



# **Practical knowledge management**

**Techniques for small and medium  
sized software companies**



**© EXTRA Consortium**

# Preface

This handbook contains practical guidelines for experience transfer and knowledge management for small and medium enterprises (SMEs), which are developing and delivering software products. The book was written in the research and development project, EXTRA, within the European collective research program, Cornet.

The partners in the EXTRA project have been:

- ICT Norway (business association)
- CITEA, Cyprus (business association)
- CETIC, Belgium (research centre)
- SINTEF, Norway (research institute)
- IntelliScape, Cyprus (SME and research partner)
- Virtual IT, Cyprus (SME and research partner)

ICT Norway has been the project coordinator, and was responsible for the project management.

The EXTRA project established SME User Committees in order to ensure that the project focused on practical and relevant knowledge management topics. The following companies participated in the committees:

- Belgium: BSB, E-Connector, NSI IT Software and Services,  
OCE Software Laboratories
- Cyprus: InfoScreen, Logicom Business Solutions, Powersoft,  
Supernova Consulting, Theova UHS
- Norway: Akvagroup Maritech, Data Design System, Lydia,  
Vianova Systems, Visma Unique

The above companies provided essential input in regards to the needs and topic selection, as well as feedback on the material produced in the project. Thanks a lot!

We would also like to express thanks to Andreas Birk from Software.Process Management, Germany, for reviewing the handbook and giving us valuable feedback.

And last, but not least, we extend our thanks to the following three organisations, which have in part funded the EXTRA project:

- DGTRE, Directorate General for Technologies, Research and Energy, Belgium
- Innovation Norway, the BIT program
- Research Promotion Foundation (IPE), Cyprus

*June 15th, 2010*

*The EXTRA project team:*

Rolf Pettersen:	ICT Norway / ITVation, Norway
Michalis Michael:	CITEA, Cyprus
Frédéric Fleurial Monfils:	CETIC, Belgium
Torgeir Dingsøy:	SINTEF, Norway
Sanae Saadaoui:	CETIC, Belgium
Finn Olav Bjørnson:	SINTEF, Norway
Katerina Neophytou:	InteliScape, Cyprus
Andreas Hadjioannou:	Virtual IT, Cyprus

# Contents

<b>1 Introduction</b>			
1.1 Purpose and target group.....	1		
1.2 Knowledge management challenges in software engineering.....	2		
1.3 How to improve the knowledge management of your company ...	5		
1.4 Handbook overview.....	7		
<b>2 Fostering the knowledge management culture</b> .....	13		
2.1 Introduction.....	13		
2.2 Knowledge management schools.....	15		
2.3 Knowledge management in practice.....	17		
<b>3 Self-assess your knowledge management practices</b> .....	21		
3.1 Motivation.....	21		
3.2 The underlying knowledge management process.....	21		
3.3 Overview of the assessment tool.....	22		
3.4 How to use the assessment tool.....	22		
3.5 Conclusion.....	26		
<b>4 How to design efficient knowledge repositories</b> .....	27		
4.1 Introduction and motivation.....	27		
4.2 When to use.....	27		
4.3 How to use.....	28		
4.4 Prerequisites.....	31		
4.5 Roles.....	31		
4.6 Results.....	31		
4.7 Limitations.....	32		
4.8 Additional information.....	32		
4.9 Checklist.....	32		
<b>5 How to transfer knowledge from past projects using a project diary</b> .....	33		
5.1 Introduction and motivation.....	33		
5.2 When to use.....	34		
5.3 How to use.....	34		
5.4 Prerequisites.....	38		
5.5 Roles.....	38		
5.6 Results.....	38		
5.7 Limitations.....	40		
5.8 Additional Information.....	40		
5.9 Checklist.....	40		
<b>6 How to do effective project retrospectives</b> .....	41		
6.1 Introduction and motivation.....	41		
6.2 When to use.....	41		
6.3 How to use.....	42		
6.4 Prerequisites.....	45		
6.5 Roles.....	47		
6.6 Results.....	47		
6.7 Limitations.....	48		
6.8 Additional information.....	48		
6.9 Checklist.....	51		
<b>7 How to design process guides in order to ease their adoption</b> .....	53		
7.1 Introduction and motivation.....	53		
7.2 When to use.....	54		
7.3 How to use.....	54		
7.4 Prerequisites.....	60		
7.5 Roles.....	61		
7.6 Results.....	62		
7.7 Limitations.....	63		
7.8 Additional information.....	63		
7.9 Checklist.....	64		

<b>8</b>	<b>How to manage project information by using project memory cards</b> .....	65	<b>11</b>	<b>How to share experience through technical information meetings</b> .....	93
8.1	Introduction and motivation .....	65	11.1	Introduction and motivation .....	93
8.2	When to use.....	66	11.2	When to use.....	94
8.3	How to use .....	66	11.3	How to use .....	94
8.4	Prerequisites .....	72	11.4	Prerequisites .....	96
8.5	Roles.....	72	11.5	Roles.....	96
8.6	Results.....	73	11.6	Results.....	96
8.7	Limitations.....	73	11.7	Limitations.....	97
8.8	Additional information.....	73	11.8	Additional information.....	97
8.9	Checklist .....	74	11.9	Checklist .....	97
<b>9</b>	<b>How to improve a product by client scene investigation</b> ...	75	<b>12</b>	<b>How to use visual boards to share knowledge in small teams</b> .....	99
9.1	Introduction and motivation .....	75	12.1	Introduction and motivation .....	99
9.2	When to use.....	75	12.2	When to use.....	99
9.3	How to use .....	76	12.3	How to use .....	100
9.4	Prerequisites .....	81	12.4	Prerequisites .....	102
9.5	Roles.....	81	12.5	Roles.....	102
9.6	Results.....	81	12.6	Results.....	102
9.7	Limitations.....	82	12.7	Limitations.....	103
9.8	Additional information.....	82	12.8	Additional information.....	103
9.9	Checklist .....	82	12.9	Checklist .....	104
<b>10</b>	<b>How to foster knowledge brokers</b> .....	85	<b>13</b>	<b>Supportive information</b> .....	105
10.1	Introduction and motivation .....	85	13.1	Online resources .....	105
10.2	When to use.....	86	13.2	Bibliography .....	105
10.3	How to use .....	87			
10.4	Prerequisites .....	90	<b>14</b>	<b>Index</b> .....	109
10.5	Roles.....	90			
10.6	Results.....	90			
10.7	Limitations.....	91			
10.8	Additional information.....	91			
10.9	Checklist .....	91			

# Introduction

*By Rolf Pettersen, Andreas Hadjioannou and Torgeir Dingsøy*

## 1.1 Purpose and target group

The purpose of this book is to help software companies increase their competitiveness by providing practical guidelines and cost effective techniques for improving their experience transfer and knowledge management. Such improvements can impact a company in many ways by:

- More efficient development and delivery.
- Improved product quality.
- Shorter time to market.
- Product functionality adapted better to market needs.
- More satisfied clients.
- Expanded market through internationalisation.
- More motivated, competent, and cooperative employees.
- Reduced dependence on critical knowledge of individuals.

The main target group is SMEs that are:

- Developing and delivering software products, including associated services. This may be pure standard products or products that are typically adapted to different geographical markets, business sectors, or individual clients.
- Operating internationally, or having intentions to expand internationally.

In Europe more than 90 % of the SMEs are actually VSEs, i.e. Very Small Enterprises with fewer than 10 employees. VSE needs are therefore given high attention. These companies often use agile, lightweight or “home” development processes and methods.

## 1.2 Knowledge management challenges in software engineering

Software development and the resulting software products are complex entities compared to most other fields. Software development is a very knowledge intensive process that is performed by individuals. The outcomes from the development are crucially dependent on the skills of the individuals and the communication between them. Experience transfer between employees and the total knowledge management in the company are therefore of critical importance to any software company.

Research shows that there is a large potential for improving efficiency, product quality, client satisfaction, and profitability by learning from and using earlier experiences, and by continuously maintaining and refining the accumulated competence within the company:

- An empirical study on knowledge sharing reported that companies with a high level of knowledge sharing show 50% more effectiveness in their software development compared to companies with a low level of knowledge sharing.
- In a competitive environment with constant technological changes it is a challenge to make room for reflection and analysis in the daily work necessary to stimulate learning.
- Some reports claim that software organizations suffer from “learning failure” in that they fail to learn from their experience in software development, or even worse that they have “learned to fail”.
- Research documents a low level of systematic use of experiences. An investigation of large European research and development companies show that only 20% of these organisations review completed projects, and even fewer apply proper reviewing techniques. The situation is hardly better in smaller companies.
- In a study of success factors of software process improvement, the alignment of software process improvement actions with business strategy and goals was found to be one of the strongest indicators of success. This means that software and business executives should focus more on experience transfer and sharing of domain knowledge.

Apart from the general situation in software engineering, the

- needs of small companies,
- development and delivery of software products,
- and increasing internationalization

all bring new challenges to knowledge management, as described in the following sections.

### **1.2.1 Small companies have special needs**

The existing approaches to knowledge management in software engineering have mainly focused on the needs of large enterprises. Such enterprises often find it profitable to apply an extensive knowledge management infrastructure, including detailed process documentation, advanced complex supporting tools, separate departments for knowledge management and process improvement.

Small software companies, however, do not find it convenient to invest time and money in such large infrastructures. They focus on delivering working software products with less attention to established formal methods, often using in-house developed, proprietary (“home”) methods.

Many small companies have recently turned to agile development. In agile processes knowledge sharing happens through interaction – programmers share knowledge by working together, and through close relations with the clients. Also short development cycles with built-in feedback loops foster knowledge sharing.

Knowledge management is closely related to software process improvement. Many of the techniques in improvement frameworks such as Total Quality Management (TQM) rely on analysing experience to foster improvement initiatives. For small companies a personalization strategy, which encompasses many of the practices of agile development, is often the most cost-effective way of transferring experience.

However, there are very few guidelines for small software companies on how to manage their knowledge today, and there is very little empirical evidence for the methods that exist.

### **1.2.2 Developing software products raises new challenges**

There is a clear and increasing trend in recent years that clients, when acquiring software solutions, prefer software products as opposed to tailor made software. Also the continuously increasing competition between software suppliers creates a strong need for reducing development costs, therefore they adopt standard product strategies. Even a small software company has the potential for reaching a global market when delivering software products. If, on the contrary, it delivers once-off software projects, the potential market will be much more restricted.

Knowledge management for software product development and delivery is different and in many ways more demanding than for the once-off software projects.

Most of the existing software engineering methodologies are based on needs and experiences from a contract development setting (where a developing organisation is



contracted to develop a software solution to a problem specific to a client organisation) or from large in-house development organisations. The success of the development depends primarily on the ability of the developers to understand and satisfy the needs of the particular client organisation.

Software product challenges will vary depending on both standardisation level and market size. For instance, having a 100 % standardised product for the mass market is different from having a more customised product for a few clients. But many fundamental challenges remain similar:

- There is not one client organisation. Rather there are many potential clients, with similar but different needs.
- You have to be prepared to satisfy the needs of potential, but at present unknown, clients.
- The success of your product depends of course on functionality, quality, and price. But to a very large extent success also depends on market image of the company and the product, on market channels, on the existing market share, and on the reference client satisfaction.
- There is competition. The competitors will continuously improve their products. Even if you have a very competitive product today, you may be out tomorrow. It is not sufficient just to keep the one and only client happy, as in client specific contract development.
- In addition to the ability to meet the needs of today, success will also depend critically on the ability of the product to evolve as the needs of the market and opportunities for improvement offered by the technology evolve. Software product life cycles often span many years.
- Variant handling of the product caused by different client needs must often be offered and taken care of through the years. Timing of version upgrades will vary between clients.
- It is an important competitive advantage to be able to satisfy new needs quickly. Smaller software product companies may have the opportunity here to respond more quickly and precisely to a specific client need than a large international enterprise.
- Delivery (including distribution and services like installation, training, consulting, and support) is much more demanding than in a one client contract development setting.

These challenges obviously require special emphasis. The need for and benefits of experience transfer and knowledge management are therefore even stronger in companies developing products than in companies developing once-off software projects.

### **1.2.3 Internationalisation challenges**

Internationalisation is a strong trend among software product companies, also among smaller SMEs. They establish companies or partners abroad to deliver and implement products. Parts of software development are also distributed internationally, to low cost countries in Asia, but also to other European countries. This raises new challenges regarding experience transfer and knowledge management, for example:

- Cultural differences
- Distributed teams
- Language barriers
- Time zone differences

## **1.3 How to improve the knowledge management of your company**

As described in section 1.2, there are many challenges and a large potential for knowledge management improvements in various fields of software engineering.

Knowledge is crucially important for software companies. Accordingly, improving the knowledge management will strengthen the company in many ways. By systematically distributing knowledge and learning from previous experiences, by repeating good experiences and avoiding bad ones, the company will benefit in many areas, as described in section 1.1.

In order to succeed in knowledge management, there is a need for easily applicable approaches that can be adapted to the situation of a company. And this is what we hope that this handbook can give you.

This book provides guidelines, suggestions, and examples on how software companies can improve their internal experience transfer and knowledge management. Nine knowledge management techniques are described at a detailed operational level. They are based on previous research and experiences with the circumstances and challenges of many European SMEs, as well as a more detailed investigation of 15 SMEs in three European countries. The techniques are simple and practical, to some extent rather obvious. But nevertheless, reality shows that there is a large room for improvement in companies by actually adopting these, or similar, techniques in a planned and systematic way.

## Meze Approach

Meze in Greek: μεζε, plural μεζεδες (mezethes, pronounced meh-ZEH-thes) is an approach, used in Cyprus and Greece, to the process of ordering, selecting, and eating Greek food. A meze is not a meal consisting of appetizers but rather a series of traditional dishes served hot or cold, alone or in combination, to provide a unique and pleasant eating experience.

Meze cannot be eaten in solitude, and no one can claim that he has managed to eat all the dishes that have been served during a meze meal. Meze is usually enjoyed by a group of people who have the flexibility to select and eat what suits them as the dishes are being served, creating in a way their own style of meal and approach to eating.

In much the same way, the techniques described in this book can be seen as Meze dishes which can be used singly or in combination depending on the needs and requirements of a particular company, project, or team. You have the flexibility to select a whole technique, a combination of techniques, or to combine the methods and tools of various techniques.

The book is accompanied by:

- A self assessment tool for SMEs. Applying the tool is an easy way to get suggestions on how a company can improve its knowledge management.
- Training material for the techniques.

We emphasise the importance of building a sustainable knowledge management culture within the company, where experience transfer and knowledge management are tightly integrated with the ordinary business activities by applying principles of continuous improvement.

Remember that it is easy to *decide* to adopt improvement activities, and it is easy to *start* implementing them. The challenge is to get the changes broadly accepted and applied throughout the organisation, especially in the long term. This requires continuous attention, in particular after the initial exciting introduction period.

The content of the handbook is presented in the next section. You can apply whichever parts of it that you prefer. Consider the book as suggestions, and feel free to

adapt the techniques to your company's special needs and circumstances. It is neither the intention, nor it is likely, that a specific company would adopt all the techniques, at least not within a short time frame.

## 1.4 Handbook overview

Knowledge management is an extensive area that can be structured in several ways. An interesting approach that we find useful and will apply here, is to group knowledge management activities in so called schools. You can read more about knowledge management schools in *chapter 2*, "Fostering the knowledge management culture". Other aspects of knowledge management are also described here, as well as general recommendations on how to improve the experience transfer and knowledge management in a company.

*Chapter 3* describes how you can conduct a self assessment of the knowledge management status and practices in your company. The assessment is based on a software tool. You have to answer some questions on what is important for your organisation and some other questions on what are you actually doing presently. Based on these answers you will get recommendations on how to improve the experience transfer and knowledge management in the company. You will see which knowledge management schools could be most relevant for you to concentrate on, and you will get suggestions which techniques to apply. The tool is available on the Internet, and in *chapter 13* "Supportive information" you will find precise information where to get it.

The main part of the handbook describes nine selected knowledge management techniques that belong to four different knowledge management schools, as shown in table 1.1.

Table 1.1: Technique overview

<b>Systems school (Main focus is technology)</b>	
Ch 4	How to design efficient knowledge repositories
Ch 5	How to transfer knowledge from past projects using a project diary
<b>Engineering school (Main focus is processes)</b>	
Ch 6	How to do effective project retrospectives
Ch 7	How to design process guides in order to ease their adoption
Ch 8	How to manage project information by using project memory cards
Ch 9	How to improve a product by client scene investigation
<b>Organizational school (Main focus is networks)</b>	
Ch 10	How to foster knowledge brokers
Ch 11	How to share experience through technical information meetings
<b>Spatial school techniques (Main focus is space)</b>	
Ch 12	How to use visual boards to share knowledge in small teams

The techniques are summarised in section 1.4.1, and are described, in a standardized format, in *chapters 4-12*.

In *chapter 13* “Supportive information“ you will find information on related material for starting the actual implementation of knowledge management improvements in your company:

- The self assessment tool.
- Available presentation and training material for the techniques.
- Other relevant material and information.

In *chapter 13* there is also a bibliography, including some publications from the EXTRA project.

### 1.4.1 Summary of the knowledge management techniques

A brief summary of the techniques is given here.

*Table 1.2: System school techniques*

<b>Systems school techniques</b>		
<b>Ch 4</b>	<b>How to design efficient knowledge repositories</b>	<p>Knowledge repositories is a common term for databases within a company storing employee expertise, knowledge, experience, and documentation, usually about a particular domain of expertise. In a repository, you find knowledge that is summarised and integrated across sources.</p> <p>Knowledge repositories should be used by companies that need to share knowledge which is easy to transfer in written format and can be applied in many situations; knowledge that is reusable.</p>
<b>Ch 5</b>	<b>How to transfer knowledge from past projects using a project diary</b>	<p>A project diary is an artefact where project managers can record project issues and related follow up actions, in order to ensure the smooth running of the project from the beginning to the end. The diary is a table of issues, which can be organized in a spreadsheet with each row representing an "issue". An issue may be a problem, task, bug, risk, observation, decision, solution, or any other topic relevant to the project.</p> <p>At the end of the project the diary will contain valuable experiences and knowledge, which can be very useful for future projects.</p>

Table 1.3: Engineering school techniques

Engineering school techniques		
Ch 6	<b>How to do effective project retrospectives</b>	<p>Retrospective analysis is a way to share knowledge following the completion of a project or a major milestone. The main motivation is to reflect on what happened in a project in order to improve future practice. The analysis is performed in a workshop, is intended to be short and effective, and to yield immediate and visible outcomes.</p> <p>Two techniques are used:</p> <ul style="list-style-type: none"> <li>• A <i>focused brainstorm method called the KJ-method</i> is used to identify the positive and negative experiences.</li> <li>• <i>Causal map diagrams</i> can then be used to analyse the causes of these experiences.</li> </ul>
Ch 7	<b>How to design process guides in order to ease their adoption</b>	<p>It is often useful to describe or map development and delivery processes in order to standardize how this is done, and how work is transferred from one department to another.</p> <p>A process guide can be seen as a structured workflow-oriented reference document for a particular process, and it exists to support participants in carrying out the intended process. The guide also defines clearly the responsibilities of the people involved in the execution of this process.</p> <p>If there are communication problems between team participants or between departments, this technique is useful for documenting and improving software development and delivery processes.</p>
Ch 8	<b>How to manage project information by using project memory cards</b>	<p>During the lifecycle of a software development project, many electronic documents (artefacts) are produced. They contain a large amount of knowledge about the project, and they should be stored, shared, and managed by using explicit information architecture. It is essential that this information is easily accessible and reusable. A typical way of handling this information is by using indexers or the search functionality of a document management system.</p> <p>However, it would often be useful to access information about a project without searching a large document base multiple times. To achieve this a project memory card can be used. This is a snapshot of the project with reusable key information about the project, available in a single document.</p>
Ch 9	<b>How to improve a product by client scene investigation</b>	<p>It is essential for a software product company to capture efficiently the requirements of their clients. and to follow effectively the changes in the market.</p> <p>Client scene investigation is a technique for capturing the client's needs and sharing this knowledge among the employees of the company. The investigation is based on several organized visits to selected clients of the company. The technique allows for capitalizing on the internal know-how of product development, on the company's sales, and on the technical marketing. The technique creates a permanent link between the organization staff in charge of the product and the clients, through the person responsible for the visits to the clients.</p>

Table 1.4: Organizational school techniques

Organizational school techniques		
Ch 10	<b>How to foster knowledge brokers</b>	A knowledge broker is a person with high communication skills, able to foster knowledge exchange among employees. He is a person that knows who knows what. He assists individuals in searching for resources. He connects people and facilitates interactions. This technique is used to foster the creation of knowledge brokers inside the company. The knowledge broker will build good relationships with employees to share knowledge with them. He will learn actively from them by focusing communication on problems and solutions.
Ch 11	<b>How to share experience through technical information meetings</b>	One approach to sharing knowledge between projects is to connect people with similar interests in a network to discuss common topics. Such networks are often referred to as “communities of practice”, and can offer several benefits, from concrete help to solve problems to establishing common practices in the organization.  <i>The Technical Information Meeting</i> technique is an easy way to establish communities, to gather and share information in the organization. Its objective is to organize regular topical meetings to get employees actively involved and informed across projects.

Table 1.5: Spatial school techniques

Spatial school techniques		
Ch 12	<b>How to use visual boards to share knowledge in small teams</b>	Many small development teams use visual boards to communicate vital project information within the team and to others who have an interest in the team’s work. A board usually displays tasks on cards, and the placement of cards on the board shows the task status. Teams have found that such boards make meetings efficient. Participants point at cards on the board to show what the team members work on, and the board shows the overall progress of the project. Physical artefacts are easy to refer to, easy to annotate, and hard to ignore. A physical board makes it easier to limit the amount of information compared with an electronic system, which is often the alternative. Such boards can help give teams a shared mental model of the project status and the importance of tasks.  Teams working in a distributed environment might choose electronic tools to communicate project information, but might be able to configure their tools according to advice given in this technique description.



*Good luck in improving the experience transfer  
and knowledge management in your company!*