

# eXPERT Approach Implementation in Software SME

*Silvia Ilieva, Penko Ivanov, Ilian Mihaylov, Eliza Stefanova, Avram Eskenazi*

*Silvia.Ilieva@acat.bg, Penko.Ivanov@rila.com, Ilian.Mihaylov@rila.com, eliza@fmi.uni-sofia.bg, eskenazi@math.bas.bg*

## **Abstract**

This article presents software development approach developed within the EC IST 34488 eXPERT project, which is systematic combination of Extreme Programming (XP) and Personal Software Process (PSP). In particular, the article describes an experiment under a project in Rila Solutions (a Bulgarian software company). The experiment consisted in performing a detailed gap analysis between the existing certified development process and the eXPERT approach, ranking the differences and showing the ways to overcome them. The article further outlines the advantages of applying the eXPERT approach, as well as the lessons learnt.

## **Keywords**

software development process, eXtreme Programming (XP), Personal Software Process (PSP), eXPERT approach.

## 1 Introduction

The latest studies on the well-known software development methodologies and their applicability to e-projects reveal that these methodologies do not fit very well the priorities, the abilities and the corporate culture of SMEs developing e-business or e-commerce applications. Traditional methodologies (incl. those more recent of an evolutionary type) assume that software engineers could more or less anticipate the complete set of requirements early enough and reduce cost by eliminating change. This result can be reasonable in stable environments, but it is not the case at all in e-projects. E-project as defined in [4] is a project which: must be delivered rapidly; is both research-like and mission critical; have to be managed in a turbulent business and technology environment. In the fast changing environment of e-projects change cannot be eliminated. Rather than eliminate rework, the new strategy is to try to reduce its cost, while retaining quality.

The main objective of EC IST 34488 project eXPert was to define and provide SMEs with a powerful and lightweight approach for software development of e-business applications. This approach is applicable to small teams developing projects characterised with often changing requirements, tight schedules, and high quality demands. Its aim is to facilitate all related activities with crucial importance for a project success: pure development, management of time, changes, quality, customer relationships, and professional growth of the employees. The approach is called eXPert and combines principles of eXtreme Programming (XP) [1,7] and the Personal Software Process (PSP) [5,3].

The eXPert project consortium established a network of Centers of Expertise (CE) in Spain, Germany and Bulgaria, and user companies associated to each CE. Seven pilot projects are run at the user companies who experimenting the application of the defined approach to e-project development. The case study this paper describes is one of those pilot projects – the Bulgarian company Rila Solutions.

The article is organised as follows: Section 2 presents eXPert approach, which is based on XP and PSP. Section 3 describes the Rila Solutions' development environment with major outcomes of the gap analysis performed in Rila Solutions and experimental results. Section 4 discusses lessons learnt. Section 5 concludes the paper.

## 2 eXPert Approach Basics

### 2.1 eXtreme Programming (XP)

Extreme Programming is a lightweight, efficient, low-risk, flexible, predictable and scientific way to develop software [1]. XP is a discipline for software development with values of communication, simplicity, feedback and courage.

The recommended practices in applying Extreme Programming are [7,9]:

- |                    |                         |
|--------------------|-------------------------|
| • On-site customer | Collective ownership    |
| • Small releases   | Continuous integration  |
| • Planning game    | Metaphor                |
| • Simple design    | Coding standards        |
| • Pair programming | 40-hour week            |
| • Refactoring      | Stand up meetings       |
| • Test-first       | Iteration retrospective |

XP emphasizes on the team style of work, understanding the team as consisting of customers, team

agers and developers. Involving the customer in all the processes of software development is one of the reasons for having a successful product delivery in time and with a happy customer.

Of all the lightweight methodologies, XP tends to be best accepted by the e-project developers due to the simplicity of its rules and practices, its flexibility to changes in a project run, refactoring orientation and collaboration ideology.

### 2.2 Personal Software Process (PSP)

PSP is a structured framework of forms, guidelines and procedures for developing software [3,5]. The PSP is a self-improvement process designed to help software developers to control, manage and improve their way of work. It educates them to estimate and plan their work and to do this before committing to start doing the job. The first step in the PSP process is planning. In order to make better plans software engineers have to gather data on:

- the time they spend in each task - using time recording log,
- the sizes of the products they produce - the principal measure is lines of code (LOC) but any size measure can be used if it provides a reasonable correlation between development time and product size
- the quality of these products - using defect recording log where there is data about injected defect, when they are injected, when they are found and fixed, how long it took to fix them.

The PSP planning process itself includes: requirements, conceptual design and estimation of product size and resources. PSP, similarly to XP, focuses on building quality products and tracking quality from the initial development phase, instead of checking it right before delivery. PSP quality management is based on two principles - early defect removal and defect prevention. Last but not least, PSP like Capability Maturity Model (CMM) [8] is organized in levels:

- PSP0 - the baseline process
- PSP1 - the personal planning process,
- PSP2 - personal quality management process
- PSP3 - a cyclic personal process

The PSP applies not only to critical software development phases as design, code and test but also to other phases like requirements engineering, product maintenance, documentation development and others.

### 2.3 The eXPert Approach

Although the XP practices seem to be very simple, they require strong individual and team discipline in order to achieve good results. There are a number of reports about XP experiments showing that they have failed due to developers' reluctance or incapability to apply the practices in a disciplined and professional manner. The incapability aspects are mainly related to making wrong estimations of individual work and failing to create a correct plan of the tasks that have to be performed. It seems that complementing XP with the PSP is a good way for resolving the problem. Even more, the PSP could also contribute to coping with the problem of reluctance. That is why the eXPert approach is built on two well-known software development approaches XP and PSP.

The eXPert approach [2] is described by means of five processes: Customer Requirements Management, Project management, Design, Code and Test. The processes are described in terms of Activities, Tasks that have to be done to complete an activity, and responsible Role for performing a task. The activities described into the eXPert approach [6] are based on the enumerated XP practices. Certain modifications are introduced mainly related to measuring the effectiveness of these activities and the defect rates. This measuring is needed in order to identify problem causes and to eliminate



them in the future. The logs for collecting project data follow the templates and the principles of PSP, but are modified as to fit the XP method, in particular to reflect its specifics that developers work in pairs and that design, testing and coding processes are strongly interrelated and executed in parallel. eXPERT approach defines the following roles: Customer, Project Leader and Developer. They are very close to the roles as defined in XP (Programmer, Customer, Coach, Tracker, Tester, Consultant, Big Boss), with some additional responsibilities coming from the application of the PSP practices. More than one role can be assigned to a single team member into a project. In such a case it is important that this team member has the necessary knowledge and skills as well as the time for playing all the roles assigned to him.

The eXPERT approach, if compared to XP, seems to be more structured, easier to be understood and applied by SME's because of the process oriented architecture. At the same time it is not as light as XP (especially for developers) because of the need to measure activities and tasks to be done - each one of the processes contains one special activity, which goal is to measure effort and time spent on tasks into the process. The idea for the measurements came from PSP, but in all other directions the eXPERT approach and PSP seem to be incomparable. All measures in the eXPERT approach are performed only when they are necessary, and their main goal is to optimize the time and cost planning. These measurements itself should be not so heavy extension for the SME's applying the eXPERT approach, if specialized tools for gathering and analyzing data from the measurements are available. That is why eXPERT could be considered as a light but well balanced approach.

### 3 Rila Solutions Context of Applying Expert Approach

#### 3.1 Reasons and Prerequisites

At Rila Solutions, as in most software developing SMEs, the necessity for providing high quality software solutions has increased enormously. Clients need both to have a feasible system as soon as possible and to be able to constantly amend the functional scope. The need for flexibility of the software development process apparently has become one of the major issues in the new development practices. Delivering software solutions is hard, but delivering quality software on time and budget is even harder. The new trends in software development are more than clear: to deliver high quality faster with smaller budget.

Rila Solutions' Development Process (developed and applied by the company) is flexible enough to allow the adoption of different Project Management (PM) methodologies depending of the matter of the project. Some of Rila Solutions projects (a small number at present) are characterized with well written specifications clear understanding of customer needs and the means to achieve this. These projects have well defined business models, technologies and goals. The technology used is well described and no variations upon the solution development are possible. In the rest of projects (possibly around 70%), changes are most likely to occur because the system definition is not stable enough. Rila is working to improve its PM process and to adopt world best practices, which should allow delivering solutions on time, within the budget and with the desired functionality. The eXPERT methodology was applied experimentally to such kind of projects.

To make the current situation clearer, we should add that Rila Solutions uses a Quality Management System, which is ISO 9001:2000 certified. It also has an impact on the application of new methodologies, and consequently on the gap analysis, which is the first step towards discovering the discrepancies between the existing Rila Solutions Software Development Process and the eXPERT approach. Description documents, standards, as well as dedicated questionnaires were used as sources to this analysis.

#### 3.2 Gap between Rila Process and eXPERT Approach

Prior to applying the eXPERT approach in the company, Rila Solutions performed gap analysis for the

differences between the current process and the approach that should be applied. The subject matter of the present analysis is the implementation of the new process of development in a professional service company.

The process of gap analysis was a typical business reengineering process. Business objectives were set for the following types of e-projects:

- Projects that do not have properly specified requirements at the beginning of the project
- Projects for clients that do not have a detailed vision of the software they need from the beginning
- Projects, detailed requirements of which cannot be entirely gathered at the analysis phase.

The gap analysis discovered various types of differences between the current project lifecycle and the project lifecycle that will become as a result of applying the eXPERT in the company. All the changes in the process that should take place were carefully analyzed and described in a "GAP Analysis" document that was presented to the top management and the team members. A short course on the principles and the practices of the eXPERT and its implementation in the company was carried out in order to prepare the team for the new framework and discipline required by the approach. The major outcomes of the process of Gap Analysis are:

- The project goals are not changed. Process phases remain the same. The changes take place in the sequence of the tasks within the phases, roles and intermediate outcomes.
- Control and status reporting - the granularity of data and the number of tracked data are significantly different according to the PSP requirements. New tracking and controlling tools are involved in the process.
- The total number of project documents was reduced by 7 tracked documents.
- The most effort consuming documents: "Basic Solution Specification" and "Detailed Solution Specification" were lightened or modified and become much easier for preparation. This led to less time for documents writing and lower total project cost and shorter time prior starting the development of the e-project having the customer available.

#### 3.3 Experiment Results

As a result of the gap analysis, Rila Solutions has developed a tailoring guide on how the new approach should be implemented and used within the company. This tailoring guide was presented to all team members that were involved in the pilot project using the eXPERT methodology. A short course on the principles and the practices of the eXPERT and its implementation in the company was carried out in order to prepare the team for the new framework and discipline required by the approach.

The selected project was conducted strictly within the framework of the new tailoring guide and the eXPERT, hereinafter referred to as "the pilot project". For the purpose of ensuring comparability of results, Rila Solutions used the time and effort tracking system, already implemented by the company, which keeps information on all activities performed by the project members on each project as well as variations on the time schedule and effort.

One of the most critical factors applying new methodologies is the adequate baseline that will be used for comparing the newly achieved results and measuring whether and how the company had achieved the desired benefits and what is the actual profit. Prior applying the eXPERT for the first time we were aware that correct result comparison may be achieved if we apply it on one and the same project with same team members that do not use the know-how collected during the first implementation. As the matter of fact this situation cannot be created and the following steps were taken:

A project with identical technology and similar project achievements was selected to serve as a baseline project. For the correct selection of the baseline project, several other metrics were used for comparison like Lines of Code (LOC), number of database tables, number of user forms and controls. The purpose was to select the best match for a baseline project with similar achievements and activities to the ones that will be performed in the pilot project. The data for the baseline project was taken out of



the time tracking system and some of the results are presented in the figures below.

Figure 1 presents the effort that was invested in the development of the pilot project using the eXPERT approach versus the effort used in the development of the quite similar baseline project. The result is decreasing the overall effort on all iterations and as a whole – for the entire project.

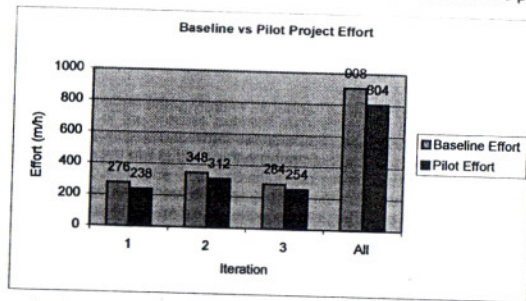


Figure 1: Decreasing the development effort by iterations with the eXPERT approach

Figure 2 presents the overall decreasing of the development effort for the pilot project according to the baseline project in percentage. It is created on the basis of the data represented in Figure 1. The negative effort deviation is a result of the less effort that was used in the implementation of the pilot project than the baseline with similar achievements.

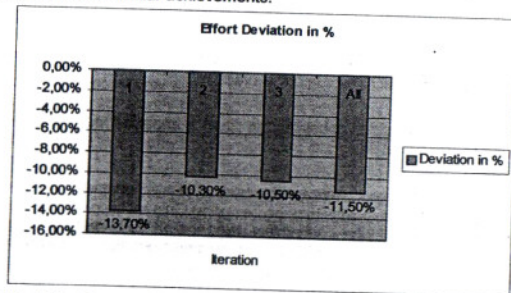


Figure 2: Effort deviation in percentage by iterations using the eXPERT approach

Apart of these measured results gathered during the pilot project implementation the whole lifecycle of the project was influenced by the eXPERT practices. Having the customer available "on-site" helped us to minimize the task "Gathering User Requirements" duration and move the start of the development phase earlier in time. The reduced document flow and testing practices from the XP also helped us to save some effort and bring the project to earlier and successful project ending.

## 4 Lessons Learnt

SMEs planning to apply the eXPERT approach should keep in mind some of the steps in Rila experiment as an example. They could repeat at least two of them: to identify whether they really need the eXPERT approach (Rila Solutions' approach was to prepare a questionnaire for all employees to analyze current process weaknesses) and to train the staff on how to apply eXPERT approach.

It is essential for the project success that the appropriate selection of the staff in general is carefully performed. When the company tries to implement a new methodology the management should choose an appropriate pilot project. Young and enthusiastic people should carry out the pilot project. The training and the adapting to the new approach are easier. If part of the team is already trained then the training of the new developer(s) involved in the team could be done on the way.

## 4.1 Benefits

Using eXPERT approach in Rila Solutions' real project has shown that its benefits are the shorter time for customers' feedback, the reduced number of documents and the simplification of some documents. The project documentation is kept to a reasonable minimum with the application of the eXPERT approach. At the same time, the total time needed for shipping the product to the customer is reduced.

The improvement of the discipline is considered to be the most important benefit from the eXPERT implementation. All measurements and records stimulate better discipline of developers. The eXPERT approach positively influences developers and, as a final result, there is an organizational and business impact.

Applying the eXPERT approach decreases the time and effort spent on design mainly because there is no detailed design documentation. From cost perspective, the cost reduction comes from the fact that there is no need to have high-qualified specialists for analysis of requirements and the design of the system developed and to spend long time for interviewing the customer on their side.

## 4.2 Specifics

Applying the eXPERT approach in Rila Solutions led to some specific peculiarities and changes to the practices described in the pure eXPERT definition. These changes resulted from the developers' and project management view on how to apply the approach to real projects.

Pair programming is used also as a way to improve the skills for one of the developers. But in cases when team members work on other company projects at the same time, applying pair programming all the time requires additional efforts to ensure the co-ordination of pair members.

Unit tests (automated tests of class or cluster of classes and their functionality), which are important part of Test-first practice, are performed easily and mainly for business logic and they are not applied or difficult to apply for the user interface part.

The defect logs has shown that the application of Test-first practice as part of the eXPERT approach leads to reduction of the errors' appearance in later project phases, reduction of not fixed errors and finally to reduction of the total time for the development and increased quality of the product.

The Customer on-site practice could not be applied as described in XP and eXPERT. In Rila Solutions experiment, it is unrealistic to have the customer present at the team office during the development – the communication with him is achieved through meetings on the customer site, phone calls, e-mails, as well as providing him with web-access to the application. The developers' team is certainly the initiating site in that communication.

It is difficult to plan in an e-project from the beginning how many releases will be performed and how much iteration will be needed in each release. When the customer performs a constant monitoring on the project and its results, the new ideas on the functionalities come on the way.

Using strict Coding standards as recommended by XP makes the code readable and understandable for all project members. Several code reviews should be performed for in order to fully adopt this practice and reduce the time for further refactoring of the code smells.

In general, the recommended practices are applicable to particular projects but, depending on the project specifics, they have to be adjusted for others: most of the eXPERT practices can be introduced separately, but their full effect is reached only when using all of them. In our view, the team should



start with coding standards (in most software SME-s they already exist) and could continue with unit testing, refactoring, pair programming and so on – finally finishing with customer on-site (the most difficult and unrealistic practice from XP). According to the pilot experiment practices coming from PSP are mandatory and are applied as they are.

### 4.3 Difficulties

Nevertheless some of the practices in the approach were found to be unrealistic to some extent for use in the Rila Solutions pilot project (apart from customer on-site) and they are reported as not used eXPERT practices. These are as follows:

- Design checks - could be substituted by very informal peer reviews
- Pair programming is difficult to be applied 100% - Developers find it very hard to work 40 hours a week at such heavy and exhausting paces, especially if they use pair programming all the time and have never used XP practices before. Nevertheless pair programming is vital for the team discipline and should be applied as much as possible.
- Test-first is difficult to be applied 100% (there are cases where tests are more time consuming than useful)

The general conclusion derived from the detailed and ranked results shows that the gap between the Rila Solutions' processes and the eXPERT approach is essential. The main reasons seem to be the very important difference in the granularity of the processes, as well as the typical top-down approach of Rila Solutions. However we can say that the gap existing with the eXPERT approach has successfully been overcome due to the flexibility of the Rila Solutions approach.

We also have to note that factors not directly connected to the application of the eXPERT approach influence its success. The most important among them are the willingness and readiness of the staff to try to apply the eXPERT approach in appropriate projects, the explicit interest of a number of staff members in eXPERT and the high qualifications of the persons directly involved of the experiment.

### 5 Conclusions

The eXPERT approach addresses various aspects of e-project development and according to the experience we acquired - helps to deal with the respective arising problems like imprecise and slipping project scope, effective communication, integration of the customer into the project development process, project estimation and planning, following sound personal and team discipline principles. These features make it particularly appropriate for a wide range of e-projects. The adoption of this approach creates new professional and personal values that are necessary for SME to enter the digital economy - flexibility, quality, efficiency, communication skills, as well as working with uncertainty, intangible assets, rapidly changing requirements, and the crippling cost of failure.

In SME's with processes comparable with Rila process, the expected benefits from the eXPERT approach are the reduced number of documents produced during the project implementation and the shorter time for feedback. As a result, the time for the whole project development is reduced. From cost prospective, the expectations are to reduce the cost at least because of the elimination of the need to have high-qualified specialists for analysis of requirements and the design of the system developed.

The biggest difficulty in the eXPERT approach implementation appeared in the necessity for introducing some changes in the people's culture and mindset. It seems that a lot of efforts will be necessary to acquire the new knowledge needed, to formulate the new rules, to start thinking differently and to stick to a new discipline. This has been the case in Rila where established processes were quite different and new specific changes were introduced during the adoption of the eXPERT approach and the requirements of the PSP.

### Acknowledgments

This work was the result of the IST-2001-34488 project, called "eXPERT", that was funded by EC 5FP.

### 6 Literature

1. Beck K., "Extreme Programming Explained: Embrace Change", Addison-Wesley, 1999
2. Bozheva T., Deliverable D1 – eXPERT approach, July 2003
3. Hayes O., "The Personal Software Process: An Empirical Study of the Impact of PSP on Individual Engineers", Carnegie Mellon, 1997
4. Highsmith J., "e-Project Management: Harnessing Innovation and Speed", e-Business Application Delivery Journal, Vol. 1, No. 1, Cutter Consortium 2000
5. Humphrey W., "A Discipline for Software Engineering", Addison-Wesley, 1995
6. Ilieva S., E. Stefanova, eXPERT approach for e-business software development, International conference "Basic Technologies for E-business'2002", 16-18 September, Albena, 2002,
7. Jeffries R., A. Anderson, C. Hendrickson, "Extreme Programming Installed", Addison-Wesley, 2000
8. Paulk M., B. Curtis, M. Chrissis, C. Weber, "The Capability Maturity Model for Software", SEI, 1999
9. Westphal F., J. Eckstein, Extreme Programming course, 2002