct version (for that increment) of the requirements specification they should be working to satisfy. For example, if the user requirements are being modified for increment 2, while the system architects are working on the design for increment 1, the systems architects should still be deriving their designs from the user requirements established for increment 1.

- Immediately notifying all teams when a requirement changes, in order to allow them to respond quickly if the change impacts their work.

- Controlling the process of change by ensuring that no changes are made without a proper review, including a full impact assessment, and finalizing changes only after the appropriate authorization has been given.

The solution now becomes a more *dynamic* approach to Requirements Management.

Introducing Dynamic Requirements Management

Dynamic Requirements Management is:

The reduction of manual effort needed to effectively manage an evolving set of requirements within a complex iterative/incremental development project

To provide the functionality needed to practice dynamic requirements management on an enterprise-wide or even global scale, Telelogic has equipped its market and technology-leading requirements management suite, Telelogic DOORS®, with the following unique capabilities:

- **Intelligent Traceability™** ensures that all teams are using the right requirements for the increment or version they are working on. Links are then intelligently kept with the right baseline as the project progresses, ensuring both conformance and quality.

- **Proactive Suspect Links** allows each team member to know about changes made by another, automatically. DOORS proactively generates change notification directly in the requirements documents so that nothing is overlooked.

- **Lifecycle Change Management** enables users to submit, review, and approve changes within the document. This configurable change process provides easier collaboration between team members, ensuring the impact of each change is understood *before* it is made.

The following sections of this paper provide an overview of each of these ground-breaking capabilities, highlighting their business benefits.

Intelligent Traceability

Traceability of requirements throughout the lifecycle is essential. Without a clear audit trail from testing through design, and ultimately to specification, how can anyone prove that the finished product satisfies its original users' specifications? Moreover, understanding the relationship between different requirements, and recording any changes, can be critical for future and successful development.

Traceability across the entire project lifecycle is a powerful solution, and is best managed with automated support from a dedicated requirements management tool. For projects that use an incremental development process, it is essential that traceability can be created and maintained between different versions or 'baselines' of artifacts, to ensure that all teams are working against the correct versions of specifications for the increment they are producing.

Managing multiple development increments can become complex. Therefore, a to clearly relate and manage documents together that pertain to a particular increment, as well as easily see the completion status of each document for that increment is needed. This allows project managers to see progress towards a milestone and to ensure a complete and consistent set of documents at each milestone completion.

To address these requirements for managing lifecycle traceability in complex incremental systems and software development projects, Telelogic has introduced the revolutionary capabilities of Intelligent Traceability™, perhaps the biggest advance in traceability over the last decade.

With Intelligent Traceability, users can create links from current working data to previously saved baselines. As a result, work can be performed on multiple increments at one time, simply by linking to specific baselines for each increment. This model reflects the real process most large-scale projects currently use for development and testing and yet, they have to implement by other means. For the first time, a requirements management tool is in sync with incremental development in a real and meaningful way. No longer do users have to work with a single set of requirements in a single document. Intelligent Traceability enables multiple documents to be baselined together. If one document is not ready to be baselined, it can be added later. The flexibility to add documents to the same baseline set at different times avoids the scheduling problem of making all teams finish each milestone at the same time. Now, the project manager can encourage faster teams to push ahead; safe in the knowledge that the resulting baseline set will have consistent and correct links between all the documents – even though they were all baselined at different times. Furthermore, it is also possible to see which documents that are part of a baseline set definition have actually been completed (baselined into the set), allowing the monitoring of progress (see Fig 4).

For a more in-depth discussion of the need and implementation of Intelligent Traceability, please read the Telelogic White Paper 'Smarter Requirements Management with Intelligent Traceability™' [Watson03].
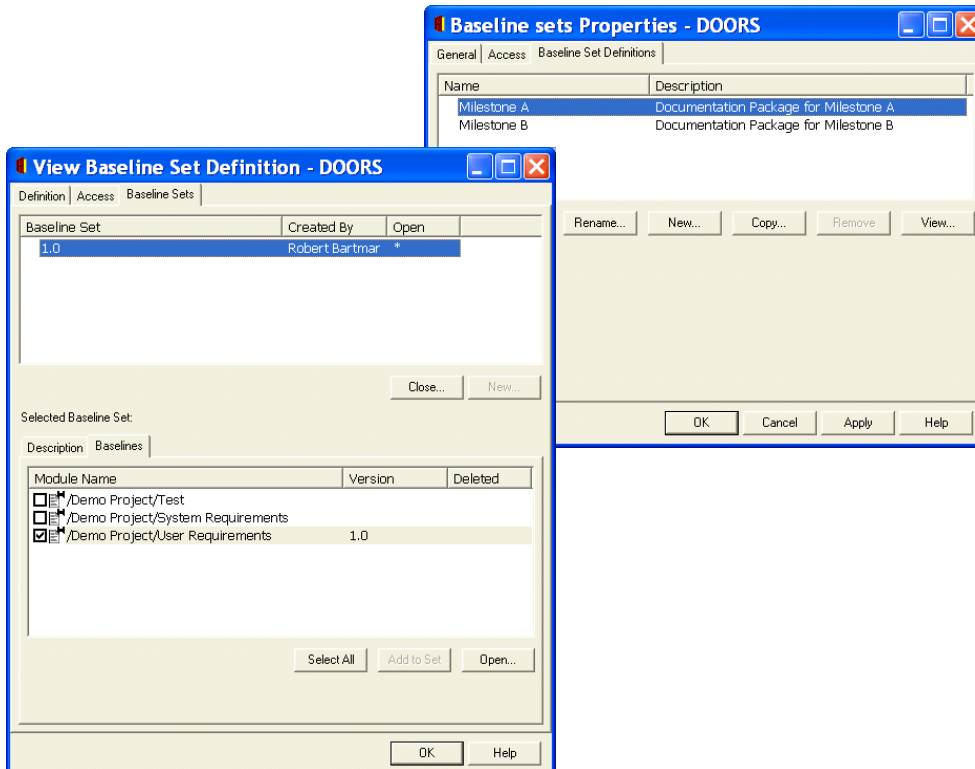
Figure 4.   – The contents of a DOORS Baseline Set, showing which documents are defined as part of the set for that milestone or increment, and which of those documents have been baselined.

Proactive Suspect Links

Projects using an incremental development approach are often fast moving and need to accommodate change. Requirement changes will most likely have an impact through many of the project stages and deliverables; for example, a change in a user requirement could mean that the system requirements, designs, software/hardware implementations, and tests that are derived from that user requirement also need to change to remain compliant.

Lifecycle Change Management enables control over the implementation of the change to the user requirement (and the review process includes the ability to produce a complete impact analysis), but how do the other teams (architects, designers, developers, and testers) know that a change has been made that could affect them?

DOORS' 'Proactive Suspect Links' (see Fig. 5) provides *instant* visual indication alongside a requirement (or other project artifact) when another requirement that it is linked to has changed.
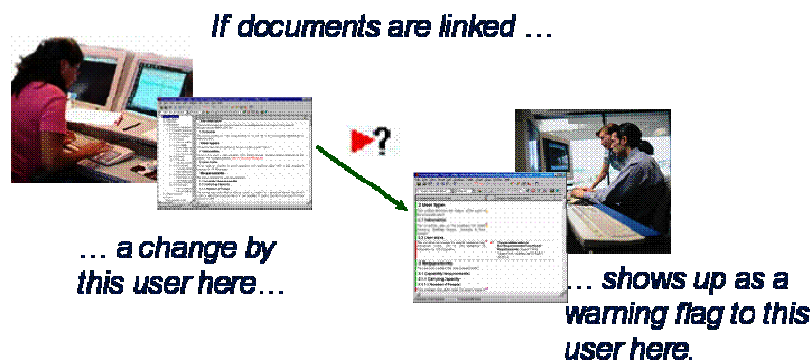
Figure 5.   – Proactive Suspect Links

The link is marked as 'suspect' because a link usually signifies 'derivation from' or 'compliance to' the target of the link. If the target has changed, the link may no longer be valid. Easy viewing of the change that has made the link suspect- without moving between documents- enables a quick assessment of what action (if any) needs to be taken as a result of the change and its impact.

Proactive Suspect Links increases the quality of products or systems by eliminating the possibility that a change could be missed. Thus, costs are reduced by eliminating the need to redo work that was completed after such changes were made.

Lifecycle Change Management

The premise that requirements will change and must be allowed to change is fundamental to Dynamic Requirements Management and its support for incremental development. However, without a controlled change management process, chaos would soon reign.

Lifecycle Change Management offers a role-based view of the requirements component of the overall change process, managed by Telelogic's change management solution, Telelogic SYNERGY/Change™. Users can propose, consolidate, review, understand, and agree on changes – without any overhead for the analysts who continue to work within DOORS.

Organizations can configure the Lifecycle Change Management solution to suit their preferred change management process or use the out-of-the-box functionality.
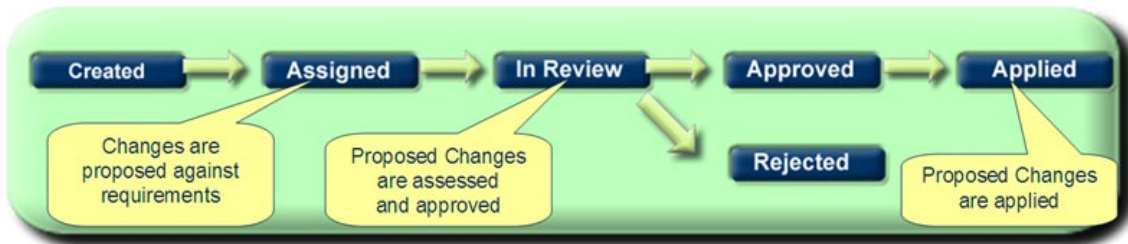
Figure 6. – Lifecycle Change Management brings customizable change management process support to requirements analysts and links requirements change management into a complete lifecycle change management process

With Lifecycle Change Management:

- Users make their changes inside DOORS –

- Once finished, changed elements are automatically identified and grouped in a consistent change package.

- A 'Proposal Manager' assigns the most appropriate people to review the change.

- Reviewers have access to all relevant information.

- A single 'Resolver' can be appointed to make a final decision.

- Approved changes are automatically applied.

By managing changing requirements within DOORS, Lifecycle Change Management removes the possibility that the changes will be lost, overlooked, or misunderstood.

The unique combination of features and functionality in DOORS and SYNERGY/Change helps make the change proposal process faster, easier, and more manageable. As a result, users can make better, faster decisions that result in higher quality results, in less time.

Summary

Effective requirements management is proven to be a major reason for project success. Conversely, its absence has shown to be a major factor for failure.

The discipline of Requirements Management has usually been associated with formal, heavyweight, 'waterfall' systems development processes. Such processes have become less popular due to their inability to deliver results quickly, and because changes in requirements are disruptive and expensive to make when adopting a complete system or a product-in-one delivery approach.

In order to become more responsive to inevitable changes in requirements or fixing development misinterpretations of requirements, more organizations are moving to 'iterative' or 'incremental' development approaches.

Requirements Management needs to be adapted to maintain its benefits of communication, collaboration, and validation, while allowing for the process of change and its impact. In essence, requirements management needs to become *dynamic*.

Telelogic DOORS delivers the enterprise-level capabilities that are required to enable Dynamic Requirements Management. Intelligent Traceability, Proactive Suspect Links, and when coupled with SYNERGY/Change, Lifecycle Change Management allows organizations to respond to changing user - and market - requirements while maintaining control over costs and delivering quality products or systems on time.

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