Strengthening and Expanding the Open Health Information Mediator (OpenHIM)

Submitted by Christopher Seebregts   (Jembi Health Systems) on   January 18, 2018 - 11:04pm
Last revised by   Web Producer   on June 21, 2018 - 3:09pm.
Proposal Status: Awarded--Partially Funded

Executive Summary

The introduction of electronic health information systems into health services in most developing countries has been driven by donors looking to capture data about specific health issues (i.e. HIV/AIDS and TB) for research or impact monitoring and evaluation purposes. Data requirements have been illness specific and the electronic systems stand alone. The result has been the growing problem of siloed health information limited by the nature of the data collected and stored within the system as well as project specific access rights. This has led to valuable, even critical information not being shared between healthcare providers and results in reduced effectiveness, more inefficiencies and increased costs for health services in low resource settings already stretched by limited human resources for health and funding. If accurate and timely health data could be shared more easily and more widely, this data would be profoundly more useful.

 Electronic system interoperability addresses this by enabling existing health information systems to exchange data, sharing important information between hospitals, laboratories, pharmacies, clinicians, healthcare workers and patients. There are other existing interoperability solutions available, but these are often difficult to implement and use, requiring highly-skilled technical personnel and specialist knowledge of data exchange standards to implement and manage. The Open Health information Mediator[i] (OpenHIM [ii]) provides an interoperability solution that makes it as easy as possible to connect systems and exchange relevant data, whilst ensuring security and privacy. The OpenHIM is a an existing open source middleware used to enable interoperability between component health information systems, either individually or as part of a health information exchange (HIE). It is currently one of the reference technologies for the interoperability layer of the Open Health Information Exchange[iii] (OpenHIE) community project. According to the Global Goods Maturity Model, the OpenHIM rating is Medium for all three core areas: global utility, community support and software maturity.

 The goals of this project are to (i) continue to harden the OpenHIM to make it a more robust and easy to implement and maintain for the growing number of implementers in Africa and other low resource countries,; (ii) grow the community of developers and implementers to ensure that the OpenHIM meets the needs of those on the ground.

Consortium team

The development of the OpenHIM has been led by Jembi Health Systems NPC (Jembi) and has been supported by an international community of practice which uses the OpenHIM as core middleware solution for the OpenHIE initiative. Jembi is an African non-profit company specializing in digital health and open source software development and implementation. Jembi has a successful track record of developing and implementing open source software in the health sector in a number of African countries. It has contributed to many open source software development projects, including OpenMRS and OpenHIE. Jembi is registered, and headquartered, in South Africa with country offices in Mozambique, Rwanda and Zambia,.

Project Description

The OpenHIM is the current reference technology for the interoperability layer component of the OpenHIE[iv] architecture (below). It is currently used in a number of projects most notably; 1) DATIM[v], which analyses data to monitor the effectiveness of the PEPFAR program globally, 2) MomConnect[vi],[vii], the South African National Department of Health's mobile maternal health messaging initiative which supports maternal health through mobile messaging at the national level[viii] and 3) a core component of mHERO, a health worker management application developed in response to the Ebola outbreak in West Africa[ix].

Key: TS (Terminology Service); CR (Client Registry); SHR (Shared Health Record), HMIS (Health Management Information System); FR (Facility registry); HWR (Health Worker Registry); ILR (Inter-Linked Registry)

Jembi proposes to build upon the success of the OpenHIM by securing funding, independent of implementation projects, to provide stability for a dedicated core product team. This will enable the team to focus on expanding the community of implementers and developers, managing the product roadmap, enhancing the quality assurance and control processes and building out the training program via an online portal. It will also fund the development of key new features, identified by a number of implementations and the OpenHIE community as a priority need:

- an online library of re-usable mediators that developers and implementers can use and adapt to suit their particular use case, with the emphasis being on ease and speed of deployment;
- the ability to easily configure the workflow and interactions between mediators via a simple user interface, with an emphasis on reducing the complexity of configuration.

Where appropriate, the OpenHIM supports the use of the IHE [x] profiles and FHIR [xi]: these are the internationally recognised standards that specify how healthcare information can be exchanged electronically. As part of the ongoing productisation of the OpenHIM the team plan to participate in connectathons to certify the tool.

The community and product management activities include: 1) driving efforts to expand the community through targeted communications, 2) promoting the OpenHIM to a wider audience, 3) facilitating the prioritisation of new features and leading the technical strategy and direction of the OpenHIM. Key functions of the product team are centralised management of the product roadmap as well as the production of documentation that is current, accessible and easy to use, including versioned functional and technical specifications, and developer guides and implementer manuals. The development of training materials and tutorials delivered via an online portal will be a valuable addition to support implementers.

Efforts to further productise the OpenHIM will centre on three key areas:

- Technical maintenance of the software, specifically dependency management, updating installation packages and evaluation of technologies as well as expanding and improving the Quality Assurance and DevOps processes.
- Providing technical support to community members and OpenHIM implementations
- Technical design and development, specifically continuing development focusing on implementation-requested features and interoperability use cases as prioritised in the product backlog.

1. Use Cases, User Stories and Activities

Major challenges still exist in a number of low- and middle-income countries (LMICs), where many siloed information systems collect data for specific health programs such as HIV/AIDS and TB, and a plethora of eHealth and mHealth projects operate in isolation. Valuable, even critical health information is being collected but not shared between healthcare providers resulting in reduced effectiveness, inefficiencies and increased costs. The case for interoperability is well understood as a means of facilitating the sharing of accurate and timely health data to improve health outcomes. The reality is that setting up even a basic health information exchange (HIE) and managing interoperability between existing systems is technically difficult, time-consuming and expensive, requiring technical skills that are particularly difficult to hire and retain in low-resource settings.

In addition, in many LMIC countries government policy and legislation restrict or prohibit the use of cloud-hosted services, limiting the potential solutions available to them. Under privacy and data protection laws, national Ministries of Health and ICT are required to store and manage their citizens' health data on internally-hosted servers, often within their own data centres. Major challenges are the limited financial resources and a lack of staff with the required level of technical skills available to manage this complex task "in-house". System administrators are often overstretched and staff retention is difficult when there is competition for these skills in the private sector.

The ability to be able to easily install, configure, manage and maintain health data exchange between systems, without the need for extensive custom development or expensive technical support contracts, is critical to building an effective and sustainable health information system.

The OpenHIM (http://www.openhim.org) is an interoperability layer: a middleware tool designed to enable interoperability between existing systems by providing a central point of control for secure access, auditing, error management and monitoring. Whilst Jembi Health Systems (Jembi) is the organisational home of this tool, it is the result of years of collaboration between a large number of organisations and individuals. The OpenHIM was initially developed in collaboration with the Health Architecture Laboratory (HeAL) at the University of KwaZulu-Natal as part of the Rwanda Health Enterprise Architecture (RHEA) project. Jembi is also part of the OpenHIE initiative , where the OpenHIM serves as the Interoperability Layer reference technology.

To date the OpenHIM has been implemented and is in current use in a number of digital health projects at national and global scale. These include:

1) DATIM, which analyses data to monitor the effectiveness of the PEPFAR program globally, 2) MomConnect,, the South African National Department of Health's mobile maternal health messaging initiative which supports maternal health through mobile messaging at the national level and 3) a core component of mHERO, a health worker management application developed in response to the Ebola outbreak in West Africa.

The MomConnect Use Case example

This use case is illustrative of how the OpenHIM is used as a core component of a health information exchange, at national level, to support a digital health intervention aimed at improving health outcomes. MomConnect is a South African National Department of Health (NDoH) initiative to use mobile phone USSD and data technology to register every pregnant woman using public health facilities in South Africa.

Through MomConnect the mother is enrolled by a health worker during a prenatal visit. The system sends the mother stage-based messages to support her and her baby during the course of her pregnancy, childbirth and up to the child's first birthday. The system also provides feedback (rating, compliments and complaints) about public health services to a central communication centre. MomConnect aims to strengthen demand and accountability of Maternal and Child Health services in order to improve access, coverage and quality of care for mothers and their children in the community.

How the OpenHIM is used in MomConnect

The OpenHIM acts as the interoperability layer component within the MomConnect HIE. It controls access and provides security and visibility into the operational functioning of the HIE. It also provides a number of orchestration and transformation services to mediate the transactions between the various systems within the HIE and the pregnancy register. Alerting, reporting and error management services are also provided to ensure that the HIE is running smoothly on a day-to-day basis.

Aggregate data exchange - the DATIM use case

The OpenHIM supports the PEPFAR DATIM project through facilitating the exchange of national level indicator data from countries to the DATIM central node. The OpenHIM manages the synchronisation of metadata descriptions, facility lists and the reported data between the country level DHIS2 instances and the DATIM Central DHIS2 instance.

Other project cases

The OpenHIM has, and continues, to be a tool of choice by a range of partners when looking for options to better facilitate data exchange within their scope of work. The OpenHIM has been implemented to support the exchange of information (Health Worker Information) during the ebola outbreak in Liberia and has become a core component of the mHero solution (www.mhero.org); it has been used by teams in Zimbabwe to facilitate data exchange for nurse and health worker management between systems; in Tanzania it has been used to support birth and immunisation data exchange; and in South Africa the OpenHIM has been used to manage aggregate data exchange, laboratory results data push into point of care systems (TIER.NET), facilitating data exchange between services for local health insurance companies, as well as the importing of data from research databases into a perioperative health record for patient.

Jembi has worked closely with a range of partners from the OpenHIE community, the non-profit and the private sector to ensure that the OpenHIM's design and functionality meets the needs of the many different projects we have been involved in.

The main goal of the OpenHIM enhancement is to provide the ability to configure the system to connect existing software tools in order to support known workflows, allowing the user (system administrator) to be able to select from predefined interfaces in order to configure the transactions needed to support data exchange. Some example use cases that this work could support are:

1. The ability to connect an electronic medical record system (e.g. OpenMRS) at a rural clinic to a regional or national laboratory service (e.g. NHLS) so that lab test results for patients can be made available to the clinicians more timeously.

2. The ability to connect an EMR (e.g. OpenEMR) to a health information management system (HMIS) e.g. DHIS2 so that clinic level patient level or aggregate data can be sent electronically to the district, regional or national level for reporting and analysis, enabling better-informed decision-making.

As the OHIE interoperability layer community's reference application, the OpenHIM has been designed to support the OpenHIE workflows . These are designed to support the following types of data exchanges with systems that have authority to access the HIE. An example workflow commonly used in a number of interoperability use cases is:

Patient Identity Management Workflow   - A Master Patient Index, also known as a Client Registry, is designed to assist in uniquely identifying individuals who receive healthcare services in the geographic region and/or use cases supported by HIE. The workflows are designed to support the following types of data exchanges:

- 1. A Point-of-Service (PoS) systems such as EMRs or other patient identity sources can add or update a patient's demographic information in the Client Registry.

- 2. A Point-of-Service (PoS) or another system that is authorized to access the HIE can query the Client Registry for the patient's unique id or demographic information.

Uses the FHIR based standards PIXm and PDQm

2. Digital Health Technologies

OpenHIM is an open-source tool (licensed under MPL2.0) and is free to use and publicly available at www.openhim.org .

Feedback from the OpenHIE community, various user groups and lessons learned from our implementation experiences have refined our understanding and helped us to prioritise the software roadmap accordingly. We hope to build on our successes to date by providing continuity of technical, product management and community support for the OpenHIM and to further enhance the tool by focusing on improvements to make even easier to deploy and use. Interoperability is hard: our goal is to make it easier!

Whilst Jembi is actively involved in a number of current projects that utilise the OpenHIM, one challenge we face is a lack of dedicated resourcing with sufficient time and availability to focus on

1. Developing an updated user interface with additional functionality aimed at making the job of the user/system administrator much simpler

2. Managing the core product effectively

3. Strengthening the existing open source community

Funding from implementation projects is often limited to ensuring delivery of defined outputs, and so there is a gap of funding for strategic goal-setting and long-term planning, improvement of internal processes, and for the provision of technical and product support to the community. Our proposal centres on these three main areas:

Software enhancement

The OpenHIM is built using JavaScript and Node.js. These technologies are lightweight, efficient, easy to use and favoured by developers globally. The transaction database is developed using MongoDB, which is inherently stable and massively scalable. The UI for the OpenHIM console is built using AngularJS.

The OpenHIM supports the Audit Trail and Node Authentication (ATNA) IHE Integration Profile which protects patient privacy and confidentiality, data integrity and user accountability.

The OpenHIM also provides support for some of the most popular and widely used data exchange IHE and FHIR standards such as the profiles for mCSD (mobile care services discovery), PIXm (patient identity) , PDQm (patient demographic query), and MHD (mobile access to health). It also supports ADX for aggregate data exchange.

A common generalised requirement highlighted time and again by many implementations and user groups has been to make the OpenHIM even easier to deploy and use, and to minimise the need for custom development. Specifically, the major enhancements planned are:

- To further extend the online library of reusable mediators so that implementers and developers can use and adapt these to suit their particular use case, with the emphasis being on ease and speed of deployment;

- To develop a generic "mediator of mediators", that provides the ability to easily configure the workflow and interactions between mediators via a simple drag and drop user interface, with an emphasis on reducing the complexity of configuration;

In addition, further productisation of the OpenHIM requires:

- Making provision for regular maintenance of technical debt including dependency management

- Improving the continuous integration process, including the addition of more comprehensive automated performance testing

- Improved deployment packaging. Whilst much work has been done to improve packaging for the OpenHIM to support Ubuntu and CentOS deployments, this work needs to be maintained over time to be in line with OS changes and implementation requirements

- Updating the technical specifications, developer guidelines and deployment instructions for each software release

- Independent security audit to provide a better basis for making improvements to security

Product management

There are already two software roadmaps: a shared OpenHIE community roadmap that supports the OpenHIE workflows and an internal Jembi roadmap based on the needs of specific projects, often with tight deadlines for deliverables. Our aim is to have more time available for the Product Manager and the Community Lead to liaise with community members so that these two roadmaps are more closely aligned. This includes working with contributors to incorporate changes back into the core and to generalise features developed for specific projects into core features that will be of value to everyone. We would also like to implement a more formalised feature request process into the community structures so that the prioritisation process is more transparent. Whilst there is existing user and technical documentation available we aim to have more product management resources to dedicate time and effort to improving and maintaining this on an ongoing basis.

3. Community Feedback

Jembi historically has been involved many open source initiatives. It currently curates a range of open source health information systems products and tools and other artifacts. Included in this list include the OpenHIM, investment and support for OpenMRS, Bahmni, HEARTH, OpenCRVS, BSIS and a range of other tools. Jembi, like other groups, have built a business model and a vision to impact the world through the appropriate and effective implementation of well functioning health systems. We have a need to ensure that products are fit for purpose, quality and impactful as well as reused by a range of persons and that there are a variety of implementations and a broad community base to better support the products' sustainability.

The OpenHIM is a direct result of community collaboration and our aim is to continue to strengthen the community to ensure sustainability of the tool over the long-term. However, this requires additional funding to support a dedicated Community Lead with a strong technical background who is able to engage with the existing community of developers, implementers and thought leaders as well as potential users and partners to drive the OpenHIM forward.. This requires dedicated time and availability to respond to and pro-actively seek out opportunities. Our experience shows that his cannot be carried out effectively when only a small % of time is allocated for this type of work.

The aim of the digital health community for OpenHIM is to use the knowledge and experience of those implementing OpenHIM and similar technologies in low resource setting to develop system functional and nonfunctional requirements that are user driven. Our goal is to retain our close relationship with the OpenHIE communities and to be able to dedicate more time and effort to increasing community engagement from other interested parties by being able to fund a dedicated technical Community Lead to drive the community discussions and seek out interested parties This includes actively following up on interest shown by 3rd parties and initiating contact with relevant stakeholders and guiding them through the onboarding process, as well as participating in discussions with existing community groups and projects teams to ensure that the collaborative efforts are well aligned.

Activities used to bring together the community will include:

- A discussion list through which people can share questions and ideas via email

- Hosting monthly community calls (this regularity may change based on participant feedback).

- Managing the public wiki which includes the roadmap for the ongoing development of OpenHIM

In addition to these activities Jembi will look for opportunities for face to face engagements. This may include hosting side-meetings alongside other popular tech events such as the HELINA, OpenMRS and OpenHIE Implementers conferences and local and international connectathons.

Jembi has extensive experience of running and participating in global open source communities including, OpenMRS, OpenHIE, DHIS, Blood Safety Information System (BSIS) and Bahmni. This includes curating online discussions as well as coordinating and facilitating face-to-face workshops, hackathons and conferences (e.g. the 2010 OpenMRS Conference hosted by Jembi in Cape Town).

4. A self-assessment on the Global Good Maturity Model

According to the Global Goods Maturity Model, the OpenHIM rating is Medium for all three core areas: global utility (6.25), community support (4) and software maturity (6.25). Please see the link to the maturity model for OpenHIM v4.0 here . We believe that this investment will raise the average maturity rating from 5.5 to 8.0.
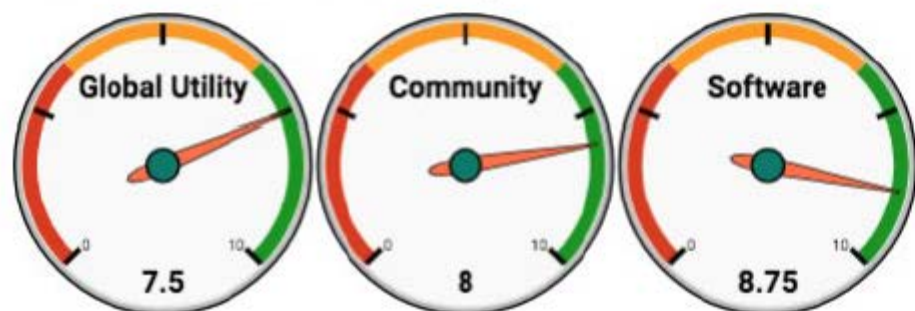
Before Investment

Global Good Maturity

Global Utility — 6.25
Community — 4
Software — 6.25

After Investment

Global Good Maturity

Global Utility — 7.5
Community — 8
Software — 8.75

Global Utility

Country utilisation and country strategy

Advocacy and promotion of the OpenHIM and strategic engagement with governments and international organisations is an ongoing activity undertaken by executive and senior management.

Digital Health Interventions

OpenHIM is designed to be configurable but currently this still requires a person with considerable development skills and technical knowledge to do so effectively. The goal of this investment is to make this process much easier and more intuitive so that the data exchange can be installed and managed by a person who does necessarily require these types of skills i.e. an implementer / system administrator.

Source Code Accessibility

The OpenHIM already meets the criteria for HIGH source code accessibility and this will be maintained at his level. The code is available at Github under an MPL v2 license and all documentation is publically available under a Creative Commons licence.

Funding and Revenue

The OpenHIM is currently funded via multiple streams with core funding coming from a 5 years grant from CDC, of which we are about to enter year 4. However, this funding isn't sufficient to allow Jembi to develop all the functionality being requested by the OpenHIM community. Other funding streams are variable, so it can be challenging to allocate appropriate resources. The product leadership is engaged in developing a long term sustainability plan with the aim of sourcing additional funding, independent of implementation funding, to maintain and enhance the core product. This strategy includes diversifying the sources of donor funding and investigation of alternative funding models such as the A Social Licence (or Global-Good Licence) - a voluntary agreement by organisations/donors/governments and other groups that derive value from the tool, to pay a nominal annual licence fee to support core maintenance of the tool. Continued investment in enhanced features in the OpenHIM will aid in promoting further adoption, expanding the pool of users and guiding the direction of the future development of the tool and supporting long term sustainability by growing the community of users.

Community Support

Community Engagement and Governance

OpenHIM currently has an active community associated with it and is part of the OpenHIE. What is needed to drive this community forward is a dedicated community lead, which this grant would facilitate.

Software roadmap and User documentation

This investment would allow for more time for a Product Manager to dedicate to managing the community and project roadmaps and product backlog and to work with the community members to define and document new feature requests in a more formalised process.

There already exist a large number of existing artifacts in the form of functional and technical specifications, message specifications and technical workflows as well as documentation for end users including guides for users, implementers and developers. This funding would allow for resources to dedicate time and effort to improving and maintaining this on an ongoing basis.

Multilingual Support

There is currently no support for a multilingual system and it has not been identified as a priority requirement at this stage.

Software

Technical documentation

There already technical specifications and associated artifacts. These need to be consolidated, updated and maintained on an ongoing basis in order to be relevant and useful to architects and developers.

Software productisation

The OpenHIM is available as a packaged deployment solution for some operating systems, but this and the supporting documentation will be improved further and will need to be maintained on an ongoing basis. Further improvements to the move from a partially automated to a fully automated continuous integration process will further strengthen the quality of the product.

5. Work Plan, Project Deliverables & Schedule

Please refer to the Gantt Chart   here that describes the expected activities with associated high-level timelines, deliverables and the roles responsible for delivery.

In order to deliver the goals of the proposed project, these are the activities and deliverables according the the 3 core areas of the Global Goods Maturity Model:

Community Support

Activities

The main product and community management activities planned are:

- Managing the shared community software roadmap effectively to provide feature-rich releases with detailed release notes

- Managing the project-specific roadmap and product backlog

- Improving communication through an updated communication strategy

- Updating the OpenHIM website www.openhim.org

- Ensuring that quality assurance and quality control processes are improved and incorporated into the contributor development process

- Making test plans and testing guidelines available to the community for use in validating the installation and setup of the OpenHIM

- Ensuring that the user and implementer documentation and training materials are up to date, easy to understand and practically focused. These are available online.

Deliverables

- A formalised feature and functionality prioritisation process agreed by the project leadership group and implemented within the community

- An updated software roadmap and product backlog available on JIRA and the OpenHIM wiki

- An updated set of functional requirements specifications (including use cases and business & technical workflows) made available on Readthedocs and the OpenHIM wiki under a Creative Commons license.

- An updated and improved set of testing guidelines and test plans made available on the OpenHIM wiki

- An improved and updated set of user documentation including user guides, installation guides, training materials and tutorials aimed at implementers and developers, publically available for each software release on Readthedocs under a Creative Commons license.

Software Maturity

Activities

- To design, develop and document new features and to generalise existing features described above to make them more broadly applicable to the community

- To improve and expand the existing quality assurance and quality control processes further and fully integrate this within our current agile development and continuous integration process

Deliverables

- A new release of OpenHIM that includes an updated, streamlined user interface that enables the user to easily configure the transactional workflow between mediators. This release will be publically available on Github.

- An updated library of reusable mediators with supporting documentation explaining the use case supported and detailing the technical specifications. This library is publically available on Github.

- An updated set of technical specifications made available on Readthedocs and the OpenHIM wiki under a Creative Commons license.

- Completed independent security audit

- Improvements to the Continuous Integration process to include automated performance testing for each release build to be designed and implemented

6. Budget Narrative

For full details please see attached Excel spreadsheet: **digital_square_budget_openhim_with_detail_narratives.xlsx**

Overall Total Amount: USD 340 123. This budget includes:

The Executive Management team consists of:

- Executive Director - Chris Seebregts (10.4 days allocation) who provides overall strategic leadership and acts as principle investigator of the project. Provides leadership in business plan development and overall sustainability of the initiative as well as input into legal and regulatory aspects of the project and guidance in open source community development from experienced leadership. Oversight of Grant and participation in advisory activities.
- Director of Technology – Pierre Dane (10.4 days allocation). Contributes to the technical architectural design of the work streams, as well as providing leadership in supporting software development teams working on the project. Oversight on interoperability standards aspect of the work stream.
- Director of Corporate Services – Jonnea Smith (24.73 days allocation) The Director of Corporate Services manages the project's grants as well as financial and contract matters regarding the all programmes. This includes the management of the annual audits and ensuring compliancy to donor rules and regulations. Please see further data on the CSD team and the allocation of costs

The Corporate Services Division staff comprise a team of 11 with an average allocation of 24.73 days per person over the 12 month period. The CSD team are responsible for Finance, Legal/risk and Compliance, ICT, Human Resources, Grant Administration, Country office administration management, Office admin, Procurement, Communications and auditing. **Please see calculation of overhead sheet on**

the Excel detailed budget spreadsheet for workings on % applied and calculation methodology

The Programme Management team consists of:

- Senior Program coordinator – Carl Fourie (52 days) Overall responsibility for the program, overseeing all activities, resourcing, budgeting, reporting, quality control and community management.

- Project Officer - (26 days). Supports the program manager with planning and activities management. Responsible for working with team on coordination of community calls and general communications. Provides general logistics, reporting and monitoring the day to day administration of Jembi.

Product Management, Community Management and Technical Development

Responsibility for the three main areas of work are split between 1. The Technical Lead, 2. The Community Lead and 3. The Product Manager. These three staff members will liaise closely but have a different focus:

- The Technical Lead – Ryan Crichton (91 days) has a background in health information exchange, interoperability and data exchange standards. Will set the technical direction for the development team and liaise with Product Manager and other stakeholders. Leading technical strategy and responsible for architecture documentation and technical specifications. Contributes to the open source community discussions. He will define the technology roadmap, the architecture and design and will translate user stories in the backlog into technical specifications and lead the development team as well as participate in the sprint work as a fulltime member of the sprint team. Key activities are:
  1. To design, develop and document new features and to generalise existing features described above to make them more broadly applicable to the community
  2. To improve and expand the existing quality assurance and quality control processes further and fully integrate this within our current agile development and continuous integration process
- The Community Lead (130 days) Is a Lead Developer with a background in Health Information Systems, data exchange and interoperability and public health systems knowledge. Will liaise with Product Owner and Technical Lead to act as the OpenHIM Community Manager. He will focus on engaging with the community, driving the discussions and seeking out potential community members and assisting with on-boarding. He will also participate on various calls and represent the OpenHIM community at meetings. Responsible for the community roadmap and eliciting requirements and managing these throughout the change request process and managing developer community contributions to the code. Key activities are:
1. Managing the shared community software roadmap effectively to provide feature-rich releases with detailed release notes
2. Improving communication through an updated communication strategy

- The Product Manager – Linda Taylor (65 days) is responsible for the overall coordination and delivery of the activities including analysis, documentation, testing and validation, that ensures selected and developed software is able to perform at an enterprise level and is ready for implementation. Responsible for the internal projects roadmap and aligning this with the community roadmap. Also responsible for ensuring all product and technical documentation is complete, relevant and up to date and that quality assurance activities are carried out. Key activities are:
  1. Managing the project-specific roadmap and product backlog
  2. Ensuring that quality assurance and quality control processes are improved and incorporated into the contributor development process

3. Making test plans and testing guidelines available to the community for use in validating the installation and setup of the OpenHIM

4. Ensuring that the user and implementer documentation and training materials are up to date, easy to understand and practically focused.

The product team is made up as follows:

- Mid-level developer (226.20 days) and Developer (111.80 days). Responsible for writing and testing software code and producing technical documentation

- Quality and Assurance Technician – To Be Hired (65 days) Responsible for defining and implementing quality assurance SOPs and oversight of all QA activities.

- Testing/QA Developer - To Be Hired (130 days) - Works with product manager and technical lead to define test cases, performs functional testing and provide test reports.

- Senior Creative Technologist (39 days) - Responsible for user interface design and usability guidelines. Also provides graphic design for product documentation.

- Training and Implementation Support Officer – (39 days) Responsible for working with product manager to develop user manuals, implementer guides and training materials

- Software Development Manager – (18.2 days) Responsible for the overall management of the Engineering team, including Software Development Lifecycle and recruitment.

References

[i] 1. Crichton R, Moodley D, Pillay A, Gakuba R, Seebregts CJ. An Architecture and Reference Implementation of an Open Health Information Mediator: Enabling Interoperability in the Rwandan Health Information Exchange. In: Weber J, Perseil I, editors. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) [Internet]. Springer Berlin Heidelberg; 2013. p. 87–104.

[ii] www.openhim.org

[iii] www.ohie.org

[iv] Open Health Information Exchange   https://ohie.org

[v] Data for Accountability, Transparency and Impact Monitoring (DATIM); https://www.datim.org/

[vi] Seebregts C, Barron P, Tanna G, Benjamin P, Fogwill T. MomConnect: an exemplar implementation of the Health Normative Standards Framework in South Africa. In: South African Health Review. Health Systems Trust; 2016 125–35. (https://journals.co.za/content/healthr/2016/1/EJC189313   )

[vii] Seebregts CJ. Dane P, Parsons AN, Fogwill T, Rogers D, Bekker M, Shaw V, Barron P. Designing for scale: optimizing the health information system architecture of MomConnect in South Africa. BMJ, Global Health 2017, submitted / accepted

[viii] http://www.health.gov.za/index.php/mom-connect

[ix] SPOTLIGHT: Behind mHERO - A look at interoperability, architecture, standards and the value of open source. May 2016. Interview by Dykki Settle with Amanda Puckett BenDor and Carl Fourie

[x] Integrating the Healthcare Enterprise   http://www.ihe.net/

[xi] Fast Healthcare Interoperability Resources   https://www.hl7.org/fhir/