KUNTIEN JA HUS:N ASIAKAS- JA POTILASTIETOJÄRJESTELMÄN HANKINTA

Perustelumuistio

Liite 6: Järjestelmän ylläpidettävyyden arvioinnin tulokset (vertailuperuste 4.2)

Sisällysluettelo

1. Dokumentin tarkoitus

Tässä dokumentissa ja sen liitteissä kuvataan vertailuperusteen 4.2 ”Järjestelmän ylläpidettävyys” arvioinnin toteutustapa, arviointimenettelyt ja lopputulokset.

2. Järjestelmän ylläpidettävyyden arviointi

Apotti asiakas- ja potilastietojärjestelmän hankinnassa lopullisten tarjousten vertailu tapahtui tarjouspyynnössä ilmoitettujen vertailuperusteiden mukaisesti. Vertailuperuste 4.2 ”Järjestelmän ylläpidettävyyden arviointi” on osa tarjousten vertailuperustetta 4., ja se tuottaa puolet vertailuperusteen 4. kokonaispisteistä (5 % kaikkien vertailuperusteiden kokonaispistemäärästä).

Vertailuperusteen 4.2 mukaisen vertailun toteuttamiseksi toteutettiin hankinnassa mukana olevien tarjoajien ratkaisujen ylläpidettävyyden arviointi (”Software Quality Metrics evaluation”, jälj. SQM-arviointi). Arviointi toteutettiin ulkoisen asiantuntijan (Software Improvement Group B.V., jälj. SIG) tuella. Järjestelmän ylläpidettävyyden arviointi on osa tarjousten vertailuperustetta 4., ja se tuottaa puolet vertailuperusteen 4. kokonaispisteistä (5 % kaikkien vertailuperusteiden kokonaispistemäärästä).

Järjestelmän ylläpidettävyyden arvioinnin tarkoituksena on löytää ratkaisun *ylläpidettävyyden ja kehittämisen* kannalta hankinnan tavoitteita parhaiten vastaava ohjelmisto sekä lisäksi tuottaa informaatiota tuotteen ylläpidon suunnittelua varten. Ylläpidettävyyden arviointi perustuu toistettavalla tavalla kansainväliseen ISO/IEC 25010-standardiin sekä arvioinnissa avustaneen asiantuntijapalvelun toimittajan laajaan benchmark-tietokantaan.

Arvioinnin kohteena olivat järjestelmähankinnassa mukana olevien toimittajien terveydenhuollon pääjärjestelmät, jotka ovat valmisohjelmistoja. Arvioitavia ohjelmistotuotteita oli siis kaksi (2) kappaletta. CGI Suomi Oy:n tuote on Cerner Millenium (www.cerner.com) ja Epic Systems Corporation tuote on toimittajan oma tuote EpicCare (www.epic.com). Molempiin ohjelmistokokonaisuuksiin sisältyy useita erillisiä ohjelmistomoduuleita, jotka täyttävät järjestelmähankinnan toiminnallisuuskartan mukaiset terveydenhuollon ydintoiminnot. Yhteensä arvioitavien ohjelmistojen koko on yli 35 000 000 riviä ohjelmistokoodia.

Arvioinnin lopputuloksena syntyy luotettava ja objektiivinen arvio tarjouskilpailussa mukana olevien järjestelmien terveydenhuollon pääjärjestelmien ylläpidettävyydestä. Ylläpidettävyyttä mitataan järjestelmien ylläpidettävyyttä ja kehittämismahdollisuuksia kuvaavan muutoskapasiteetin (”change capacity”) avulla. Muutoskapasiteetti perustuu järjestelmän lähdekoodin ISO/IECE2501-standardissa määriteltyyn ylläpidettävyyteen (”Maintainability”)

sekä järjestelmän kokoon ja toimittajan henkilöresursseihin, jotka yhdessä kuvaavat järjestelmän ylläpidettävyyttä ja kehittämismahdollisuuksia. Arvioinnin lopputuloksena parhaat arviointipisteet saa taho, jonka järjestelmä on muutoskapasiteettia kuvaavan luvun perusteella ylläpidettävämpi.

3. Arvioinnin käytännön järjestelyt

Tarjoajat saivat hankintarenkaan ja SIG:n yhteistyössä laatimat ohjeet (liite 1: ”Vendor Instructions”) ylläpidettävyyden arvioinnin käytännön toteuttamisesta 26.3.2015. Samalla Tarjoajat saivat kyselykaavakkeen (liite 2: ”Vendor Questionnaire”), jolla kerättiin esitietoja järjestelmästä, sen arkkitehtuurista, tuotantokäytön käytännöistä ja tuotekehitysprosessista. Tarjoajien tuli palauttaa kyselykaavakkeet täytettynä 15.4.2015 mennessä.

Osana arviointiprosessia SIG toteutti arviointikäynnin Tarjoajien nimeämiin tuotekehityskeskuksiin. Arviointikäynnin yhteydessä SIG:n asiantuntijat kävivät arviointikeskustelut Tarjoajien nimeämien asiantuntijoiden kanssa. Arviointivierailut ja evaluaatiot suoritettiin 28.4.-1.5.2015 (CGI) ja 4.5.-7.5.2015 (Epic) välisenä aikana.

SIG raportoi arvioinnin tulokset hankintarenkaalle, ja tuloksia käsiteltiin yhteisissä työpajoissa.

4. Arvioinnin tekninen toteutustapa

Ylläpidettävyyden arvioinnin käytännön toteutustapa perustui SIG:n standardoituun tapaan mitata ohjelmistojen ylläpidettävyyttä muutoskapasiteetin (”change capacity”) avulla. Mittaustapa on luotu yhteistyössä TÜViT:n (TÜV Informationstechnik GmbH) kanssa, ja se perustuu ISO / IEC25010-standardin mukaisiin ohjelmistotuotteiden laatuarvioinnin määritelmiin. Ohjelmistoarviointi toteutettiin SIG:n ISO/IEC17025-standardin mukaisessa arviointilaboratoriossa.

Muutoskapasiteetin avulla arvioidaan, kuinka muutettavissa arvioitava järjestelmä on. Loppukäyttäjien ja järjestelmän käytettävyyden kannalta on tärkeää arvioida, kuinka nopeasti uusia ominaisuuksia kyetään toteuttamaan ja kuinka nopeasti järjestelmään liittyviä ongelmia kyetään ratkaisemaan. Arvioinnin perustana on käytetty SIG:n arviointilaboratorion tuottamia tuloksia, joiden mukaan arvioitavien ratkaisujen kaltaiset järjestelmät edellyttävät keskimäärin 15 % vuotuista muutosta. Vertailuluku perustuu SIG:n ISO 25010-standardin pohjalta kehittämään tilastolliseen menetelmään. Ratkaisujen muutoskapasiteetin avulla arvioidaan, kykeneekö järjestelmän toimittaja keskimääräiseen muutostasoon.

Muutoskapasiteetti ilmentää sitä prosentuaalista osuutta järjestelmästä, joka voidaan vuositasolla uudistaa. Osuus perustuu järjestelmän kokoon, sen ylläpidettävyyteen (”Maintainability”) sekä järjestelmätoimittajan kehitystiimin henkilömäärään.

Muutoskapasiteetti laskettiin standardoidulla tavalla seuraaviin muuttujiin perustuen:

- *Volyymi (vastaavan järjestelmän rakentamisen edellyttämien henkilötyövuosien määrä)*
  - *Järjestelmän volyymi perustuu järjestelmän koodimäärään, jota on verrattu vastaavan järjestelmän uudelleen rakentamisen edellyttämiin henkilötyövuosiin alan keskimääräisten tuottavuustaulukoiden perusteella. Keskiarvot perustuvat riippumattoman tahon laatimiin tuottavuustaulukoihin.*
- *Järjestelmän ylläpidettävyys (”Maintainability”)*
  - *Ylläpidettävyyden luokitus perustuu SIG / TÜViT:n kehittämään ISO/IEC25010-standardin mukaiseen ylläpidettävyyden mittaustapaan SIG:n ISO/IEC17025-standardin mukaisen arviointilaboratorion toimesta*
- *Käytettävissä olevien kehittäjien määrä järjestelmän ylläpitämiseksi*
  - *Järjestelmän kehittäjien henkilömäärä perustui tarjoajien antamiin tietoihin.*

Mittaustulokset validoitiin yhteistyössä tarjoajien teknisen henkilöstön toimesta ennen muutoskapasiteetin laskemista.

Mittaustulosten perusteella arvioitavalle järjestelmälle laskettiin ohjelmiston ylläpidettävyyttä kuvaava vertailuluku, joka perustuu SIG:n ISO 25010-standardin pohjalta kehittämään tilastolliseen menetelmään. Tätä lukua verrattiin kahteen muuhun muuttujaan (volyymi, henkilömäärä). Näiden tulosten perusteella laskettiin arvio siitä kuinka suuren osan ohjelmistokokonaisuuden uusimisesta vuositasolla arvioitu ohjelmiston vuotuinen ylläpitokapasiteetti tekisi mahdolliseksi. Teollisuuden keskiarvo tälle luvulle on edellä mainittu 15% vuodessa. Tarjouspyynnössä ilmoitetusti arvolla 25% saavuttaa täydet vertailupisteet.

Ylläpidettävyyden arviointi kohdistui asiakas- ja potilastietojärjestelmän ohjelmistomoduuleihin, joilla tuotetaan tarjouspyynnössä (liite 5.3) ja liitteessä 1. ilmoitetut järjestelmän toiminnallisuudet.

Arvioinnin teknistä toteutustapaa ja muutoskapasiteetin määrittelyä on kuvattu tarkemmin liitteessä 1. ja liitteessä 3. (”Technical evaluation for APOTTI tender”).

5. Pisteytys

Arvioinnin lopputuloksena syntyi järjestelmän *ylläpidettävyyttä ja kehittämistä* kuvaava muutoskapasiteetin vertailuluku, jota verrattiin ilmoitettuun toimialan keskiarvoon (15 %). Muutoskapasiteettia kuvaava luku muutettiin vertailupisteiksi seuraavia sääntöjä noudattaen:

Tarjoaja, jonka muutoskapasiteetti on 25 % tai enemmän saa täydet arviointipisteet (5 pistettä). Tarjoaja, jonka muutoskapasiteetti on alle 25 %, saa suhteessa alhaisemman pistemäärän. Esimerkiksi tarjoaja, jonka muutoskapasiteetti on 15 %, saa 3 pistettä (15/25), ja tarjoaja, joka muutoskapasiteetti on 22 %, saa 4.4 pistettä (22/25).

Arvioinnissa eniten pisteitä saanut tarjous saa vertailuperusteen osalta täydet vertailupisteet (5 p). Arvioinnissa heikommin menestynyt tarjous saa vertailupisteitä seuraavan kaavan mukaisesti:

”Tarjoajan järjestelmän ylläpidettävyyden arvioinnissa saamat pisteet” / ”Arvioinnin parhaat pisteet” x 5 p”.

6. Lopputulokset

Arvioinnin pisteet

CGI:n tarjoaman järjestelmän arviointipisteet (*ylläpidettävyyttä ja kehittämistä* kuvaava muutoskapasiteetin vertailuluku) ovat arvioinnin perusteella 4.6.

Epicin tarjoaman järjestelmän arviointipisteet (*ylläpidettävyyttä ja kehittämistä* kuvaava muutoskapasiteetin vertailuluku) ovat arvioinnin perusteella 5.0.

Vertailupisteet

Epic sai vertailuperusteen 4.2 arvioinnissa korkeammat pisteet, jolloin Epic saa täydet viisi (5,00) vertailupistettä. Arvioinnissa vähemmän pisteitä saanut CGI saa vertailupisteitä suhteessa *”Tarjoajan järjestelmän ylläpidettävyyden arvioinnissa saamat pisteet” / ”Arvioinnin parhaat pisteet” x 5 p”*, eli yhteensä 4.60 pistettä. Vertailupisteet on esitetty seuraavassa taulukossa.

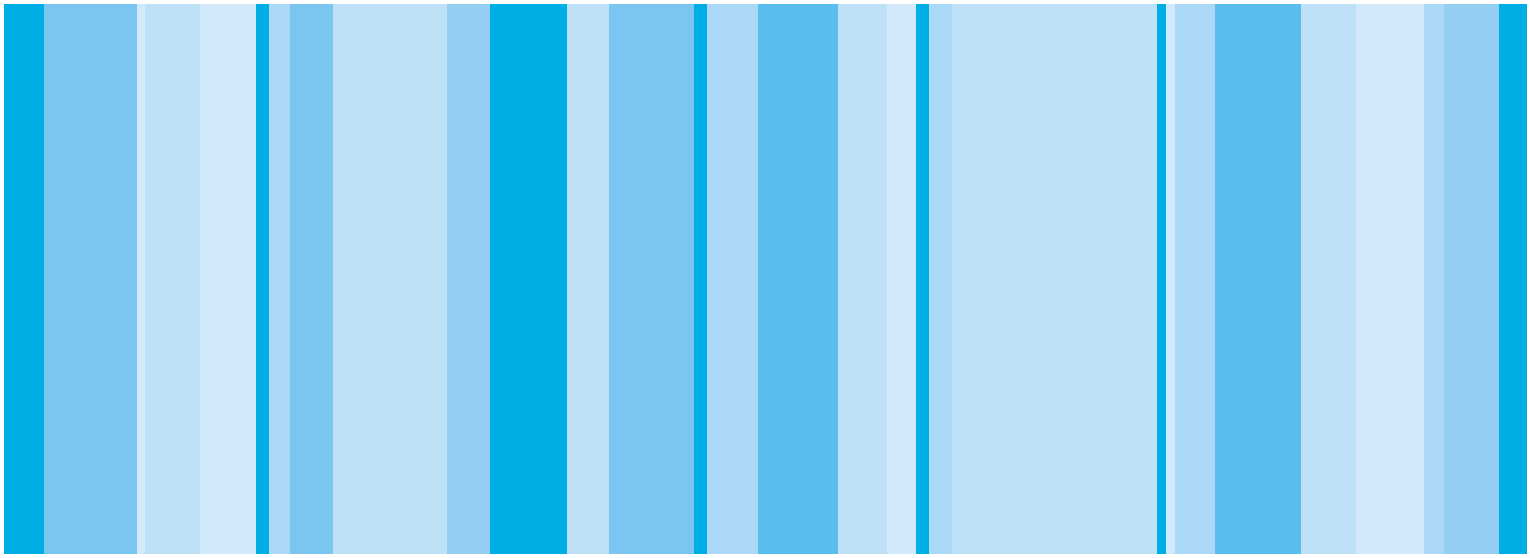
Tarjoaja	Vertailupisteet
CGI Suomi Oy	4,60
Epic Systems Corporation	5,00

7. Liitteet

Liite 6A. Vendor Instructions (ohjeet tarjoajille)

Liite 6B. Vendor Questionnaire (kyselylomake)

Liite 6C. Technical evaluation for APOTTI tender



Vendor instruction

Technical evaluation of Health Care Software Products for APOTTI, Finland

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1 Introduction

1.1 Introduction APOTTI and tender process

The Finnish Hospital District of Helsinki and Uusimaa (HUS), the cities of Helsinki, Vantaa and Kauniainen and the municipality of Kirkkonummi are planning to procure a shared social welfare and health care client and patient data system. To prepare for the procurement, a program management organization named APOTTI has been setup with representatives from all participating stakeholders.

The aim of the system procurement process is to find the best supplier or consortium of suppliers that will supply a comprehensive and unified system and related system services. The system will consist of advanced social welfare and health care products currently available on the market that can be flexibly configured.

With the tender, the APOTTI program aims to procure a low-risk, high-quality and sustainable solution that meets both functional and non-functional requirements for its stakeholders.

To support the evaluation process and gain a deep technical understanding about the solutions presented, APOTTI has asked the Software Improvement Group (SIG), an independent and objective third party, to perform a technical evaluation of the solutions considered.

1.2 Introduction Software Improvement Group

1.2.1 Background

Since the late 1990's the Software Improvement Group has been committed to delivering management insight in IT systems in order to reduce cost, increase effectiveness and decrease delivery time of IT projects.

SIG started as a spin-off of the Dutch National Research Centre for Mathematics and Computer Science (CWI). Headquartered in Amsterdam, The Netherlands, SIG has grown over the years to a 90+ staff consulting organization with a presence in 7 countries and a dedicated, internationally recognized, research group.

SIG helps clients "Getting Software Right".

1.2.2 Independent, objective and impartial

In order to provide objective advice on IT landscapes or systems, and guide software development teams to successful delivery, SIG's independence, objectivity and impartiality is important to both our clients and us.
SIG does not have any formal partnership with consulting companies or software houses, nor does SIG build software for its clients. SIG has partnerships with other established authorities, such as the German certification authority TÜViT and universities worldwide.

2 Vendor instruction

2.1 Goals, focus and evaluation scope

2.1.1 Goals and focus

APOTTI has asked SIG to provide technical insight in the vendor's health care products, focussing on the following ISO/IEC 25010-defined quality aspects:

- **Maintainability:** The degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers;
- **Reliability:** The degree to which a system, product or component performs specified functions under specified conditions for a specified period of time;
- **Performance efficiency:** Performance relative to the amount of resources used under stated conditions.

During the evaluation process, the health care products will be measured and investigated evaluated to understand the system from a technical perspective, their technical characteristics as well as the organisation developing and maintaining these systems. To this end, topics such as development process (including quality assurance), solution architecture, technologies used and the actual implementation are areas of investigation.

2.1.2 Evaluation scope

To create a level playing field between the vendors, the scope of the evaluation will be the limited to the core health care system/functionality. Social care and Dental care are not in scope of the evaluation.

The target for the assessment will consist of the software modules and components required to fulfil the following functionalities (as defined by APOTTI), regardless whether these components are of functional or technical nature.

1. Vuodeosasto ja vuodepaikkojen hallinta, Inpatient/ Ward Care and Ward Capacity Management
2. Vastaanottotoiminta, Ambulatory/Outpatient Care
3. Potilashallinto, Patient administration and Scheduling
4. Kansalaisen/potilaan sähköinen asiointi, Patient portal and e-Services over Internet Browser
5. Potilaan kotihoito/Home Care Resource planning
6. Leikkaussalin toiminnanohjaus, Operation room/Theater resource planning
7. Suljetun lääkekierron toteukseen vaadittavat komponentit / All functionality required for Closed Loop Medication
8. Seuraavat lääketieteen erikoisalat ja toiminnallisuudet: Following Medical specialties and functional areas:
   - Kardiologia/Cardiology;
   - Anestesia / Anesthesia;
   - Teho-osasto / Intensive Care;
   - Synnytystoiminta / Obstetrics;
   - Syöpätautien erikoistoiminnallisuudet, Oncology.

If a software module provides other functionality in addition to the main functionality identified here, the entire module will be subject to analysis and included into assessment. The evaluation will include technical components (e.g. database solutions, integration components, etc.) that are maintained by the vendor.

Not in scope of the evaluation are parts of the solution that deliver functionality for:

- Social care;
- Dental care,

unless its components that are an undividable part of other components that deliver the functionality mentioned as 'in scope' of the evaluation.

2.2 Weight of the results in the overall evaluation process

The result of the SIG evaluation will contribute for max. 5% to the overall APOTTI tender evaluation.

If the vendor chooses to participate in the technical evaluation, a maximum 5% of the total points can be awarded. It the vendor chooses not to participate in the SIG evaluation, 5% of the total tender points will not be awarded.

The 5% of the points will be awarded based on a composite metric to approximate the vendor's annual 'change capacity', given the functional scope of the system. The metric is composed of:

- **Volume** – Total source code volume measured;
- **Maintainability** – Maintainability rating according to SIG's evaluation model used;
- **Number of developers** available to maintain the source code in scope.

Empirical research shows that the industry average amount of change for systems that are under active development lies around 15% per annum. A calculated value of 25% or move will achieve the full score for the vendor's 'change capacity'. A lower 'change capacity' will result in a lower score according to a linear model.

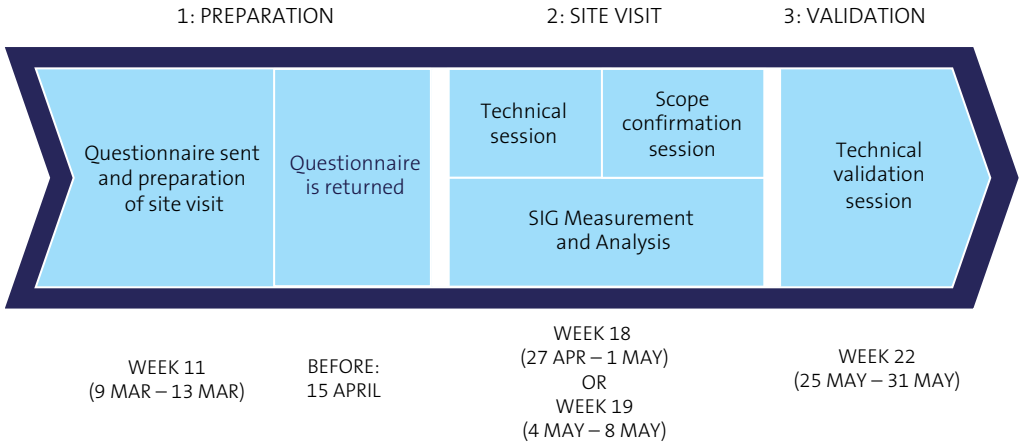
Apart from this numeric result, the evaluation will bring other technical insights to the APOTTI program, which will be part of the discussion with and reporting to the APOTTI program.

Exactly the same evaluation process and evaluation models will be used for both vendors.

2.3 Process and timeline

The evaluation will follow a proven process, starting with a vendor questionnaire, followed by a four-day site visit to the vendor's location in the US and will conclude with a validation session to discuss/confirm SIG's observations and measurement results. The validation session will take the form of a conference call.

The planning for the evaluation is as follows.



With the vendor's input and confirmation, SIG would like to finalize the planning as soon as possible. The vendors are kindly asked to contact SIG as soon as possible to confirm participation and arrange formalities (e.g. NDA) and practicalities (e.g. visiting dates, logistics) needed.

The vendors can indicate their preference for the week of the site visit (week 18 or week 19), but the planning needs to be made taking various aspects into account, so no guarantees can be given.

2.4 Questionnaire

The questionnaire to prepare for the site visit is presented as an appendix to this document.

The answers to the questionnaire shall be provided before 15 April, so SIG has the time to prepare for the site visit based on vendor's answers.

2.5 Source code preparation for the site visit

To ensure an efficient process, the vendors are kindly asked to prepare the source code corresponding to the scope mentioned on a memory stick of portable hard drive, so it is ready before the first day of the site visit.

The vendor is asked to prepare three source code snapshots:

- 1 Jan 2015;
- 1 Jan 2014;
- 1 Jan 2013.

The most recent snapshot will be used for the Maintainability measurement. The earlier snapshots will be used to measure code changes / churn.

2.6 Description of the site visit and sessions

The following table describes the meetings where the vendor is expected to participate, as well as the goals for the meetings. Since during the meetings, various topics to be discussed in the open before any conclusions are drawn, the client will not participate in these discussions.

MEETING/ASPECT	VENDOR	SIG
Questionnaire	The vendor will answer SIG's questions.	Based on the answers provided, SIG will prepare for the site visit.
Technical session 2-3 hours (on-site, first day of the site visit)	The vendor will explain the solution's architecture, source code and related artifacts and comment on their answers to the questionnaire. Attending should be a lead architect and lead developer.	To gain an insight into the different aspects of the architecture and development of the system, in order to help and guide the technical analysis.
SIG analysis and fact-finding (on-site)	Vendor should be available for questions, but no presence is needed all time.	SIG will work autonomously, based on the input provided.
Scope confirmation session (on-site, last day of the site visit)	Vendor will confirm the scope of the measurements. Wrap-up of the site visit.	SIG will present the scope of the measurements. Wrap-up of the site visit.
Validation session (2-3 hours, conf. call)	SIG will present its findings and measurement results to the vendor via a conference call, to arrive at a common understanding of the factual situation of the system. Attending should be a lead architect and lead developer.	To validate findings with the vendor based on measurements.

The SIG team that will visit the headquarters will consist of three consultants.

A detailed planning of the site visit will be aligned with the vendors after participation has been confirmed.

2.7 Security, confidentiality and NDA

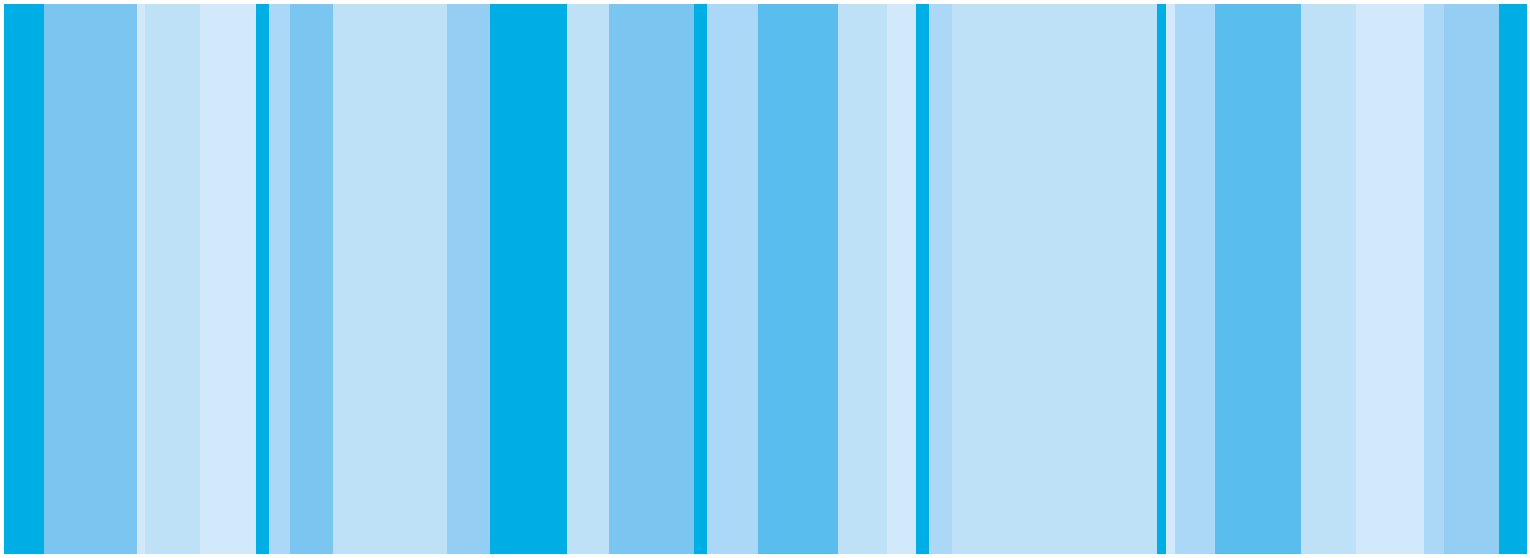
The vendor and SIG will put a NDA in place, to ensure confidentiality throughout the entire evaluation process. All documents and material that will be provided by the vendor to SIG as part of the evaluation will be treated as confidential. If the vendor will share information with SIG that cannot be shared confidentially with the APOTTI team, this information should be marked accordingly.
To maximize efficiency, SIG proposes to use the NDA that was put in place during the previous on-site evaluation between SIG and the vendor as a template for the NDA for the APOTTI evaluation. Details of the NDA and the site visit will be discussed between SIG and the vendor bi-laterally.
In the case that no agreement can be made between SIG and vendor on the terms and conditions of the NDA and/or site visit, the APOTTI program will be involved to mediate. As an ultimate consequence, vendor has the ability to not participate in the technical evaluation, waiving the 5% of the tender result points that can be achieved.

2.8 Point of contact

Point of contact on SIG's side is:

Mark Hissink Muller, Delivery lead SIG Nordic
m.hissinkmuller@sig.eu
mobile: +45 28 602 101 (Mark is based in København, DK, CET)

The vendors are kindly asked to schedule a brief call with Mark Hissink Muller as soon as possible, to align, for SIG to answer any questions and to start making formal and practical arrangements.



Vendor questionnaire

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1 About this questionnaire

The participating vendors are asked to answer to the questions in this questionnaire as part of the technical evaluation process.

The answers will be used by SIG to prepare for the site visit, as well as the technical validation sessions.

The answers to this questionnaire need to be uploaded via SIG's secure upload portal at:

https://portal.sig.eu

The answers need to be provided before 15 April 2015.

Chapter 2 contains the actual questionnaire. Chapter 3 contains background information on applicable standards and the SIG evaluation models for Maintainability, Reliability and Performance efficiency.

2 Questionnaire

This chapter contains the questionnaire that participating vendors need to answer by 10 April 2015.

The goal of the questionnaire is to ease and streamline information gathering during the evaluation process and to make the discussion during the sessions between the vendor and SIG more efficient. It is not intended to provide a complete description of everything SIG would like to discuss. SIG would like to use answers to certain questions as findings in the evaluation process, but not before they have been discussed in the technical session and/or validation session.

2.1 Guidelines for answering the questions

The questionnaire contains questions related to the solution architecture and implementation, the non-functional aspects of particular interest to the client, and the process for development and quality assurance.

In this questionnaire, the following terminology is used:

- The term ***product*** refers to the unimplemented (standard) software health care product from the vendor that will form the basis for the solution for the client;
- The term ***solution*** refers to the complete future software solution that has been configured, customized, integrated and implemented for the client;
- The term ***vendor*** refers to a party that is proposing a product and implementation program to arrive at a working solution for the client.

When answering this questionnaire, please note the following guidelines:

- In case a diagram or answer to a question can be found in a supplied document, please indicate the document title, section and page;
- Please provide all documents that you would like to submit in either Microsoft Office or PDF format;
- If it is not possible to provide precise numbers for a certain question, it is ok to provide an estimate, if indicated as such;
- When needed, please the answers based on a best practice configuration given the scale and size required for APOTTI in Finland;
- If you cannot answer a question at all, please provide the reason for this.

Any information shared as answer to this questionnaire, including the answers to the questionnaire itself, fall under the NDA between SIG and the vendor. The answers provided will be discussed in the technical and validation sessions before they are used in reporting towards the client. After discussion of the answers with the vendor during the technical session and after vendor's consent, the answers (or parts of these) will be provided to APOTTI.

If there are any answers that cannot be shared with APOTTI, the vendor is asked to indicate, so those can be removed from the material that is provided to APOTTI at later stage.

Please read all questions carefully. They are based on a standard SIG questionnaire, but it has been customized given APOTTI's particular needs.

2.2 Questions to be answered

2.2.1 System architecture

1. Please provide a concise (max. 12 pages) introduction to the (solution) architecture of the product. Discuss in this introduction:
    a. The components (logical parts) distinguished in the product, their functionality, if and how these components communicate;
    b. Logical, process and a typical deployment view of the product (provide three diagrams);
    c. The technology stack (major programming languages, major frameworks, middleware, libraries, OS) used and their versions;
    d. Compatibility with existing technologies for clients, in particular virtualization technologies (such as Citrix), older versions of MS Windows and older Internet browsers.
    e. The rationale for the architecture and any major design decisions which characterize your product.

2. Please describe the top 10 technologies used in the product (languages, frameworks or third-party components), describe their function and location in the solution architecture. A language is considered major if the amount of source code in the solution exceeds more than 100,000 lines of code, a framework if it exceeds more than 50,000 lines of code.

TECHNOLOGY (LANGUAGE, FRAMEWORK)	FUNCTION AND LOCATION IN THE SOLUTION ARCHITECTURE

   For example: “Java language | A core technology used throughout both the front-end and the back-end of the solution”.

3. Please explain how and where in the architecture the product will be extended, customized or integrated to meet the ***Social care*** and ***Dental care*** requirements of the client, as well as integrate in the client’s application landscape (1-2 pages).

2.2.2 Specific non-functional quality aspects

The client has indicated that specific non-functional requirements are of particular interest. This section is divided into four parts, using the ISO/IEC 25010 standard terminology, related to the specific non-functional concerns of APOTTI.

ISO/IEC 25010 Maintainability

4. Describe the top 5 most important or influential measures (technical, procedural, organizational) to ensure a high maintainability of your solution. Examples may include training, peer review, quality monitoring/measurements, etc. (1-2 page).

ISO/IEC 25010 Reliability

5. Please describe your approach to ensuring high reliability and highlight relevant aspects of the architecture, standards and quality assurance process (2 pages).

6. What is the typical availability for installations similar size and nature as APOTTI?

7. Describe the overall approach to fault isolation across functional components (max. 1 page). If necessary, add technology-specific aspects.
8. Describe how transactions are handled and propagated between components, based on the example of entering blood test lab results in the system. Describe to which extent application state and data can be rolled back.

9. Is there a way to run the system in a degraded setting? Could you please elaborate how this works and which functionalities are given priority?

10. Describe the deployment process, its level of automation and min/mean/max duration for a solution similar in size and nature to APOTTI. Can a deployment be rolled back? Discuss in which situation a deployment can no longer rolled back.

11. How many hours of operational maintenance from a system administrator does an installation of the size of APOTTI require typically per month. Please provide examples of the kind of maintenance, including backup and restore processes.

12. Please describe the quality assurance process for reliability and failover testing with concrete examples. In particular, how often are these tests performed?

ISO/IEC 25010 Performance efficiency

13. Elaborating on the response to questions 1, please provide a high-level overview of a deployment architecture of the product, if possible the one that would be proposed for APOTTI. If no typical overview is available, please provide an overview for the largest installation of the product. The overview should show at least:
    a. Which categories of machines involved in running the product/solution (e.g. web server, application server, database server, terminals, etc.);
    b. Which logical part(s) of the product are executed on which machines;
    c. Which machines communicate with each other, and via which protocols;
    d. Indicate how many machines are deployed for each category and the manner in which they are redundant.

(VIRTUAL) MACHINE	CATEGORY	EXECUTES PARTS	COMMUNICATES WTH	# DEPLOYED/REDUNDANT

14. Describe in which way communication with Social care and Dental care functionalities will impact performance (max. 1 page).

15. For three installations of your product comparable in size and nature to APOTTI, please provide the following numbers:
    a. Number of physical sites where the product is deployed (hospitals, clinics, etc.);
    b. Number of users (doctors, medical personnel, etc.);
    c. Number of patients (active) in the product;
    d. Number of <X> transactions per day (of different types);
    e. Average and maximum number of concurrent transactions per day for the past year;
    f. Average and maximum CPU load during for all categories of machines (see previous question).

Provide answers in tabular format as follows.

# PHYSICAL SITES	# USERS (MEDICAL STAFF)	# PATIENTS	# TRANSACTIONS / DAY	AVERAGE/MAX CPU LOAD

Add additional columns if necessary.

16. For the proposed installation for APOTTI, please indicate:
    a. Which important functions (if any) are handled by centralized servers (as opposed to servers specific to a site), and how?
    b. What important data (if any) is replicated between sites, and how?
    c. Explain which measures have been taken to guarantee that resource-consuming non-primary functions such as reporting do not interfere with the primary functionality of the system.

17. How in your development process do you guarantee that the reliability, performance and scalability demands for APOTTI are met? Please indicate:
    a. Name the most important measures taken to guarantee and observe/measure that these requirements will be met ***during implementation*** and ***in production***?
    b. Up to how many users and transactions the product has been tested in your most recent representative internal performance test.
    c. What the primary bottlenecks are for adding more users, data and transactions for the configuration mentioned under question 15.
    d. Which mechanisms are available for scaling the product to more users and more transactions, for the configuration as mentioned in question 15.

2.2.3 Development, test and quality assurance process

18. Please briefly describe your development and maintenance methodology/process (max. 1 page).

19. For the largest installation and customization of your product, please provide the following figures:
    a. The number of man-months spent on solution implementation (integration, configuration and customization).
    b. The minimum and maximum size of the implementation team in FTE;
    c. The percentage of FTE located on-site at your customer, the number of FTE at an offshore location, if applicable;
    d. The duration of the implementation project.

20. Regarding the development and maintenance of your solution, how many developers (FTE) are responsible for the components that represent the functional scope of the evaluation, as defined by APOTTI. Please describe how the development groups are organized and where they are located.

21. Please describe your overall approach to quality assurance, including relevant processes, standards and KPIs tracked by development leadership (1-2 pages).

3 Applicable standards

This appendix contains a brief introduction to applicable standards. For more information, see: https://www.sig.eu/en/about-sig/sig-lab.

3.1 ISO/IEC 17025 Certified evaluation laboratory

SIG operates a software evaluation laboratory governed by the Quality Management System as required by the ISO/IEC 17025 international standard for testing laboratories. The general requirements for the competence of testing and calibration laboratories can be found on the website of the International Organization for Standardization.

3.2 ISO/IEC 25010

The international standard for evaluation of software quality (ISO 25010) is used as a basis to evaluate vendor's solutions with respect to APOTTI's key concerns. The following characteristics of ISO 25010 are recognized as key concern areas:

- **Maintainability:** The degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers;
- **Reliability:** The degree to which a system, product or component performs specified functions under specified conditions for a specified period of time;
- **Performance Efficiency:** Performance relative to the amount of resources used under stated conditions.

Figure 1: ISO 25010 software quality characteristics

3.3 Maintainability model SIG/TÜViT

For evaluating ISO 25010 Maintainability, the SIG/TÜViT evaluation model will be used as a basis. A refinement will be made to do justice to the size of the systems under evaluation. The final version of the evaluation model will be communicated before the site visits commence.

	Volume	Duplication	Unit size	Unit complexity	Unit interfacing	Module coupling	Component balance	Component independence
Analysability	X	X	X				X	
Modifiability		X		X		X		
Testability	X			X				X
Modularity						X	X	X
Reusability			X		X			

More detail about this model can be found in the SIG/TÜViT Evaluation Criteria documentation on SIG's website.

3.4 Reliability model SIG

For evaluating ISO 25010 Reliability, the following SIG evaluation model will be used.

	Fault isolation	Transaction handling	Redundancy	Deployment automation	System autonomy	Reliability testing	Failover	Uptime
Availability								X
Maturity	X				X	X		
Fault Tolerance	X	X	X					
Recoverability		X		X	X		X	

Relevant aspects of the model will be explained during the site visit.

3.5 Performance efficiency model SIG

For evaluating ISO 25010 Performance efficiency, the SIG evaluation model will be used.

	Internal communication	External communication	Single transaction optimization	Transaction scalability	Data scalability	Isolation	Resource elasticity	Observability
Time behavior	X	X	X					X
Capacity				X	X	X		X
Resource utilization			X				X	X

Relevant aspects of the model will be explained during the site visit.

Technical evaluation for APOTTI tender

Subject	Method for awarding points based on 'change capacity' measured
Date	24 June 2015

Introduction

SIG was asked by the APOTTI programme to evaluate various technical quality aspects of the software healthcare products that are presented in response to APOTTI's request for tender. A part of SIG's evaluation results – the change capacity of the vendors – will contribute for 5% to the overall APOTTI tender bid evaluation. Out of a total of 100 points, a maximum of 5 points will be awarded for the change capacity results based on SIG's evaluation.

This document explains the method for calculating the 'change capacity', based on SIG's standardised way of measuring maintainability of a software system. SIG's model to measure maintainability is based on the definitions provided by the ISO/IEC25010 standard for software product quality. In collaboration with TÜViT, SIG has created a model to measure maintainability in a standardised way. The software measurements are done in line with the ISO/IEC17025 procedures, for which SIG's software evaluation laboratory has received accreditation.

Industry average change rate

The basis of relevance for the calculation of the change capacity lies in the observation that software systems that are actively used need to see sufficient change. Software that cannot be changed fast enough will not see a sufficient amount of new features, or have bugs resolved at an acceptable rate to keep its end-users happy. Measurements done in SIG's software evaluation laboratory indicate that on average, systems change 15% per year.

To understand whether a vendor is able to meet an industry average amount of change for its software product, the 'change capacity' is calculated.

Change capacity

'Change capacity' is a percentage that expresses the amount of the system that can be changed on annual basis, given the volume, the maintainability and the size of the development team. The change capacity is calculated in a standardised way from following underlying parameters:

- The volume of system in man-years (MY) of rebuild equivalent;
- The maintainability rating of the system based on the SIG/TÜViT quality model for Maintainability and measured following the measurement method and tooling of SIG's ISO/IEC17025 accredited evaluation laboratory;
- The amount of developers (FTE) available to maintain the measured scope.

The volume of a system is measured as the production scope (all the source code used to build the application, where test code, generated code, inline comments and empty lines are excluded), which is translated to man-years (MY) of rebuild equivalent based on industry average productivity tables from SPR, an independent consultancy.

The maintainability rating is measured based on the agreed and validated measurement scope.

The amount of developers that work on system maintenance is a number that is provided by the vendor.

The individual measurement results have been validated with the vendor's technical staff before calculating the 'change capacity'.

Evaluation of the change capacity

The calculated change capacity is translated to a final score that will contribute towards the APOTTI evaluation process based on the following rules:

- A vendor that has a calculated change capacity of 25% or more will receive the full five points.
- A vendor that has a calculated change capacity of less than 25% will receive a relative lower amount of points. E.g. The vendor that has a change capacity of 15% will receive 15/25 * 5 = 3.0 points. The vendor that has a change capacity of 22% will receive 22/25 * 5 = 4.4 points.

References

- SIG Maintainability model – https://www.sig.eu/en/about-sig/sig-research/sig-model-maintainability/ and pdf documents from this page
- Software Productivity Research (SPR) – http://spr.com/