

Defining Project Scenarios for the Agile Requirements Engineering Product-line Development Questionnaire

co-published as

UTDCS-21-07

**Department of Computer Science
The University of Texas at Dallas
and**

LSI-07-14-R

**The Department of Software (Llenguatges i Sistemes Informatics)
Universitat Politècnica de Catalunya**

Version 1.0

March 24, 2007

Ph.D. Students

Kunwu Feng
The University of Texas at Dallas
kwfeng@students.utdallas.edu

Meli Lempert
Universitat Politècnica de Catalunya
Meli.lempert@gmail.com

Yan Tang
The University of Texas at Dallas
tangyan1981@students.utdallas.edu

Kun Tian
The University of Texas at Dallas
kun.tian@students.utdallas.edu

Faculty Advisers

Kendra M.L. Cooper
The University of Texas at Dallas
kcooper@utdallas.edu

Xavier Franch
Universitat Politècnica de Catalunya
franch@lsi.upc.edu

Table of Contents

1.	Introduction.....	3
2.	Project Scenario Requirements.....	5
3.	Project Scenario Definition Methodology.....	7
4.	Project Scenario Set.....	11
4.1	Home Appliance Control System.....	11
4.2	Online Shopping System.....	21
4.3	Online Banking System.....	31
4.4	Accounting System.....	41
4.5	Student Registration System.....	51
4.6	Income Tax System.....	61
4.7	Medical System.....	71
4.8	Printer System.....	79
4.9	Automotive Embedded System.....	87
5.	Conclusions.....	95
6.	References.....	95

1. Introduction

Agile development practices [1] respect “the quality of being agile; readiness for motion; nimbleness, activity, dexterity in motion”. Agile methods are attempting to offer an answer to the eager business community asking for lighter weight along with faster and nimbler software development processes. However, the current agile methods, like XP or Scrum, are focused on practices of small, rapid developing and iteration, more people-oriented, less documentation projects, and the use of the methods in large, product line projects are somehow difficult. Software product lines refer to engineering techniques for creating a portfolio of similar software systems from a shared set of software assets using a common means of production. Manufacturers have long used analogous engineering techniques to create a product line of similar products using a common factory that assembles and configures parts designed to be reused across the varying products in the product line.

The aim of the overall project approach is to develop an expert system that can assist a requirements engineer in selecting a requirements engineering process that is well suited for their project, in particular with respect to the use of agile and product line engineering methods. To the best of our knowledge, this is the first expert system to do this.

At a high level, the development of an expert system generally has two main steps (refer to Figure 1). The first is to acquire knowledge from experts in the domain. The second is to embody, or represent, the knowledge; this can be accomplished using a variety of approaches including rule based, Bayesian Belief Networks, etc. Once represented, the knowledge can be reasoned about.

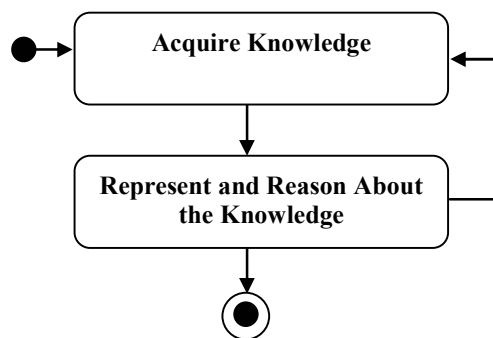


Figure 1 Overview of Developing the Expert System

Knowledge acquisition is achieved in our research by developing a questionnaire [2] and obtaining the expertise of researchers and practitioners actively involved in software development using agile, product line engineering techniques. Questionnaires [3, 4] are frequently used in quantitative marketing research and social research in general. They are a valuable method of collecting a wide range of information from a large number of

respondents. In addition, our questionnaire is web-based, as our (international) respondents are geographically distributed.

The questionnaire used in this research is organized into two parts. The purpose of the first part is to collect information about the expert's specific area of expertise. For example, some experts may work in embedded software development, web based software development, information systems, and so on. The purpose of the second part of the questionnaire is to present a small set of project scenarios to the expert, which are as closely related to their area of expertise as possible, and obtain the expert's opinion about what kind of RE process to use on these projects. In turn, based on the data collected from the second part of the questionnaire, a decision network will be developed to provide various options regarding to specific software product line and agile method techniques for each phase of requirement engineering for a specific project.

This report focuses on the second part of the questionnaire. More specifically, we present the project scenario requirements, development methodology, and the initial set of 162 project scenarios defined. In the future, version 2 of this report will be released, which will include additional scenarios.

The structure of this report is as follows. The requirements for the project scenarios are presented in Section 2. The methodology used to define the scenarios is in Section 3 and the set of scenarios developed is in Section 4. Conclusions are in Section 5.

2. Project Scenario Requirements

The requirements for the project scenarios are captured and presented in this section using a straightforward approach: shall statements. Each requirement is stated, followed by the reason why the requirements have been included (i.e., the rationale).

- ✚ The scenarios shall include applications that are new projects and on-going enhancements.

Rationale: Need to include diverse types of projects, as experts may believe this is highly related to the degree of agility and/or the use of product line engineering techniques that are suitable for a project.

- ✚ The scenarios shall include a wide variety of domains: Online Shopping System, Online Banking System, Accounting System, and Student Registration System, Home Appliance Control System, Automotive Embedded System, Medical System, and Printer System.

Rationale: Need to include multiple domains; as product line engineering techniques are being used in diverse domains, as experts may believe that the domain may be highly related to the degree of agility and/or the use of product line engineering techniques that are suitable for a project.

- ✚ The scenarios shall include web-based information systems, traditional client-server information systems, and embedded systems.

Rationale: Need to include diverse kinds of projects as experts may believe that the domain may be highly related to the degree of agility and/or the use of product line engineering techniques that are suitable for a project.

- ✚ The scenarios shall include applications that are under product-line and single product development.

Rationale: Need to include diverse kinds of projects; the single product development can be viewed as the a product line with one family member

- ✚ The scenarios shall include applications that are using agile and planned methodologies.

Rationale: Need to include diverse kinds of projects; range of projects from very agile to very planned need to be supported.

- ✚ The scenarios shall include applications that are developed in one or more geographic sites.

Rationale: Need to include diverse kinds of projects; geographically distributed projects need to be considered as outsourcing becomes more common. Experts may believe that the geographic distribution may be highly related to the degree of agility and/or the use of product line engineering techniques that are suitable for a project (e.g., the principles of agile methods promote face-to-face meetings)

- ✚ The scenarios shall include applications that have a range of stakeholder involvement in the requirements engineering process.

Rationale: Need to include diverse kinds of projects; range of projects from very high (frequent) level of stakeholder interaction to very low (infrequent) level of interaction. Experts may believe that the level of stakeholder interaction may be highly related to the degree of agility and/or the use of product line engineering techniques that are suitable for a project (e.g., the principles of agile methods promote frequent, stakeholder user interaction).

- ✚ The scenarios shall include applications that range in size (SLOC estimates) from <10 KSLOC to >1000 KSLOC.

Rationale: Need to include diverse sizes of projects. Experts may believe that the size of the project may be highly related to the degree of agility and/or the use of product line engineering techniques that are suitable for a project. The SLOC estimate is a simple way to estimate the size, although other metrics could be used in the future.

3. Project Scenario Definition Methodology

A systematic methodology has been used to define the project scenarios for the questionnaire (refer to Figure 2). The steps include define project properties, define an initial set of project scenarios, identify additional sets of project scenarios, review and revise the scenarios, organize the scenarios into report form. Each of these steps is described below.

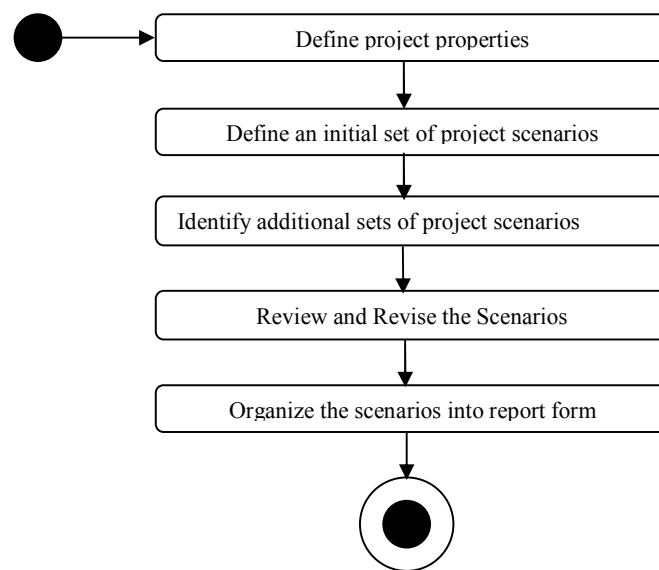


Figure 2 Scenario Definition Methodology

🚩 Step 1: Define project properties.

Purpose: Define properties about the projects in each scenario.

Role: Senior team member

Inputs: Vision Document for a Home Appliance Control System (HACS) [5] example.

Outputs: A properties list as a guideline is defined in this step.

The properties is abstracted from the HACS example, which are cover most important project profile, including project specific configuration, e.g. developers number, duration, size, etc, product line – sensitive attribute like if the project is a new system or enhanced version of a existent system, and agile method - sensitive attribute like if the project is safety and security critical and how many locations are the developers scattered in.

Step 2: Define an initial set of project scenarios.

Purpose: Define a set of scenarios that can be used by junior members of the team (Ph.D. students) as an example, to assist them in defining additional sets of scenarios.

Role: Senior team member

Inputs: Vision Document for a Home Appliance Control System (HACS) [5] example.

Outputs: A set of 18 scenarios for a HACS have been defined in this step. These are presented in Section 4.1

Step 3: Identify additional sets of project scenarios to define.

Purpose: Create a more complete repository of examples to be used in the questionnaire.

Role: Junior team members

Inputs: HACS scenario set.

Outputs: An additional eight sets of project scenarios have been defined, including Online Shopping System, Online Banking System, Accounting System, Student Registration System, Income Tax System, Medical System, Printer System and Automotive Embedded System.

The scenarios are collected from software engineering industry, and they were recorded as much in detail as possible. For each application area in every domain, more than 10 scenarios are gathered.

Some of the scenarios are coming from open source website [6], like <http://sourceforge.net/>. Open source describes the principles and methodologies to promote open access to the production and design process for various goods, products, resources and technical conclusions or advice. The term is most commonly applied to the source code of software that is made available to the general public with either relaxed or non-existent intellectual property restrictions. This allows users to create user-generated software content through either incremental individual effort, or collaboration. The open source model of operation can be extended to open source culture in decision making which allows concurrent input of different agendas, approaches and priorities, in contrast with more centralized models of development such as those typically used in commercial companies. "Open source" as applied to culture defines a culture in which collective decisions or fixations are shared during development and made generally available in the public domain. This collective approach moderates ethical concerns over a "conflict of roles" or conflict of interest. Participants in such a culture are able to modify the collective outcomes and share them with the community.

A JAVA tool is developed to calculate the lines of code. For open source projects, we always assume that they are all using agile methodology. In addition, based on the duration and number of developers provided by those open source projects, we estimate the “real” project profile for those projects.

Step 4: Review and Revise the Scenarios.

Purpose: Thoroughly review the scenarios for completeness and correctness, with respect to the requirements, and clarity of the scenarios.

Role: Junior team members

Inputs: All scenario sets.

Outputs: Revised version for all scenario sets

Because most of the project scenarios are coming from open source, the project duration, the number of locations, demonstration frequency and some other project profiles need to be adjusted to be more realistic.

The following data are estimated in the scenarios.

For agile method estimated general productivity is 30 LOC - 200 LOC per day per man, it varies:

For Embedded system: 30 - 50 LOC per day per man

For information systems : 50 - 100 LOC per day per man

For extremely agile product like games: 100 - 200 per day per man

For product line, the estimated general productivity is 30 - 80 LOC per day per man

And the projects in product line are more rigorous than those in Agile, mostly these project are in areas like embedded system or even military.

Step 5: Organize the scenarios into report form.

Purpose: Integrate all the scenarios sets into one entity. Make it easier to manage and can be readily extended to consider additional scenarios.

Role: Junior team members

Inputs: All scenario set documents.

Outputs: Final technical report: *Defining Requirements Engineering Processes for Product-line Development: Building Scenarios*

4. Project Scenario Set

4.1 Home Appliance Control System


The Home Appliance Control System (HACS) monitors, controls, and coordinates a wide variety of home appliances such as the air conditioner, microwave oven, radios, televisions, CD players, indoor and outdoor lighting, water sprinkler, and home security and safety systems. The system supports local access through a keypad and remote access through land-line phones, cell phones or handheld computers (e.g., palm-top, personal digital assistant).

Scenario #	New or Enhanced system	Product line	Developer's expertise	People	Duration	Size	Dev. Locations	Component use	Customer demos.	Safety/security critical
1	New	No	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	Very limited
2	""	""	""	8	6 mo.	30 KSLOC	2	""	""	Limited
3	""	""	""	15	12 mo.	75 KSLOC	3	""	Every 4 mo.	High
4	New	Yes First of three (simplest)	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	Very limited
5	""	""	""	8	6 mo.	30 KSLOC	2	""	""	Limited
6	""	""	""	15	12	75 KSLOC	3	""	Every 4 mo.	High
7	Enhanced	No	high	4	4 mo.	10 KSLOC base; 5 KSLOC enhancements	1	Limited, standards based	Every 2 mo.	Very limited
8	""	""	""	8	6 mo.	30 KSLOC base; 15 KSLOC enhancements	2	""	""	Limited
9	""	""	""	15	12	75 KSLOC base; 35 KSLOC enhancements	3	""	Every 4 mo.	High

10	Enhanced	Yes First of three (simplest)	high	4	4 mo.	10 KSLOC base; 5 KSLOC enhancements	1	Limited, standards based	Every 2 mo.	Very limited
11	“”	“”	“”	8	6 mo.	30 KSLOC base; 15 KSLOC enhancements	2	“”	“”	Limited
12	“”	“”	“”	15	12	75 KSLOC base; 35 KSLOC enhancements	3	“”	Every 4 mo.	High
13	New	Yes Last of three (most complex)	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	Very limited
14	“”	“”	“”	8	6 mo.	30 KSLOC	2	“”	“”	Limited
15	“”	“”	“”	15	12	75 KSLOC	3	“”	Every 4 mo.	High
16	Enhanced	Yes Last of three (most complex)	high	4	4 mo.	10 KSLOC base; 5 KSLOC enhancements	1	Limited, standards based	Every 2 mo.	Very limited
17	“”	“”	“”	8	6 mo.	30 KSLOC base; 15 KSLOC enhancements	2	“”	“”	Limited
18	“”	“”	“”	15	12	75 KSLOC base; 35 KSLOC enhancements	3	“”	Every 4 mo.	High

 **Conjecture: this project is suitable for very agile, single product development**

1. A new home appliance control system application is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The home appliance control system has limited functionality and is only intended to control appliances that are not safety or security critical (e.g., controlling lights)

 **Conjecture: this project is suitable for moderately agile, single product development**

2. A new home appliance control system application is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The home appliance control system has limited functionality and is only intended to control one appliance that is safety or security critical (e.g., controlling a burglar alarm in addition to other appliances such as lights).

 **Conjecture: this project is suitable for less agile, single product development**

3. A new home appliance control system application is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The home appliance control system has extensive functionality and is intended to control a wide variety of safety or security critical appliances (e.g., burglar alarm, smoke detectors, emergency medical alert system in addition to other appliances such as lights).

✚ Conjecture: this project is suitable for very agile, product line development

4. A new home appliance control system application is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. This home appliance control system has limited functionality and is only intended to control appliances that are not safety or security critical (e.g., controlling lights).

✚ Conjecture: this project is suitable for moderately agile, product line development

5. A new home appliance control system application is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. This home appliance control system has limited functionality and is only intended to control one appliance that is safety or security critical (e.g., controlling a burglar alarm in addition to other appliances such as lights).


✚ Conjecture: this project is suitable for less agile, product line development

6. A new home appliance control system application is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The home appliance control system has

extensive functionality and is intended to control a wide variety of safety or security critical appliances (e.g., burglar alarm, smoke detectors, emergency medical alert system in addition to other appliances such as lights).

 **Conjecture: this project is suitable for very agile, single product development**

7. Feature enhancements to an existing home appliance control system application are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 4 months. The existing system is ~10 KSLOC and use components to realize international standards in security (e.g., password encryption) and communication capabilities. The feature enhancements are estimated at an additional 5 KSLOC. It will be developed in one location. The senior management expects product demonstrations every 2 months. The home appliance control system has limited functionality and is only intended to control appliances that are not safety or security critical (e.g., controlling lights)

 **Conjecture: this project is suitable for moderately agile, single product development**

8. Enhancements to an existing home appliance control system application are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The existing system is ~30 KSLOC and uses components to realize international standards in security (e.g., password encryption) and communication capabilities. The feature enhancements are estimated at an additional 15 KSLOC. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The home appliance control system has limited functionality and is only intended to control one appliance that is safety or security critical (e.g., controlling a burglar alarm in addition to other appliances such as lights).

 **Conjecture: this project is suitable for less agile, single product development**

9. Enhancements to an existing home appliance control system application are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field.

Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The existing system is ~75 KSLOC and uses components to realize international standards in security (e.g., password encryption) and communication capabilities. The feature enhancements are estimated at an additional 30 KSLOC. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The home appliance control system has extensive functionality and is intended to control a wide variety of safety or security critical appliances (e.g., burglar alarm, smoke detectors, emergency medical alert system in addition to other appliances such as lights).

 **Conjecture: this project is suitable for very agile, product line development**

10. Enhancements to an existing home appliance control system application are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The existing system is ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. The feature enhancements are estimated at an additional 5 KSLOC. It will be developed in one location. The senior management expects product demonstrations every 2 months. This home appliance control system has limited functionality and is only intended to control appliances that are not safety or security critical (e.g., controlling lights).

 **Conjecture: this project is suitable for moderately agile, product line development**

11. Enhancements to an existing home appliance control system application are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The existing system is ~30 KSLOC and uses components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in two locations. The feature enhancements are estimated at an additional 15 KSLOC. The senior management expects product demonstrations every 2 months. This home appliance control system has limited functionality and is only intended to control one appliance that is safety or security critical (e.g., controlling a burglar alarm in addition to other appliances such as lights).

✚ Conjecture: this project is suitable for less agile, product line development

12. Enhancements to an existing home appliance control system application are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The existing system is ~75 KSLOC and uses components to realize international standards in security (e.g., password encryption) and communication capabilities. The feature enhancements are estimated at an additional 30 KSLOC. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The home appliance control system has extensive functionality and is intended to control a wide variety of safety or security critical appliances (e.g., burglar alarm, smoke detectors, emergency medical alert system in addition to other appliances such as lights).


✚ Conjecture: this project is suitable for very agile, product line development

13. A new home appliance control system application is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. This home appliance control system has limited functionality and is only intended to control appliances that are not safety or security critical (e.g., controlling lights).


✚ Conjecture: this project is suitable for moderately agile, product line development

14. A new home appliance control system application is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international

standards in security (e.g., password encryption) and communication capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. This home appliance control system has limited functionality and is only intended to control one appliance that is safety or security critical (e.g., controlling a burglar alarm in addition to other appliances such as lights).

 **Conjecture: this project is suitable for less agile, product line development**


15. A new home appliance control system application is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The home appliance control system has extensive functionality and is intended to control a wide variety of safety or security critical appliances (e.g., burglar alarm, smoke detectors, emergency medical alert system in addition to other appliances such as lights).

 **Conjecture: this project is suitable for very agile, product line development**

16. Enhancements to an existing home appliance control system application are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The existing system is ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. The feature enhancements are estimated at an additional 5 KSLOC. It will be developed in one location. The senior management expects product demonstrations every 2 months. This home appliance control system has limited functionality and is only intended to control appliances that are not safety or security critical (e.g., controlling lights).

 **Conjecture: this project is suitable for moderately agile, product line development**

17. Enhancements to an existing home appliance control system application are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The existing system is ~30 KSLOC and uses components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in two locations. The feature enhancements are estimated at an additional 15 KSLOC. The senior management expects product demonstrations every 2 months. This home appliance control system has limited functionality and is only intended to control one appliance that is safety or security critical (e.g., controlling a burglar alarm in addition to other appliances such as lights).

 **Conjecture: this project is suitable for less agile, product line development**

18. Enhancements to an existing home appliance control system application are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The existing system is ~75 KSLOC and uses components to realize international standards in security (e.g., password encryption) and communication capabilities. The feature enhancements are estimated at an additional 30 KSLOC. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The home appliance control system has extensive functionality and is intended to control a wide variety of safety or security critical appliances (e.g., burglar alarm, smoke detectors, emergency medical alert system in addition to other appliances such as lights).

4.2 Online Shopping System

Online Shopping System is a complete ecommerce software solution that provides all businesses need to build, operate, and maintain an online store. It includes easy-to-use shopping cart software forms for managing product or customer information, a built-in search engine and tracking system. A successful online mall demands a solution that integrates all the offerings into one common interface, at the same time allowing each vendor the flexibility to add, edit and change their offerings in real time. Businesses also need an efficient order processing and management system that automatically “splits” the order in the backend making the system autonomous and attractive to the vendors.

Scenario #	New or Enhanced system	Product line	Developer's expertise	People	Duration	Size	Dev. Locations	Component use	Customer demos.	Safety/security critical
1	New	No	high	8	4 mo.	30 KSLOC	1	Limited, standards based	Every 2 mo.	High
2	""	""	""	8	6 mo.	50 KSLOC	2	""	""	High
3	""	""	""	15	12 mo.	100 KSLOC	3	""	Every 4 mo.	High
4	New	Yes First of three (simplest)	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	High
5	""	""	""	8	6 mo.	50 KSLOC	2	""	""	High
6	""	""	""	15	12	100 KSLOC	3	""	Every 4 mo.	High
7	Enhanced	No	high	4	4 mo.	15 KSLOC base; 10KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
8	""	""	""	8	6 mo.	80 KSLOC base; 30 KSLOC enhancements	2	""	""	High
9	""	""	""	15	12	150 KSLOC base; 100 KSLOC enhancements	3	""	Every 4 mo.	High
10	Enhanced	Yes	high	4	4 mo.	15 KSLOC	1	Limited,	Every 2 mo.	High

		First of three (simplest)				base; 10 KSLOC enhancements		standards based		
11	“”	“”	“”	8	6 mo.	80 KSLOC base; 30 KSLOC enhancements	2	“”	“”	High
12	“”	“”	“”	15	12	150 KSLOC base; 100 KSLOC enhancements	3	“”	Every 4 mo.	High
13	New	Yes Last of three (most complex)	high	4	4 mo.	15 KSLOC	1	Limited, standards based	Every 2 mo.	High
14	“”	“”	“”	8	6 mo.	50 KSLOC	2	“”	“”	High
15	“”	“”	“”	15	12	100 KSLOC	3	“”	Every 4 mo.	High
16	Enhanced	Yes Last of three (most complex)	high	4	4 mo.	15 KSLOC base; 10 KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
17	“”	“”	“”	8	6 mo.	80 KSLOC base; 30 KSLOC enhancements	2	“”	“”	High
18	“”	“”	“”	15	12	150 KSLOC base; 100 KSLOC enhancements	3	“”	Every 4 mo.	High

✚ Conjecture: this project is suitable for very agile, single product development

1. A new online shopping system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online shopping system has limited functionality and is only intended to perform basic online store features (e.g., search engine, customer accounts, shipping preview, service sales support)


✚ Conjecture: this project is suitable for moderately agile, single product development

2. A new online shopping system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~50 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The online shopping system has medium functionality and is intended to perform online store features (e.g., tell a friend, gift certificates, gift reminder of upcoming events), inventory management features (e.g., database import utility, stock tracking) and basic reporting features (e.g., sales and traffic reporting, member sales reports).


✚ Conjecture: this project is suitable for less agile, single product development

3. A new online shopping system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online shopping system has extensive functionality and is intended to provide extended


online features (e.g., product rating system, digital products sales, wish list) and marketing and communication features (e.g., newsletters, coupon/discount management, sale pricing)

 **Conjecture: this project is suitable for very agile, product line development**

4. A new online shopping system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online shopping system has limited functionality and is only intended to perform basic online store features (e.g., search engine, customer accounts, shipping preview, service sales support)

 **Conjecture: this project is suitable for moderately agile, product line development**

5. A new online shopping system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~50 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The online shopping system has medium functionality and is intended to perform online store features (e.g., tell a friend, gift certificates, gift reminder of upcoming events), inventory management features (e.g., database import utility, stock tracking) and basic reporting features (e.g., sales and traffic reporting, member sales reports).


 **Conjecture: this project is suitable for less agile, product line development**

6. A new online shopping system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field.

Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online shopping system has extensive functionality and is intended to provide extended online features (e.g., product rating system, digital products sales, wish list) and marketing and communication features (e.g., newsletters, coupon/discount management, sale pricing)

 **Conjecture: this project is suitable for very agile, single product development**


7. Feature enhancements to an existing online shopping system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online shopping system has limited functionality and is only intended to perform basic online store features (e.g., search engine, customer accounts, shipping preview, service sales support)

 **Conjecture: this project is suitable for moderately agile, single product development**

8. Feature enhancements to an existing online shopping system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The online shopping system has medium functionality and is intended to perform online store features (e.g., tell a friend, gift certificates, gift reminder of upcoming events), inventory management features (e.g., database import utility, stock tracking) and basic reporting features (e.g., sales and traffic reporting, member sales reports).

 **Conjecture: this project is suitable for less agile, single product development**

9. Feature enhancements to an existing online shopping system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online shopping system has extensive functionality and is intended to provide extended online features (e.g., product rating system, digital products sales, wish list) and marketing and communication features (e.g., newsletters, coupon/discount management, sale pricing)


 **Conjecture: this project is suitable for very agile, product line development**

10. Enhancements to an existing online shopping system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online shopping system has limited functionality and is only intended to perform basic online store features (e.g., search engine, customer accounts, shipping preview, service sales support)


 **Conjecture: this project is suitable for moderately agile, product line development**

11. Enhancements to an existing online shopping system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior

management expects product demonstrations every 2 months. The online shopping system has medium functionality and is intended to perform online store features (e.g., tell a friend, gift certificates, gift reminder of upcoming events), inventory management features (e.g., database import utility, stock tracking) and basic reporting features (e.g., sales and traffic reporting, member sales reports).

 **Conjecture: this project is suitable for less agile, product line development**


12. Enhancements to an existing online shopping system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online shopping system has extensive functionality and is intended to provide extended online features (e.g., product rating system, digital products sales, wish list) and marketing and communication features (e.g., newsletters, coupon/discount management, sale pricing)

 **Conjecture: this project is suitable for very agile, product line development**

13. A new online shopping system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~15 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online shopping system has limited functionality and is only intended to perform basic online store features (e.g., search engine, customer accounts, shipping preview, service sales support)

 **Conjecture: this project is suitable for moderately agile, product line development**

14. A new online shopping system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~50 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online shopping system has limited functionality and is only intended to perform basic online store features (e.g., search engine, customer accounts, shipping preview, service sales support)

 **Conjecture: this project is suitable for less agile, product line development**

15. A new online shopping system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online shopping system has extensive functionality and is intended to provide extended online features (e.g., product rating system, digital products sales, wish list) and marketing and communication features (e.g., newsletters, coupon/discount management, sale pricing)

 **Conjecture: this project is suitable for very agile, product line development**

16. Enhancements to an existing online shopping system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~15 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online shopping system has limited functionality and is only intended to perform basic online store features (e.g., search engine, customer accounts, shipping preview, service sales support)

✚ Conjecture: this project is suitable for moderately agile, product line development

17. Enhancements to an existing online shopping system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~50 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online shopping system has limited functionality and is only intended to perform basic online store features (e.g., search engine, customer accounts, shipping preview, service sales support)

✚ Conjecture: this project is suitable for less agile, product line development

18. Enhancements to an existing online shopping system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online shopping system has extensive functionality and is intended to provide extended online features (e.g., product rating system, digital products sales, wish list) and marketing and communication features (e.g., newsletters, coupon/discount management, sale pricing)

4.3 Online Banking System

Online banking system is defined as the automated delivery of new and traditional banking products and services directly to customers through electronic, interactive communication channels. includes the systems that enable financial institution customers, individuals or businesses, to access accounts, transact business, or obtain information on financial products and services through a public or private network, including the Internet. Customers access e-banking services using an intelligent electronic device, such as a personal computer (PC), personal digital assistant (PDA), automated teller machine (ATM), kiosk, or Touch Tone telephone. While the risks and controls are similar for the various e-banking access channels, those systems focus specifically on Internet-based services due to the Internet's widely accessible public network.

Scenario #	New or Enhanced system	Product line	Developer's expertise	People	Duration	Size	Dev. Locations	Component use	Customer demos.	Safety/security critical
1	New	No	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	High
2	"	"	"	8	6 mo.	30 KSLOC	2	"	"	High
3	"	"	"	12	12 mo.	75 KSLOC	3	"	Every 4 mo.	High
4	New	Yes First of three (simplest)	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	High
5	"	"	"	8	6 mo.	30 KSLOC	2	"	"	High
6	"	"	"	12	12	75 KSLOC	3	"	Every 4 mo.	High
7	Enhanced	No	high	4	4 mo.	30 KSLOC base; 15KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
8	"	"	"	8	6 mo.	80 KSLOC base; 40 KSLOC enhancements	2	"	"	High
9	"	"	"	12	12	150 KSLOC base; 100 KSLOC enhancements	3	"	Every 4 mo.	High
10	Enhanced	Yes	high	4	4 mo.	30 KSLOC	1	Limited,	Every 2 mo.	High

		First of three (simplest)				base; 15KSLOC enhancements		standards based		
11	“”	“”	“”	8	6 mo.	80 KSLOC base; 40 KSLOC enhancements	2	“”	“”	High
12	“”	“”	“”	12	12	150 KSLOC base; 100 KSLOC enhancements	3	“”	Every 4 mo.	High
13	New	Yes Last of three (most complex)	high	4	4 mo.	15 KSLOC	1	Limited, standards based	Every 2 mo.	High
14	“”	“”	“”	8	6 mo.	50 KSLOC	2	“”	“”	High
15	“”	“”	“”	12	12	100 KSLOC	3	“”	Every 4 mo.	High
16	Enhanced	Yes Last of three (most complex)	high	4	4 mo.	30 KSLOC base; 15KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
17	“”	“”	“”	8	6 mo.	80 KSLOC base; 40 KSLOC enhancements	2	“”	“”	High
18	“”	“”	“”	12	12	150 KSLOC base; 100 KSLOC enhancements	3	“”	Every 4 mo.	High

🚩 Conjecture: this project is suitable for very agile, single product development

1. A new online banking system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online banking system has limited functionality and is only intended to perform basic online account features such as viewing general account information (e.g. account balances and transaction history) and handling bank documents (e.g. transfers, pay bills and exchange currency).

🚩 Conjecture: this project is suitable for moderately agile, single product development

2. A new online banking system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The online banking system has medium functionality and is intended to perform online account features such as balance in any chosen currency, full control of payment processes (e.g. sent payment, completed payment, payment in process, denied payment) and setup automatic billing (e.g. bills, interests on loans and rent).

🚩 Conjecture: this project is suitable for less agile, single product development

3. A new online banking system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online banking system has extensive functionality and is intended to provide extended online account features such as

customer services (e.g. opening additional accounts, closing accounts), get electronic or SMS notifications (e.g. changes on accounts, balances and transfers to/from accounts)

 **Conjecture: this project is suitable for very agile, product line development**

4. A new online banking system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online banking system has limited functionality and is only intended to perform basic online account features such as viewing general account information (e.g. account balances and transaction history) and handling bank documents (e.g. transfers, pay bills and exchange currency).

 **Conjecture: this project is suitable for moderately agile, product line development**

5. A new online banking system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The online banking system has medium functionality and is intended to perform online account features such as balance in any chosen currency, full control of payment processes (e.g. sent payment, completed payment, payment in process, denied payment) and setup automatic billing (e.g. bills, interests on loans and rent).


 **Conjecture: this project is suitable for less agile, product line development**

6. A new online banking system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 12 months. The system is estimated

at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online banking system has extensive functionality and is intended to provide extended online account features such as customer services (e.g. opening additional accounts, closing accounts), get electronic or SMS notifications (e.g. changes on accounts, balances and transfers to/from accounts).

 **Conjecture: this project is suitable for very agile, single product development**

7. Feature enhancements to an existing online banking system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~15 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online banking system has limited functionality and is only intended to perform basic online account features such as viewing general account information (e.g. account balances and transaction history) and handling bank documents (e.g. transfers, pay bills and exchange currency).

 **Conjecture: this project is suitable for moderately agile, single product development**

8. Feature enhancements to an existing online banking system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~40 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The online banking system has medium functionality and is intended to perform online account features such as balance in any chosen currency, full control of payment processes (e.g. sent payment, completed payment, payment in process, denied payment) and setup automatic billing (e.g. bills, interests on loans and rent).

🚩 Conjecture: this project is suitable for less agile, single product development

9. Feature enhancements to an existing online banking system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online banking system has extensive functionality and is intended to provide extended online account features such as customer services (e.g. opening additional accounts, closing accounts), get electronic or SMS notifications (e.g. changes on accounts, balances and transfers to/from accounts).


🚩 Conjecture: this project is suitable for very agile, product line development

10. Enhancements to an existing online banking system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~15 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online banking system has limited functionality and is only intended to perform basic online account features such as viewing general account information (e.g. account balances and transaction history) and handling bank documents (e.g. transfers, pay bills and exchange currency).


🚩 Conjecture: this project is suitable for moderately agile, product line development

11. Enhancements to an existing online banking system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~40 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The online banking system has medium functionality and is intended to perform online

account features such as balance in any chosen currency, full control of payment processes (e.g. sent payment, completed payment, payment in process, denied payment) and setup automatic billing (e.g. bills, interests on loans and rent).

 **Conjecture: this project is suitable for less agile, product line development**

12. Enhancements to an existing online banking system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online banking system has extensive functionality and is intended to provide extended online account features such as customer services (e.g. opening additional accounts, closing accounts), get electronic or SMS notifications (e.g. changes on accounts, balances and transfers to/from accounts).


 **Conjecture: this project is suitable for very agile, product line development**

13. A new online banking system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~15 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online banking system has limited functionality and is only intended to perform basic online account features such as viewing general account information (e.g. account balances and transaction history) and handling bank documents (e.g. transfers, pay bills and exchange currency).

 **Conjecture: this project is suitable for moderately agile, product line development**

14. A new online banking system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at

~50 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online banking system has medium functionality and is intended to perform online account features such as balance in any chosen currency, full control of payment processes (e.g. sent payment, completed payment, payment in process, denied payment) and setup automatic billing (e.g. bills, interests on loans and rent).

 **Conjecture: this project is suitable for less agile, product line development**

15. A new online banking system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online banking system has extensive functionality and is intended to provide extended online account features such as customer services (e.g. opening additional accounts, closing accounts), get electronic or SMS notifications (e.g. changes on accounts, balances and transfers to/from accounts).

 **Conjecture: this project is suitable for very agile, product line development**

16. Enhancements to an existing online banking system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~15KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online banking system has limited functionality and is only intended to perform basic online account features such as viewing general account information (e.g. account balances and transaction history) and handling bank documents (e.g. transfers, pay bills and exchange currency).

 **Conjecture: this project is suitable for moderately agile, product line development**

17. Enhancements to an existing online banking system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~40 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The online banking system has medium functionality and is intended to perform online account features such as balance in any chosen currency, full control of payment processes (e.g. sent payment, completed payment, payment in process, denied payment) and setup automatic billing (e.g. bills, interests on loans and rent).

 **Conjecture: this project is suitable for less agile, product line development**

18. Enhancements to an existing online banking system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The online banking system has extensive functionality and is intended to provide extended online account features such as customer services (e.g. opening additional accounts, closing accounts), get electronic or SMS notifications (e.g. changes on accounts, balances and transfers to/from accounts).

4.4 Accounting System

Accounting software records and processes accounting transactions within functional modules, such as accounts payable, accounts receivable, payroll and trial balance. It functions as an accounting information system.

Scenario #	New or Enhanced system	Product line	Developer's expertise	People	Duration	Size	Dev. Locations	Component use	Customer demos.	Safety/security critical
1	New	No	high	4	6 mo.	110 KSLOC	1	Limited, standards based	Every 2 mo.	High
2	""	""	""	8	18 mo.	300 KSLOC	2	""	""	High
3	""	""	""	12	25 mo.	450 KSLOC	3	""	Every 4 mo.	High
4	New	Yes First of three (simplest)	high	4	11 mo.	110 KSLOC	1	Limited, standards based	Every 2 mo.	High
5	""	""	""	8	25 mo.	300 KSLOC	2	""	""	High
6	""	""	""	12	31	450 KSLOC	3	""	Every 4 mo.	High
7	Enhanced	No	high	4	6 mo.	110 KSLOC base; 15KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
8	""	""	""	8	18 mo.	300 KSLOC base; 50 KSLOC enhancements	2	""	""	High
9	""	""	""	12	25	450 KSLOC base; 100 KSLOC enhancements	3	""	Every 4 mo.	High

10	Enhanced	Yes First of three (simplest)	high	4	11 mo.	110 KSLOC base; 15KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
11	“”	“”	“”	8	25 mo.	300 KSLOC base; 50 KSLOC enhancements	2	“”	“”	High
12	“”	“”	“”	12	31	450 KSLOC base; 100 KSLOC enhancements	3	“”	Every 4 mo.	High
13	New	Yes Last of three (most complex)	high	4	11 mo.	110 KSLOC	1	Limited, standards based	Every 2 mo.	High
14	“”	“”	“”	8	25 mo.	300 KSLOC	2	“”	“”	High
15	“”	“”	“”	12	31	450 KSLOC	3	“”	Every 4 mo.	High
16	Enhanced	Yes Last of three (most complex)	high	4	11 mo.	110 KSLOC base; 15KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
17	“”	“”	“”	8	25 mo.	300 KSLOC base; 50 KSLOC enhancements	2	“”	“”	High
18	“”	“”	“”	12	31	450 KSLOC base; 100 KSLOC enhancements	3	“”	Every 4 mo.	High

Conjecture: this project is suitable for very agile, single product development

1. A new accounting system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 6 months. The system is estimated at ~110 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The accounting system has is intended to fulfil personal users requirements such as account reconciling, budget setup, QIF files imports, export to PDF, HTML and QIF files, and obtaining basic reports


Conjecture: this project is suitable for moderately agile, single product development

2. A new accounting system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 18 months. The system is estimated at ~300 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The accounting system has medium functionality and is intended to perform features for small businesses such as double-entry bookkeeping, general ledgers, accounts receivables and payables, customizable reports and multi-user capability.

Conjecture: this project is suitable for less agile, single product development

3. A new accounting system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 25 months. The system is estimated at ~450 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The accounting system extensive functionality and is intended to provide extended features for medium to large companies such as inventory control, bill of materials, customizable taxes,

internationalization features (e.g. currency and date format, languages) and multi-company support.

 **Conjecture: this project is suitable for very agile, product line development**

4. A new accounting system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 11 months. The system is estimated at ~110 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in one location. The accounting system has is intended to fulfil personal users requirements such as account reconciling, budget setup, QIF files imports, export to PDF, HTML and QIF files, and obtaining basic reports.

 **Conjecture: this project is suitable for moderately agile, product line development**

5. A new accounting system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 25 months. The system is estimated at ~300 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The accounting system has medium functionality and is intended to perform features for small businesses such as double-entry bookkeeping, general ledgers, accounts receivables and payables, customizable reports and multi-user capability.


 **Conjecture: this project is suitable for less agile, product line development**

6. A new accounting system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 31 months. The system is estimated at ~450 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The accounting system extensive functionality and is intended to provide extended features for medium

to large companies such as inventory control, bill of materials, customizable taxes, internationalization features (e.g. currency and date format, languages) and multi-company support.

 **Conjecture: this project is suitable for very agile, single product development**

7. Feature enhancements to an existing accounting system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 6 months. The system is estimated at ~110 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The accounting system has is intended to fulfil personal users requirements such as account reconciling, budget setup, QIF files imports, export to PDF, HTML and QIF files, and obtaining basic reports.


 **Conjecture: this project is suitable for moderately agile, single product development**

8. Feature enhancements to an existing accounting system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 18 months. The system is estimated at ~300 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The accounting system has medium functionality and is intended to perform features for small businesses such as double-entry bookkeeping, general ledgers, accounts receivables and payables, customizable reports and multi-user capability.

 **Conjecture: this project is suitable for less agile, single product development**

9. Feature enhancements to an existing accounting system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 25 months. The system is estimated at ~450 KSLOC and will use components to realize international standards in security (e.g.,

password encryption, SSL Encryption, data encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The accounting system extensive functionality and is intended to provide extended features for medium to large companies such as inventory control, bill of materials, customizable taxes, internationalization features (e.g. currency and date format, languages) and multi-company support.

 **Conjecture: this project is suitable for very agile, product line development**

10. Enhancements to an existing accounting system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 11 months. The system is estimated at ~110 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The accounting system has is intended to fulfil personal users requirements such as account reconciling, budget setup, QIF files imports, export to PDF, HTML and QIF files, and obtaining basic reports.

 **Conjecture: this project is suitable for moderately agile, product line development**

11. Enhancements to an existing accounting system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 25 months. The system is estimated at ~300 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The accounting system has medium functionality and is intended to perform features for small businesses such as double-entry bookkeeping, general ledgers, accounts receivables and payables, customizable reports and multi-user capability.

 **Conjecture: this project is suitable for less agile, product line development**

12. Enhancements to an existing accounting system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a

leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 31 months. The system is estimated at ~450 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The accounting system extensive functionality and is intended to provide extended features for medium to large companies such as inventory control, bill of materials, customizable taxes, internationalization features (e.g. currency and date format, languages) and multi-company support.

 **Conjecture: this project is suitable for very agile, product line development**

13. A new accounting system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 11 months. The system is estimated at ~110 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in one location. The accounting system has is intended to fulfil personal users requirements such as account reconciling, budget setup, QIF files imports, export to PDF, HTML and QIF files, and obtaining basic reports.

 **Conjecture: this project is suitable for moderately agile, product line development**

14. A new accounting system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 25 months. The system is estimated at ~300 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The accounting system has medium functionality and is intended to perform features for small businesses such as double-entry bookkeeping, general ledgers, accounts receivables and payables, customizable reports and multi-user capability.

 **Conjecture: this project is suitable for less agile, product line development**


15. A new accounting system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 31 months. The system is estimated at ~450 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The accounting system extensive functionality and is intended to provide extended features for medium to large companies such as inventory control, bill of materials, customizable taxes, internationalization features (e.g. currency and date format, languages) and multi-company support.

 **Conjecture: this project is suitable for very agile, product line development**

16. Enhancements to an existing accounting system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 11 months. The system is estimated at ~110 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The accounting system has is intended to fulfil personal users requirements such as account reconciling, budget setup, QIF files imports, export to PDF, HTML and QIF files, and obtaining basic reports.

 **Conjecture: this project is suitable for moderately agile, product line development**

17. Enhancements to an existing accounting system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 25 months. The system is estimated at ~300 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The accounting system has medium functionality and is intended to perform features for small businesses such as double-entry bookkeeping, general ledgers, accounts receivables and payables, customizable reports and multi-user capability.

 **Conjecture: this project is suitable for less agile, product line development**

18. Enhancements to an existing accounting system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 31 months. The system is estimated at ~450 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, data encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The accounting system extensive functionality and is intended to provide extended features for medium to large companies such as inventory control, bill of materials, customizable taxes, internationalization features (e.g. currency and date format, languages) and multi-company support.

4.5 Student Registration System

Student registration system is an advanced student information management system that provides all information about students' registration, courses, tuition and fee and other information at school. Students can update and find their activities at school and manage their own schedule from this online system. They can register courses, pay tuition and fees and have their personal university email box for communication. The goal of student registration system is to simplify how an individual conducts business with the schools and universities.

Scenario #	New or Enhanced system	Product line	Developer's expertise	People	Duration	Size	Dev. Locations	Component use	Customer demos.	Safety/security critical
1	New	No	high	8	4 mo.	30 KSLOC	1	Limited, standards based	Every 2 mo.	High
2	""	""	""	8	6 mo.	50 KSLOC	2	""	""	High
3	""	""	""	15	12 mo.	100 KSLOC	3	""	Every 4 mo.	High
4	New	Yes First of three (simplest)	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	High
5	""	""	""	8	6 mo.	50 KSLOC	2	""	""	High
6	""	""	""	15	12	100 KSLOC	3	""	Every 4 mo.	High
7	Enhanced	No	high	4	4 mo.	15 KSLOC base; 10KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
8	""	""	""	8	6 mo.	80 KSLOC base; 30 KSLOC enhancements	2	""	""	High
9	""	""	""	15	12	150 KSLOC base; 100 KSLOC enhancements	3	""	Every 4 mo.	High

10	Enhanced	Yes First of three (simplest)	high	4	4 mo.	15 KSLOC base; 10 KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
11	“”	“”	“”	8	6 mo.	80 KSLOC base; 30 KSLOC enhancements	2	“”	“”	High
12	“”	“”	“”	15	12	150 KSLOC base; 100 KSLOC enhancements	3	“”	Every 4 mo.	High
13	New	Yes Last of three (most complex)	high	4	4 mo.	15 KSLOC	1	Limited, standards based	Every 2 mo.	High
14	“”	“”	“”	8	6 mo.	50 KSLOC	2	“”	“”	High
15	“”	“”	“”	15	12	100 KSLOC	3	“”	Every 4 mo.	High
16	Enhanced	Yes Last of three (most complex)	high	4	4 mo.	15 KSLOC base; 10 KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
17	“”	“”	“”	8	6 mo.	80 KSLOC base; 30 KSLOC enhancements	2	“”	“”	High
18	“”	“”	“”	15	12	150 KSLOC base; 100 KSLOC enhancements	3	“”	Every 4 mo.	High

✚ Conjecture: this project is suitable for very agile, single product development

1. A new student registration system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The student registration system has limited functionality and is only intended to perform basic features regarding students (e.g. name, address, cv, photograph, contact information), teachers (name, address, contact information, SSN) and courses (e.g. dates, time, department, maximum number of seats, hours/ credits, location, instructors, fees) information

✚ Conjecture: this project is suitable for moderately agile, single product development

2. A new student registration system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~50 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The student registration system has medium functionality and is intended to perform features such as room use and payment module (e.g. payment type, payment details, receipt/invoice number)

✚ Conjecture: this project is suitable for less agile, single product development

3. A new student registration system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The student registration system extensive functionality and is intended to provide extended

features: mailing lists and marketing tools, reporting functionality, budgeting (e.g. registration income, expenses, budget results)

✚ Conjecture: this project is suitable for very agile, product line development

4. A new student registration system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The student registration system has limited functionality and is only intended to perform basic features regarding students (e.g. name, address, cv, photograph, contact information), teachers (name, address, contact information, SSN) and courses (e.g. dates, time, department, maximum number of seats, hours/ credits, location, instructors, fees) information.

✚ Conjecture: this project is suitable for moderately agile, product line development

5. A new student registration system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~50 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The student registration system has medium functionality and is intended to perform features such as room use and payment module (e.g. payment type, payment details, receipt/invoice number).

✚ Conjecture: this project is suitable for less agile, product line development

6. A new student registration system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication

capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The student registration system extensive functionality and is intended to provide extended features: mailing lists and marketing tools, reporting functionality, budgeting (e.g. registration income, expenses, budget results)

✚ Conjecture: this project is suitable for very agile, single product development

7. Feature enhancements to an existing student registration system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The student registration system has limited functionality and is only intended to perform basic features regarding students (e.g. name, address, cv, photograph, contact information), teachers (name, address, contact information, SSN) and courses (e.g. dates, time, department, maximum number of seats, hours/ credits, location, instructors, fees) information.

✚ Conjecture: this project is suitable for moderately agile, single product development

8. Feature enhancements to an existing student registration system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The student registration system has medium functionality and is intended to perform features such as room use and payment module (e.g. payment type, payment details, receipt/invoice number).

✚ Conjecture: this project is suitable for less agile, single product development

9. Feature enhancements to an existing student registration system are planned. It is not part of a product line. The company has significant experience developing

this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The student registration system extensive functionality and is intended to provide extended features: mailing lists and marketing tools, reporting functionality, budgeting (e.g. registration income, expenses, budget results)

 **Conjecture: this project is suitable for very agile, product line development**

10. Enhancements to an existing student registration system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The student registration system has limited functionality and is only intended to perform basic features regarding students (e.g. name, address, cv, photograph, contact information), teachers (name, address, contact information, SSN) and courses (e.g. dates, time, department, maximum number of seats, hours/ credits, location, instructors, fees) information

 **Conjecture: this project is suitable for moderately agile, product line development**

11. Enhancements to an existing student registration system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. T The student registration system has medium functionality and is intended to perform features such as room use and payment module (e.g. payment type, payment details, receipt/invoice number).

✚ Conjecture: this project is suitable for less agile, product line development

12. Enhancements to an existing student registration system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The student registration system extensive functionality and is intended to provide extended features: mailing lists and marketing tools, reporting functionality, budgeting (e.g. registration income, expenses, budget results)

✚ Conjecture: this project is suitable for very agile, product line development

13. A new student registration system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The student registration system has limited functionality and in only intended to perform basic features regarding students (e.g. name, address, cv, photograph, contact information), teachers (name, address, contact information, SSN) and courses (e.g. dates, time, department, maximum number of seats, hours/ credits, location, instructors, fees) information.

✚ Conjecture: this project is suitable for moderately agile, product line development

14. A new student registration system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~50 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The student registration system has medium functionality and is intended to perform features such as room use and payment module (e.g. payment type, payment details, receipt/invoice number)

✚ Conjecture: this project is suitable for less agile, product line development

15. A new student registration system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The student registration system extensive functionality and is intended to provide extended features: mailing lists and marketing tools, reporting functionality, budgeting (e.g. registration income, expenses, budget results)


✚ Conjecture: this project is suitable for very agile, product line development

16. Enhancements to an existing student registration system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The student registration system has limited functionality and is only intended to perform basic features regarding students (e.g. name, address, cv, photograph, contact information), teachers (name, address, contact information, SSN) and courses (e.g. dates, time, department, maximum number of seats, hours/ credits, location, instructors, fees) information

✚ Conjecture: this project is suitable for moderately agile, product line development

17. Enhancements to an existing student registration system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one

location. The senior management expects product demonstrations every 2 months. The student registration system has medium functionality and is intended to perform features such as room use and payment module (e.g. payment type, payment details, receipt/invoice number).

 **Conjecture: this project is suitable for less agile, product line development**

18. Enhancements to an existing student registration system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~100 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The student registration system extensive functionality and is intended to provide extended features: mailing lists and marketing tools, reporting functionality, budgeting (e.g. registration income, expenses, budget results)

4.6 *Income Tax System*

Income Tax System provides a completely integrated tax software program, electronic filing, and RAL and PERC Check system. It can offer all kinds of federal tax forms and state tax software modules to choose from. Most of tax software programs are database driven, simple to use, and feature the modern, logical, and familiar, Windows interface.

Scenario #	New or Enhanced system	Product line	Developer's expertise	People	Duration	Size	Dev. Locations	Component use	Customer demos.	Safety/security critical
1	New	No	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	High
2	""	""	""	6	6 mo.	30 KSLOC	2	""	""	High
3	""	""	""	8	12 mo.	75 KSLOC	3	""	Every 4 mo.	High
4	New	Yes First of three (simplest)	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	High
5	""	""	""	6	6 mo.	30 KSLOC	2	""	""	High
6	""	""	""	8	12	75 KSLOC	3	""	Every 4 mo.	High
7	Enhanced	No	high	4	4 mo.	10 KSLOC base; 5KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
8	""	""	""	6	6 mo.	30 KSLOC base; 15 KSLOC enhancements	2	""	""	High
9	""	""	""	8	12	75 KSLOC base; 35 KSLOC enhancements	3	""	Every 4 mo.	High

10	Enhanced	Yes First of three (simplest)	high	4	4 mo.	10 KSLOC base; 5KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
11	“”	“”	“”	6	6 mo.	30 KSLOC base; 15 KSLOC enhancements	2	“”	“”	High
12	“”	“”	“”	8	12	75 KSLOC base; 35 KSLOC enhancements	3	“”	Every 4 mo.	High
13	New	Yes Last of three (most complex)	high	4	4 mo.	10 KSLOC	1	Limited, standards based	Every 2 mo.	High
14	“”	“”	“”	6	6 mo.	30 KSLOC	2	“”	“”	High
15	“”	“”	“”	8	12	75 KSLOC	3	“”	Every 4 mo.	High
16	Enhanced	Yes Last of three (most complex)	high	4	4 mo.	10 KSLOC base; 5KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
17	“”	“”	“”	6	6 mo.	30 KSLOC base; 15 KSLOC enhancements	2	“”	“”	High
18	“”	“”	“”	8	12	75 KSLOC base; 35 KSLOC enhancements	3	“”	Every 4 mo.	High

🚩 Conjecture: this project is suitable for very agile, single product development

1. A new income tax system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The income tax system has limited functionality such as guided interview interface, error checks for common errors and e-files creation.

🚩 Conjecture: this project is suitable for moderately agile, single product development

2. A new income tax system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 6 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The income tax system has medium functionality and is intended to perform features such as previous gain/loss carryovers returns, tax data import from other applications, exporting to Excel spreadsheets and a wizard for identifying applicable tax deductions.

🚩 Conjecture: this project is suitable for less agile, single product development


3. A new income tax system is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, digital signatures) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The income tax system extensive functionality and is intended to provide extended features: specific industry interview, retirement planning and investment assistant.

 **Conjecture: this project is suitable for very agile, product line development**

4. A new income tax system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The income tax system has limited functionality such as guided interview interface, error checks for common errors and e-files creation.

 **Conjecture: this project is suitable for moderately agile, product line development**

5. A new income tax system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 6 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The income tax system has medium functionality and is intended to perform features such as previous gain/loss carryovers returns, tax data import from other applications, exporting to Excel spreadsheets and a wizard for identifying applicable tax deductions.

 **Conjecture: this project is suitable for less agile, product line development**

6. A new income tax system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The income tax system extensive functionality and is intended to provide extended features: specific industry interview, retirement planning and investment assistant.

🚩 Conjecture: this project is suitable for very agile, single product development


7. Feature enhancements to an existing income tax system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The income tax system has limited functionality such as guided interview interface, error checks for common errors and e-files creation.

🚩 Conjecture: this project is suitable for moderately agile, single product development

8. Feature enhancements to an existing income tax system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 6 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The income tax system has medium functionality and is intended to perform features such as previous gain/loss carryovers returns, tax data import from other applications, exporting to Excel spreadsheets and a wizard for identifying applicable tax deductions.

🚩 Conjecture: this project is suitable for less agile, single product development

9. Feature enhancements to an existing income tax system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The income tax system extensive functionality and is intended to provide extended features: specific industry interview, retirement planning and investment assistant.

 **Conjecture: this project is suitable for very agile, product line development**

10. Enhancements to an existing income tax system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The income tax system has limited functionality such as guided interview interface, error checks for common errors and e-files creation.


 **Conjecture: this project is suitable for moderately agile, product line development**

11. Enhancements to an existing income tax system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 6 over 6 months. The system is estimated at ~30 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The income tax system has medium functionality and is intended to perform features such as previous gain/loss carryovers returns, tax data import from other applications, exporting to Excel spreadsheets and a wizard for identifying applicable tax deductions.

 **Conjecture: this project is suitable for less agile, product line development**

12. Enhancements to an existing income tax system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The income tax


system extensive functionality and is intended to provide extended features: specific industry interview, retirement planning and investment assistant.

 **Conjecture: this project is suitable for very agile, product line development**

13. A new income tax system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The income tax system has limited functionality such as guided interview interface, error checks for common errors and e-files creation.


 **Conjecture: this project is suitable for moderately agile, product line development**

14. A new income tax system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 6 over 6 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The income tax system has medium functionality and is intended to perform features such as previous gain/loss carryovers returns, tax data import from other applications, exporting to Excel spreadsheets and a wizard for identifying applicable tax deductions.

 **Conjecture: this project is suitable for less agile, product line development**

15. A new income tax system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior management expects product demonstrations every 4 months. The income tax system extensive functionality

and is intended to provide extended features: specific industry interview, retirement planning and investment assistant.

 **Conjecture: this project is suitable for very agile, product line development**

16. Enhancements to an existing income tax system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 4 over 4 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The income tax system has limited functionality such as guided interview interface, error checks for common errors and e-files creation.

 **Conjecture: this project is suitable for moderately agile, product line development**

17. Enhancements to an existing income tax system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 6 over 6 months. The system is estimated at ~10 KSLOC and will use components to realize international standards in security (e.g., password encryption, SSL Encryption, public key certificates) capabilities. It will be developed in one location. The senior management expects product demonstrations every 2 months. The income tax system has medium functionality and is intended to perform features such as previous gain/loss carryovers returns, tax data import from other applications, exporting to Excel spreadsheets and a wizard for identifying applicable tax deductions.

 **Conjecture: this project is suitable for less agile, product line development**

18. Enhancements to an existing income tax system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 12 months. The system is estimated at ~75 KSLOC and will use components to realize international standards in security (e.g., password encryption) and communication capabilities. It will be developed in three locations. The senior

management expects product demonstrations every 4 months. The income tax system extensive functionality and is intended to provide extended features: specific industry interview, retirement planning and investment assistant.

4.7 Medical System

Medical software is a significant branch of software engineering. Many medical devices that monitor or control patients are predominantly controlled by software. It includes different areas, such as:

Monitors: heart rate, blood pressure, breathing rate, use software to interpret the sensor information and display it in a meaningful way on a monitor.

Medication pumps: These devices are programmed to pump a certain amount of plasma, blood, saline solution, or other medication into a patient at a certain rate. The software provides the ability to control many aspects of treatment procedures.

Analysis: Many devices, such as CAT scanners, measure raw data that is essentially meaningless to people. Software reinterprets this data to create images that doctors can read and understand.

Expert Systems: A variety of expert systems have been created to indicate what should be done. These are less used than the other things just mentioned.

Medical informatics: Software for the business and informational aspect of medicine.

Therapy delivery: The software in implantable pacemakers and defibrillators provides fault-tolerant, real-time, mission-critical monitoring of cardiac rhythms and associated therapy delivery.

Medical and healthcare educational software: Software used as an educational or study tool for healthcare professionals.

Scenario #	New or Enhanced system	Product line	Developer's expertise	People	Duration	Size	Dev. Locations	Component use	Customer demos.	Safety/security critical
1	New	No	high	1	2 mo.	6 KSLOC	1	Limited, standards based	When released	High
2	""	""	""	10	6 mo.	80 KSLOC	2	""	Every 2 mo.	High
3	""	""	""	15	6 mo.	120 KSLOC	3	""	Every 3 mo.	High
4	New	Yes First of three (simplest)	high	8	4 mo.	50 KSLOC	1	Limited, standards based	Every 2 mo.	High
5	""	""	""	15	6 mo.	100 KSLOC	2	""	""	High
6	""	""	""	15	12	200 KSLOC	3	""	Every 4 mo.	High
7	Enhanced	No	high	10	4 mo.	100 KSLOC base; 40KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
8	""	""	""	12	6 mo.	300 KSLOC base; 80 KSLOC enhancements	2	""	""	High
9	""	""	""	15	12	800 KSLOC base; 120 KSLOC enhancements	3	""	Every 4 mo.	High

10	Enhanced	Yes First of three (simplest)	high	16	4 mo.	200 KSLOC base; 60KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
11	“”	“”	“”	20	6 mo.	300 KSLOC base; 120 KSLOC enhancements	2	“”	“”	High
12	“”	“”	“”	15	12	1 MSLOC base; 200 KSLOC enhancements	3	“”	Every 4 mo.	High
13	New	Yes Last of three (most complex)	high	12	6 mo.	70 KSLOC	1	Limited, standards based	Every 2 mo.	High
14	“”	“”	“”	16	8 mo.	120 KSLOC	2	“”	“”	High
15	“”	“”	“”	20	12 mo.	200 KSLOC	3	“”	Every 4 mo.	High
16	Enhanced	Yes Last of three (most complex)	high	12	6 mo.	300 KSLOC base; 60 KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
17	“”	“”	“”	16	8 mo.	400 KSLOC base; 120 KSLOC enhancements	2	“”	“”	High
18	“”	“”	“”	20	12	500 KSLOC base; 200 KSLOC enhancements	3	“”	Every 4 mo.	High

🚩 Conjecture: this project is suitable for very agile, single product development

1. A basic (uncelebrated) hearing test program is planned [7]. The organization has significant experience developing this kind of product. The project is expected to need one staff over two months. The system is estimated at ~6 KSLOC.

🚩 Conjecture: this project is suitable for moderately agile, single product development


2. A new medical device system application is planned. It is a new project. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 10 over 6 months. The system is estimated at ~80 KSLOC. It will be developed in two locations. The senior management expects product demonstrations once when the project is released.

🚩 Conjecture: this project is suitable for less agile, single product development


3. A new medical device system application is planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 6 months. The system is estimated at ~120 KSLOC and will use components to realize international standards. It will be developed in three locations. The senior management expects product demonstrations every 3 months.

🚩 Conjecture: this project is suitable for very agile, product line development

4. A new medical device system application is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 4 months. The system is estimated at ~50 KSLOC and will use components to realize international. It will be developed in one location. The senior management expects product demonstrations every 2 months.

 **Conjecture: this project is suitable for moderately agile, product line development**


5. A new medical device system application is planned [8]. GPL-licensed Electronic Medical Record and Practice Management system for medical providers that runs in any web browser in multiple languages. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 6 months. The system is estimated at ~100 KSLOC and will use components to realize international standards. It will be developed in two locations. The senior management expects product demonstrations every 2 months. The system provides an XML-RPC backend and multiple import and export formats, as well as reporting and other features.

 **Conjecture: this project is suitable for less agile, product line development**

6. A new medical device system application is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~200 KSLOC and will use components to realize international standards. It will be developed in three locations. The senior management expects product demonstrations every 4 months.


 **Conjecture: this project is suitable for very agile, single product development**

7. Feature enhancements to an existing medical device system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 10 over 4 months. The system is estimated at ~40 KSLOC and will use components to realize international. It will be developed in one location. The senior management expects product demonstrations every 2 months.

 **Conjecture: this project is suitable for moderately agile, single product development**

8. Feature enhancements to an existing medical device system are planned. It is not part of a product line. The company has significant experience developing


this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 6 months. The system is estimated at ~80 KSLOC and will use components to realize international. It will be developed in two locations. The senior management expects product demonstrations every 2 months.

 **Conjecture: this project is suitable for less agile, single product development**

9. Feature enhancements to an existing medical device system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~120 KSLOC and will use components to realize international. It will be developed in three locations. The senior management expects product demonstrations every 4 months.

 **Conjecture: this project is suitable for very agile, single product development**

10. Feature enhancements to an existing medical device system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 16 over 4 months. The system is estimated at ~60 KSLOC and will use components to realize international. It will be developed in one location. The senior management expects product demonstrations every 2 months.

 **Conjecture: this project is suitable for moderately agile, single product development**

11. Feature enhancements to an existing medical device system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 20 over 6 months. The system is estimated at ~120 KSLOC and will use components to realize international. It will be developed in two locations. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for less agile, single product development

12. Feature enhancements to an existing medical device system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~200 KSLOC and will use components to realize international. It will be developed in three locations. The senior management expects product demonstrations every 4 months.

🚩 Conjecture: this project is suitable for very agile, product line development

13. A new medical device system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 6 months. The system is estimated at ~70 KSLOC and will use components to realize international. It will be developed in one location. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for moderately agile, product line development

14. A new medical device system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 16 over 8 months. The system is estimated at ~120 KSLOC and will use components to realize international. It will be developed in one location. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for less agile, product line development

15. A new medical device system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 20 over 12 months. The system is estimated at ~200 KSLOC and will use components to realize international. It

will be developed in three locations. The senior management expects product demonstrations every 4 months.

 **Conjecture: this project is suitable for very agile, product line development**

16. Enhancements to an existing medical device system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 6 months. The system is estimated at ~60 KSLOC and will use components to realize international. It will be developed in one location. The senior management expects product demonstrations every 2 months.

 **Conjecture: this project is suitable for moderately agile, product line development**

17. Enhancements to an existing medical device system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 16 over 8 months. The system is estimated at ~120 KSLOC and will use components to realize international standards in security. It will be developed in one location. The senior management expects product demonstrations every 2 months.

 **Conjecture: this project is suitable for less agile, product line development**

18. Enhancements to an existing online shopping system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 20 over 12 months. The system is estimated at ~200 KSLOC and will use components to realize international standards in. It will be developed in three locations. The senior management expects product demonstrations every 4 months.

4.8 Printer System

Printer system is a modular printing system for computer operating systems that allows a computer to act as a powerful print server. It can be a printer driver or a common UNIX printing system (CUPS). A computer running CUPS is a host which can accept print jobs from client computers, process them, and send them to the appropriate printer.

CUPS consists of a print spooler and scheduler, a filter system that converts the print data to a format that the printer will understand, and a backend system that sends this data to the print device. CUPS uses the Internet Printing Protocol (IPP) as the basis for managing print jobs and queues. It also provides the traditional command line interfaces for the System V and Berkeley print systems, along with limited support for the server message block (SMB) protocol.

Scenario #	New or Enhanced system	Product line	Developer's expertise	People	Duration	Size	Dev. Locations	Component use	Customer demos.	Safety/security critical
1	New	No	high	1	3 mo.	10 KSLOC	1	Limited, standards based	Every 4 weeks	High
2	“”	“”	“”	2	1 mo.	6 KSLOC	1	“”	When released.	High
3	“”	“”	“”	3	2 mo.	20 KSLOC	1	“”	When released.	High
4	New	Yes First of three (simplest)	high	2	2 mo.	10 KSLOC	1	Limited, standards based	When released.	High
5	“”	“”	“”	4	2 mo.	10 KSLOC	2	“”	“”	High
6	“”	“”	“”	6	4 mo.	30 KSLOC	3	“”	Every 4 mo.	High
7	Enhanced	No	high	4	4 mo.	100 KSLOC base; 40KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
8	“”	“”	“”	8	24 mo.	300 KSLOC base; 100 KSLOC enhancements	2	“”	“”	High
9	“”	“”	“”	37	24 mo.	800 KSLOC base; 400 KSLOC enhancements	3	“”	Every 4 mo.	High

10	Enhanced	Yes First of three (simplest)	high	16	4 mo.	200 KSLOC base; 60KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
11	“”	“”	“”	20	6 mo.	300 KSLOC base; 120 KSLOC enhancements	2	“”	“”	High
12	“”	“”	“”	15	12	1 MSLOC base; 200 KSLOC enhancements	3	“”	Every 4 mo.	High
13	New	Yes Last of three (most complex)	high	12	6 mo.	70 KSLOC	1	Limited, standards based	Every 2 mo.	High
14	“”	“”	“”	16	8 mo.	120 KSLOC	2	“”	“”	High
15	“”	“”	“”	20	12 mo.	200 KSLOC	3	“”	Every 4 mo.	High
16	Enhanced	Yes Last of three (most complex)	high	12	6 mo.	300 KSLOC base; 60 KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
17	“”	“”	“”	16	8 mo.	400 KSLOC base; 120 KSLOC enhancements	2	“”	“”	High
18	“”	“”	“”	20	12	500 KSLOC base; 200 KSLOC enhancements	3	“”	Every 4 mo.	High

✚ Conjecture: this project is suitable for very agile, single product development

1. A portable real time scheduler (RTOS kernel) for small embedded systems is planned [9]. It is a single product. The organization has significant experience developing this kind of product. The project is expected to need one developer over 3 months. The system is estimated at ~60 KSLOC. It will be developed in one location. The developer expects product demonstrations once when the project is released. The printer driver system is included for several microcontroller architectures

✚ Conjecture: this project is suitable for very agile, single product line development

2. A new application is planned [10]. Colour Management System with integrated printer driver. The system uses ICM profiles as specified by the International Color Consortium. The organization has significant experience developing this kind of product. The project is expected to need two developers over 2 weeks. The system is estimated at ~6 KSLOC. It will be developed in one location. The developer expects product demonstrations once when the project is released.

✚ Conjecture: this project is suitable for very agile, product line development

3. A new application is planned [11]. Sipix A6 Printer has been discontinued; Original Sipix drivers support Palm OS up to 4.x, and Pocket PC devices running Windows CE 2.0-3.1. The team will develop a new driver to increase the speed of the Pocket Printer A6 by up to 40% and increase the font size by up to 10%. The organization has significant experience developing this kind of product. The project is expected to need three developers over 6 weeks. The system is estimated at ~20 KSLOC. It will be developed in two locations. The developer expects product demonstrations once when the project is released.

✚ Conjecture: this project is suitable for very agile, single product development

4. A new Linux printer driver for the Konica is planned [12]. It is not part of a product line. The organization has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 3 over 6 weeks. The system is estimated at ~10 KSLOC. It will be developed in one location. The senior management expects product demonstrations once when the project is released. The printer driver system has limited functionality and is only intended for being used in conjunction with ghostscript, foomatic and CUPS.

✚ **Conjecture: this project is suitable for very agile, product line development**

5. A new application is planned [13]. A Linux printer driver/filter for the Lexmark Z11 and the Compaq IJ300 printer, supporting color and b/w printing, variable page size and more. The organization has significant experience developing this kind of product. The project is expected to need four developers over 4 weeks. The system is estimated at ~10 KSLOC. It will be developed in two locations. The developer expects product demonstrations once when the project is released.

✚ **Conjecture: this project is suitable for less agile, product line development**

6. A new application is planned [14]. Epson Printer Driver System supports for the Epson EPL-5x00L/6x00L printer family under linux and other unix-like systems. This effort is not endorsed by nor affiliated with Epson. The organization has significant experience developing this kind of product. The project is expected to need 6 developers over 4 months. The system is estimated at ~100 KSLOC. It will be developed in two locations. The developer expects product demonstrations once when the project is released.

✚ **Conjecture: this project is suitable for less agile, single product development**

7. A very high quality package of printer drivers is planned [15]. It is a new project. The organization is significant experience developing this kind of product before. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 40 over 6 months. The system is estimated at ~400 KSLOC. It will be developed in several locations. The senior management expects product demonstrations every 4 weeks. The printer driver system has extended functionality for Ghostscript and Common UNIX Printing System.

✚ **Conjecture: this project is suitable for less agile, single product development**

8. A very high quality package of printer drivers is planned [16]. It is a new project. The organization is significant experience developing this kind of product before. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 8 over 12 months. The system is estimated at ~500 KSLOC. It will be developed in several locations. The senior management expects product demonstrations every 3 months. This project includes 4 main modules to use with CUPS: "KUPS", a KDE administration

front-end, "XPP", a light graphical printing frontend, "QTCUPS", a front-end and library for Qt, and "CUPS-DRIVERS", GS drivers which allow printing to any printer.

✚ Conjecture: this project is suitable for less agile, single product development

9. A very high quality package of printer drivers is planned [17]. It is a new project. The organization is significant experience developing this kind of product before. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 5 over 2 months. The system is estimated at ~50 KSLOC. It will be developed in several locations. The senior management expects product demonstrations every 3 months. Imprints is a project to implement a UNIX equivalent of the Windows NT Add Printer Wizard and has been taken on in part by the Samba Team, VA Linux Systems, and Hewlett-Packard. See the project Home Page for more details.

✚ Conjecture: this project is suitable for agile, single product development

10. A very high quality package of printer drivers is planned to develop good BJC-210/240/250/265/1000 printer driver for GhostScript [18]. It is a new project. The organization is moderately experienced at developing this kind of product before. Limited experts in the domain are available to work on the new project. The project is expected to need a staff of 2 with 6 to 12 months. The system is estimated at ~30 KSLOC. It will be developed in only 1 location. The senior management expects product demonstrations every 2 months.

✚ Conjecture: this project is suitable for agile, single product development

11. A new application is planned [19]. It is used as printer and scanner drivers for the Kyocera Mita FS-1016 MFP under Linux. The organization has significant experience developing this kind of product. The project is expected to need 1 developer over 16 weeks. The system is estimated at ~6 KSLOC. It will be developed in one location. The developer expects product demonstrations once when the project is released.

✚ Conjecture: this project is suitable for agile, single product development

12. A new application is planned. Support for the HP JetReady 4.x protocol printer family (Color Laserjet 3500/3550/3600) under linux and other unix-like systems. This effort is not endorsed by nor affiliated with HP [20]. The organization has not significant experience developing this kind of product. The project is expected to need 1 developer over 24 weeks. The system is estimated at ~10

KSLOC. It will be developed in one location. The developer expects product demonstrations once when the project is released.

✚ Conjecture: this project is suitable for agile, single product development

13. A new application is planned [21]. The Samsung ML-1210 printer works perfect under Win32, under linux (not so good), but not under Win64. This tool is not a complete driver, even presently not a 64-bit, but it allows printing graphic files. It uses code from ghostscript 5.10 for linux. The organization has not significant experience developing this kind of product. The project is expected to need 2 developers over 4 weeks. The system is estimated at ~9 KSLOC. It will be developed in one location. The developer expects product demonstrations once when the project is released.

✚ Conjecture: this project is suitable for moderately agile, product line development

14. A new application is planned. The system is estimated at around 20 KSLOC. It will be developed in one location. The developer expects product demonstrations every week. This printer driver is for use of Canon BJC series printer (all types) on Windows Vista platform.

✚ Conjecture: this project is suitable for less agile, product line development

15. A new application is planned. The system is estimated at around 30 KSLOC. It will be developed in one location. The developer expects product demonstrations every week. This tool is for use of HP laser series printer on Windows Vista platform, and will be developed by a third party company.

✚ Conjecture: this project is suitable for very agile, product line development

16. A new application is planned. The system is an enhancement of current Canon laser printer drivers, and it is estimated at around 11 KSLOC. It will be developed in more than one location. The developer expects product demonstrations every week. This tool is for use of Cannon laser printer series (all types) on Linux platform.

✚ Conjecture: this project is suitable for moderately agile, product line development

17. A new application is planned. The system is estimated at around 20 KSLOC. It will be developed in one location. The developer expects product demonstrations every week. A small company is dedicated to develop a universal driver for HP office inkjets series printers on Linux platforms.

✚ **Conjecture: this project is suitable for less agile, product line development**

18. A new application is planned. The system is estimated at around 10 KSLOC. It will be developed in one location. The developer expects product demonstrations every week. This new tool is for Lexmark printer on WinXP platforms.

4.9 Automotive Embedded System

Today's automotive development processes are characterized by increasing technical requirements within a competitive market and therefore by a growing complexity regarding mechanics and electronics. On the electronic side, comfort and safety requirements such as climate control and dynamic stability control systems lead to an increasing number of on-vehicle embedded systems with more and more software solutions using several distributed electronic control units.

Scenario #	New or Enhanced system	Product line	Developer's expertise	People	Duration	Size	Dev. Locations	Component use	Customer demos.	Safety/security critical
1	New	No	high	8	6 mo.	40 KSLOC	1	Limited, standards based	When released	High
2	""	""	""	10	6 mo.	80 KSLOC	2	""	Every 2 mo.	High
3	""	""	""	15	6 mo.	200 KSLOC	3	""	Every 3 mo.	High
4	New	Yes First of three (simplest)	high	8	4 mo.	50 KSLOC	1	Limited, standards based	Every 2 mo.	High
5	""	""	""	15	6 mo.	100 KSLOC	2	""	""	High
6	""	""	""	19	12	240 KSLOC	3	""	Every 4 mo.	High
7	Enhanced	No	high	10	4 mo.	100 KSLOC base; 40KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
8	""	""	""	12	6 mo.	300 KSLOC base; 80 KSLOC enhancements	2	""	""	High
9	""	""	""	15	12	800 KSLOC base; 120 KSLOC enhancements	3	""	Every 4 mo.	High

10	Enhanced	Yes First of three (simplest)	high	16	4 mo.	200 KSLOC base; 60KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
11	“”	“”	“”	20	6 mo.	300 KSLOC base; 120 KSLOC enhancements	2	“”	“”	High
12	“”	“”	“”	15	12	1 MSLOC base; 200 KSLOC enhancements	3	“”	Every 4 mo.	High
13	New	Yes Last of three (most complex)	high	12	6 mo.	70 KSLOC	1	Limited, standards based	Every 2 mo.	High
14	“”	“”	“”	16	8 mo.	120 KSLOC	2	“”	“”	High
15	“”	“”	“”	20	12 mo.	200 KSLOC	3	“”	Every 4 mo.	High
16	Enhanced	Yes Last of three (most complex)	high	12	6 mo.	300 KSLOC base; 60 KSLOC enhancements	1	Limited, standards based	Every 2 mo.	High
17	“”	“”	“”	16	8 mo.	400 KSLOC base; 120 KSLOC enhancements	2	“”	“”	High
18	“”	“”	“”	20	12	500 KSLOC base; 200 KSLOC enhancements	3	“”	Every 4 mo.	High

🚩 Conjecture: this project is suitable for agile, single product development

1. This project is a collection of software and embedded system designs that are developed for controlling trains on a modular model railroad as used by FREMO [22]. The project is expected to need 8 staff over 6 months. The system is estimated at ~6 KSLOC.

🚩 Conjecture: this project is suitable for moderately agile, single product development

2. This project intends to develop a system to control the vehicles over a wireless network [23]. Each vehicle contains embedded software that interfaces with a set of sensors and actuators that allow the vehicle to navigate, to communicate with roadside sensors, The project is expected to need staff of 10 over 6 months. The system is estimated at ~40 KSLOC. It will be developed in 5 locations.

🚩 Conjecture: this project is suitable for less agile, single product development


3. Macam is focused on developing webcam support for Mac OS X [24]. We are trying to incorporate many different camera types. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 6 months. The system is estimated at ~400 KSLOC and will use components to realize international standards. It will be developed in 2 locations. The senior management expects product demonstrations every 3 months.

🚩 Conjecture: this project is suitable for moderate product line development

4. OWFS -- 1-Wire file system [25]. Use the Dallas 1-Wire and iButton chips with standard linux commands. Create temperature loggers. Monitor everything. OWHTTPD -- same system, only used as a light weight web server. OWFS is also ported to WRT54G and Coldfire .Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 19 over 12 months. The system is estimated at ~ 2000 KSLOC and will use components to realize international. It will be developed in 3 locations. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for very product line development


5. XboxMediaCenter (XBMC) is a free multimedia player jukebox for Microsoft Xbox game console, it is capable of playing back almost all known video, audio and picture formats from the Xbox harddrive, the Xbox DVD-ROM, a local-network, and even the internet. Numerous experts in the domain are available to work on the new project [26]. The project is expected to need staffs of 43 over 24 months. The system is estimated at ~8000 KSLOC and will use components to realize international standards. It will be developed in 6 locations. The senior management expects product demonstrations every 4 months.

 **Conjecture: this project is suitable for less agile, product line development**

6. A new automotive embedded system is planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 19 over 12 months. The system is estimated at ~240 KSLOC. It will be developed in three locations. The senior management expects product demonstrations every 4 months.

 **Conjecture: this project is suitable for very agile, single product development**

7. Feature enhancements to an existing automotive embedded system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 10 over 4 months. The system is estimated at ~40 KSLOC. It will be developed in one location. The senior management expects product demonstrations every 2 months.

 **Conjecture: this project is suitable for moderately agile, single product development**

8. Feature enhancements to an existing automotive embedded system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 6 months. The system is estimated at ~80 KSLOC. It will be developed in two locations. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for less agile, single product development

9. Feature enhancements to an existing automotive embedded system are planned. It is not part of a product line. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~120 KSLOC. It will be developed in three locations. The senior management expects product demonstrations every 4 months.

🚩 Conjecture: this project is suitable for very agile, product line development

10. Enhancements to an existing automotive embedded system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 16 over 4 months. The system is estimated at ~60 KSLOC. It will be developed in one location. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for moderately agile, product line development

11. Enhancements to an existing automotive embedded system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 20 over 6 months. The system is estimated at ~120 KSLOC. It will be developed in two locations. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for less agile, product line development

12. Enhancements to an existing income tax system are planned. It is the first, simplest product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 15 over 12 months. The system is estimated at ~200 KSLOC. It will be developed in three locations. The senior management expects product demonstrations every 4 months.

🚩 Conjecture: this project is suitable for very agile, product line development

13. A new automotive embedded system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 6 months. The system is estimated at ~70 KSLOC. It will be developed in one location. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for moderately agile, product line development

14. A new automotive embedded system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 16 over 8 months. The system is estimated at ~120 KSLOC. It will be developed in one location. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for less agile, product line development

15. A new automotive embedded system is planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 20 over 12 months. The system is estimated at ~200 KSLOC. It will be developed in three locations. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for very agile, product line development

16. Enhancements to an existing automotive embedded system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 12 over 6 months. The system is estimated at ~60 KSLOC. It will be developed in one location. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for moderately agile, product line development

17. Enhancements to an existing automotive embedded system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 16 over 8 months. The system is estimated at ~10 KSLOC. It will be developed in one location. The senior management expects product demonstrations every 2 months.

🚩 Conjecture: this project is suitable for less agile, product line development

18. Enhancements to an existing automotive embedded system are planned. It is the third, most complex product in a planned line of three products. The company has significant experience developing this kind of product before and is considered a leader in the field. Numerous experts in the domain are available to work on the new project. The project is expected to need a staff of 20 over 12 months. The system is estimated at ~200 KSLOC. It will be developed in three locations. The senior management expects product demonstrations every 4 months.

5. Conclusions

The aim of the overall project approach is to develop an expert system that can assist a requirements engineer in selecting a requirements engineering process that is well suited for their project, in particular with respect to the use of agile and product line engineering methods. The expert system is systematically developed. The knowledge acquisition is achieved by developing a questionnaire and obtaining the expertise of researchers and practitioners actively involved in software development using agile, product line engineering techniques. The questionnaire is organized into two parts. The purpose of the first part is to collect information about the expert's specific area of expertise. The purpose of the second part of the questionnaire is to present a small set of project scenarios to the expert, which are as closely related to their area of expertise as possible, and obtain the expert's opinion about what kind of RE process to use on these projects. In turn, based on the data collected from the second part of the questionnaire, a decision network will be developed to provide various options regarding to specific software product line and agile method techniques for each phase of requirement engineering for a specific project.

A systematic methodology has been used to define the project scenarios for the questionnaire. Currently, there are nine sets of project scenarios defined (one set for an application); each set has 18 specific scenarios that vary in size, duration, complexity, etc. in the scenario collection. The application domains include: home appliance control system, online shopping system, online banking system, accounting system, student registration system, income tax system, medical system, printer system and automotive embedded system. The scenarios have been incorporated into Part II of the questionnaire.

The next step in the scenario development is to define an additional nine sets of 18 scenarios. These scenarios will cover additional application domains including: automatic braking system for automobiles, aircraft collision detection and avoidance system, telecommunications switch or base station, missile target system, train controller system, payroll system, employee information system, healthcare system, and a retail point of sale system. Once defined, the additional scenarios will also be included in Part II of the questionnaire.

6. References

- [1] Manifesto for Agile Software Development, available at: www.agilemanifesto.org.
- [2] Feng, K., Lempert M., Tang, Y., Tian, K., Cooper, K., Franch, X., "Developing a Survey to Collect Expertise in Agile Product Line Requirements Engineering Processes", Technical report, co-published as UTDCS-18-07 (UTD) and LSI-07-15-R (UPC), 2007.
- [3] Oppenheim, O.N., "Questionnaire Design And Attitude Measurement." New York: Basic Books Inc, 1966.
- [4] Berdie, Doug R., Anderson, John F., Niebuhr, Marsha A, "Questionnaires: Design and Use", 2nd edition. The Scarecrow Press Inc, 1986.

- [5] L. Chung, K. Cooper, and S. Courtney, RUP Vision Document for the Home Appliance Control System: Defining Stakeholders, Goals and COTS Components, UTDCS-17-04, The University of Texas at Dallas, Department of Computer Science, 2004.
- [6] Open Source Technology Group, available at: <http://sourceforge.net/>
- [7] Open Source Technology Group , Interactive audiology (hearing) test, available at: <http://sourceforge.net/projects/wavc/>
- [8] Open Source Technology Group, FreeMED, available at: <http://sourceforge.net/projects/freemed>
- [9] Open Source Technology Group, FreeRTOS Real Time Kernel, available at: <http://sourceforge.net/projects/freertos/>
- [10] Open Source Technology Group, Generic Colour Management System, available at: <http://sourceforge.net/projects/gcms/>
- [11] Open Source Technology Group, Sipix A6 Printer, available at: <http://sourceforge.net/projects/a6driver/>
- [12] Open Source Technology Group, M2300W, available at: <http://sourceforge.net/projects/m2300w/>
- [13] Open Source Technology Group, Lexmark Z11 printer driver for Linux, available at: <http://sourceforge.net/projects/lz11/>
- [14] Open Source Technology Group, Epson EPL-5x00L/EPL-6x00L Printer Driver, available at: <http://sourceforge.net/projects/epsonepl/>
- [15] Open Source Technology Group, Gimp-Print, available at: <http://sourceforge.net/projects/gimp-print/>
- [16] Open Source Technology Group, CUPS related stuff, available at: <http://sourceforge.net/projects/cups/>
- [17] Open Source Technology Group, Imprints Project, available at: <http://sourceforge.net/projects/imprints/>
- [18] Open Source Technology Group, Canon BJC-2xx driver for GS and utils, available at: <http://sourceforge.net/projects/bjc250gs/>
- [19] Open Source Technology Group, Kyocera Mita FS-1016MFP drivers, available at: <http://sourceforge.net/projects/kyo-fs1016mfp/>
- [20] Open Source Technology Group, HP JetReady - Color Laserjet 3500/3550, available at: <http://sourceforge.net/projects/hp-pxl-jetready/>
- [21] Open Source Technology Group, ML-1210 tool for Windows x64, available at: <http://sourceforge.net/projects/mltool/>
- [22] Open Source Technology Group, Interactive audiology (hearing) test, available at: <http://sourceforge.net/projects/wavc/>
- [23] Open Source Technology Group, Autonomous Vehicle Control System, available at: <http://sourceforge.net/projects/avcs/>
- [24] Open Source Technology Group, macam - webcam driver for Mac OS X, available at: <http://sourceforge.net/projects/webcam-osx>
- [25] Open Source Technology Group, OWFS, available at: <http://sourceforge.net/projects/owfs/>
- [26] Open Source Technology Group, Xbox Media Center (XBMC), available at: <http://sourceforge.net/projects/xbmc/>