

MTAT.03.244 – Software Economics

Final Exam – 15 December 2009

Notes:

- The exam is open-book and open-laptop. Web browsing is allowed, but you are not allowed to use e-mail clients nor Instant Messaging clients.
- If you find that there is not enough information in the text below to answer a given question, and you need to make additional assumptions, please write down your assumptions together with your answer.
- The sum of the points is 70. However, the maximum possible score is 60 points. If you score more than 60 points, your exam grade will be 60.

QUESTION 1: Software Metrics [10 points]

Assume you are a software development manager at a software development company that employs around 400 people, including 30 project managers, 60 analysts/architects, 160 developers/testers, 50 system administrators and 100 sales, management and administrative staff. The company plans to double its revenues in the next 2 years. Your management board is putting pressure on you to measure and monitor productivity more closely and to put in place initiatives to increase productivity in order to improve the company's competitiveness and profit margins. Specifically, you are asked to "improve the company's software development productivity by 20% in the next 3 years".

- a) Propose a Goal-Question-Metrics model for this goal.
- b) Classify the metrics that you derived from the previous question in a balanced scorecard.
- c) Which metrics would you focus on as a matter of priority, and why?

QUESTION 2: Cost Estimation and Business Case Analysis [40 points]

A bookstore specialized in technical literature is considering the option to expand its online presence. Currently (in December 2009), the bookstore's Web site gives customers access to the catalogue of all books sold by the bookstore, their prices, whether or not they are available on stock at the bookstore, and if they are not available, the number of days it would take to receive them. Customers are not able to place orders online. Instead, they have to call the bookstore or go to one of the bookstore's branches in order to place orders. Orders are entered and tracked by a separate application that only employees of the bookstore can use. So when a customer wants to enquire about an order, they have to call the bookstore or send an e-mail. When a book arrives to the bookstore, an employee updates the status of the order and notifies the customer.

The application for order creation and tracking was developed in Java/PostgreSQL by a software development company called WorkingMouse. It was deployed in June 2004, after a development project that took 6 months to a team of 2 analyst-programmers and that was completed and delivered on time. The application was estimated to have 300 function-points. The application included functionality for maintaining the catalogue of books up-to-date based on electronic listings sent

regularly by the publishers to the bookstore. It also allowed employees to enter and track orders via a Web interface. This part of the application was left as simple as possible to be able to deliver the project on time. The application has no user management or access control. This is the reason why the order creation and tracking functionality is only accessible inside the bookstore to a handful of employees. The two analyst-developers who had developed this application were very experienced. They had worked together for more than 5 years in similar projects. After its deployment, the application required one person-month of maintenance effort per year. This maintenance effort was required mainly to incorporate new publishers or changes in the way publishers transmitted their listings to the bookstore, and some other minor changes in the application functionality.

- a) What was the cost of the application for order creation and tracking? Compare this actual cost with the cost estimation you would obtain using Cocomo II. Explain which parameter settings you chose for your Cocomo II estimation. Assume that the rate of WorkingMouse in 2004 was EUR 60 per person-hour and that a person-month is equal to 152 person-hours. Justify each cost factor/scale driver if you set it to a value other than nominal. **[6 points]**

In November 2006, the bookstore decided to outsource the development of a Web application for catalogue browsing and online ordering. This application would reuse the database containing the book catalogue that was previously developed by WorkingMouse. However it would not reuse the user interface for online creation and tracking developed by WorkingMouse due to the fact it did not have user management nor access control, and also because Java Web frameworks had evolved significantly in the meantime, and it had become possible to build more user-friendly and more maintainable applications using these new frameworks.

When outsourcing this new project, the bookstore found that the cost per man-hour of WorkingMouse was too high compared to other alternatives. So in November 2006, they outsourced the project to another company, namely CheapCoders. The resulting application was deployed in December 2007 after a 12-months effort that was initially intended to last for six months only. The project involved two analyst-programmers initially, but in September 2007, two additional programmers were added to the team, with the aim of meeting the 30 November deadline that the bookstore had set. After many disputes with CheapCoders, the bookstore settled for a payment of EUR 40.000 for the project (the original quote was for EUR 120.000). Because of this dispute, the application was not given any maintenance after its deployment, despite numerous complaints by customers regarding the lack of functionality and lack of usability of the application. At the beginning of the project, the application was estimated to have 600 function-points, but at the end, only 50% of the functionality was implemented. Specifically, only the catalogue browsing functionality was implemented. The order management functionality was left out.

Despite these difficulties, the catalogue browsing application receives 1000 visits per month since its deployment, and it is estimated that 10% of these visits lead to purchases. It is estimated that about 50% of these purchases would not occur if the bookshop did not have an online catalogue, because customers would then prefer to go to a competitor's site.

Each purchase is for an average of 1.5 books, and on average the bookstore makes a profit of EUR 8 per book sold. Additionally, the fact that customers can browse the catalogue online reduces the number of phone enquiries by around 25 calls per day.

Each phone enquiry takes 6 minutes of a store employee's time on average. A store employee costs around EUR 10 per hour.

- b) What do you think about the decision taken in September 2009 to add two programmers in order to speed up the project? **[2 points]**
- c) Has the catalogue browsing application reached its break-even point? Explain your answer. **[4 points]**

In October 2009, a consultancy company (RightConsultants) made a market analysis for the bookstore. They concluded that if the bookstore replaces the current catalogue browsing application with a full online order management application (as was initially planned in 2007), the number of customers using their web site for browsing the catalogue and for ordering books would double, and the ratio of conversion of online customer visits into orders would also double (from 10% to 20%). Moreover, by selling to neighboring countries, the number of customer visits could be quadrupled from their current levels, with a conversion rate of 20% between visits and purchases.

The consultancy company also reviewed and updated the requirements analysis document that had been prepared by CheapCoders in 2006. They extended this document in order to include "multi-language user interface" as a requirement, so that the bookstore can start selling in neighboring countries. In order to actually make the application multi-language, an additional upfront investment of EUR 10 000 would be needed to hire a translation agency for translating the contents of the web-site (the titles and descriptions of the books would be left in original language). In addition, an online marketing campaign worth EUR 10 000 would have to be launched in order to create awareness of the bookstore in neighboring countries. The deployment of the application would require a server upgrade at a cost estimated at EUR 5.000. Maintenance of the server would cost around EUR 2.000 per year.

The bookstore paid a fee of EUR 12 000 to RightConsultants in November 2009 for their services. The bookstore manager is now engaged in negotiations with WorkingMouse regarding the future online order management application. Based on the requirements analysis document, WorkingMouse estimates that the application will consist of around 800 function-points. The application will be developed in Java. WorkingMouse will provide a team of experienced analyst-developers. All team members have over 5 years experience in similar projects, and they have worked successfully together for around three years. They follow a sound project planning and tracking method, and they use advanced software development tools.

- d) Using Cocomo II, make an estimate of the amount of person-months required by WorkingMouse to develop this new application? Explain your choice of cost drivers and scale factors. Justify each cost factor/scale driver, if you set it to a value other than nominal. **[6 points]**
- e) The manager wants to know how long would the development of this new application take. He wants the application to be ready by July 2010, before the start of the school year. Assume you are WorkingMouse's representative. Please give an answer to the manager's question. **[3 points]**
- f) At the end of the meeting, WorkingMouse proposed two payment options for developing the online order management application. In the first option, WorkingMouse would bill on a person-month basis at the end of every month. In other words, if WorkingMouse spends 2 person-months on the project during the first month, they would bill: $2 * 152 \text{ hours} * 60 \text{ EUR/hour}$ (a person-month is equal to 152 person-hours). In the second option, the fee is

calculated as follows. Let E be the total number of person-months that WorkingMouse proposes as an estimate. The fee is: $1.2 * E * 152 * 60$ EUR/hour. The 1.2 factor includes a risk premium of 20%, since, should the project require more man-months than estimated, WorkingMouse would provide them at no additional cost. The flat-fee would be paid 50% at the beginning of the project and 50% at the end of the project. As the manager, what factors would you take into consideration when making a choice between these two options? Which option would you recommend? **[3 points]**

- g) Prepare a business case for this project. The business case should include a discounted cash flow, NPV, IRR, payback period and a recommendation on whether to execute the project or not. Please make the following assumptions:
- The discount factor is 25%
 - The development cost is a flat fee of 250 000. Half of this fee is payable at the start of the development project and the other half at the end of the development project.
 - The development time is 12 months
 - The maintenance effort is 1 person-month per year.
 - The application will be used for a period of 6 years, and therefore the business case should be done over a period of 7 years.

You are only required to develop a business case for the scenario where the application is built with multi-lingual support and opened to the international market. No baseline scenario is required. **[16 points]**

QUESTION 4: Software Pricing & Open-Source Software [20 points]

This question is based on the Nuway Software case study. Assume that Nuway software is considering selling their software platform commercially and you have to help Nuway Software to choose a pricing model for their platform.

- a) Would you recommend a flat perpetual pricing model? Why or why not? **[2 points]**
- b) Would you recommend a periodic perpetual pricing model? Why or why not? **[2 points]**
- c) Would you recommend some form of first-degree price discrimination? If so, how exactly would you discriminate? **[2 points]**
- d) Would you recommend some form of second-degree price discrimination? If so, how exactly would you discriminate? **[2 points]**
- e) Would you recommend some form of third-degree price discrimination? If so, how exactly would you discriminate? **[2 points]**

Assume now that Nuway software is considering the possibility of open-sourcing their platform.

- f) What type of open-source license would you recommend and why? **[2 points]**
- g) What business model would you suggest to Nuway software in order to make profit out of an open-source strategy? **[2 points]**
- h) Does your business model exploits any system effects? **[2 points]**
- i) Does your business model exploits any network effects? **[2 points]**
- j) Describe a scenario in which your business model would allow Nuway software to make profit. **[2 points]**