DEVELOPING A FIELD FORCE COMMUNICATION SYSTEM BASED ON A THIRD PARTY APPLICATION MARKET STUDY

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by
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İZMİR

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We have read the thesis entitled **"DEVELOPING A FIELD FORCE COMMUNICATION SYSTEM BASED ON A THIRD PARTY APPLICATION MARKET STUDY"** completed by **SEDAT İLBEYİ** under supervision of **PROF. DR. ALP KUT** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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The errors idiocies and inconsistencies remain my own.

Sedat İLBEYİ

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ABSTRACT

The aim of this study is to develop a Field Force communication system which is based on a market study and its results for Actemium.

All requirements are gathered with requirement analysis and used in the market research to find out all alternative solutions. Those solutions are analyzed and compared with each other to choose the best suited solution. Finally, a Field Force system is designed based on selected solution.

Requirement analysis is made by organizing meetings and interviews to specify the scope and needs of the organization. To finalize requirement analysis, all requirements, including business requirements, are evaluated with the management.

In-house development is chosen as best solution. Actemium has sufficient knowledge and experience to develop software solutions just like Metrack solution. Metrack is a base solution that is customized for customer requirements. The same development method is used for Field Force. Base solution is designed and it will be customized for customer requirements. Microsoft .NET Framework and its components are used in the solution such as Windows Communication Foundation (WCF), CF.NET. SQL Server 2008 and SQL Server Compact 3.5 are used as data sources in the solution.

Keywords: Field Force, Order Force, Sales Force, Field Sales, Field Force Automation, Mobile Device Development

PAZAR ARAŞTIRMASI VE SONUÇLARINA GÖRE FIELD FORCE SİSTEM TASARIMI

ÖZ

Bu çalışmanın amacı, pazar araştırması ve sonuçlarına göre, Actemium şirketinin istek ve ihtiyaçlarına en uygun Field Force (mobil iletişim) sistemi tasarımını bir pazar araştırması ve bunun sonuçlarına göre yapmaktır.

Şirketin ihtiyaçlarının neler olduğu ve geliştirilecek çözümün kapsamı Gereksinim (requirement) Analizi yapılarak yeniden saptanmıştır. Belirlenen bu gereksinimler doğrultusunda, pazarda bulunan alternatif çözümler incelenmiş ve karşılaştırma yapılarak, içlerinden en uygun çözüm seçilmiş ve buna uygun sistem tasarımı yapılmıştır.

Gereksinim analizi, anahtar kullanıcılar ile yapılan mülakat ve toplantılarla gerçekleştirilmiş ve derlenmiştir. Derlenen bu gereksinimler, şirket yönetimi ile tartışılmış ve bu aşama sonlandılırmıştır.

Pazar araştırmasında bulunan alernatif çözümler karşılaştırılmış ve sonuç olarak Field Force çözümünün yeniden ve şirketin kendi imkanları ile Microsoft teknolojileri kullanılarak, yeniden geliştririlmesinin en uygun çözüm olduğu sonucuna varılmıştır. Halen kullanılmakta olan "Metrack" çözümünde kullanılan yöntemin, Field Force çözümü için de kullanılmasının daha uygun olacağı görülmüştür. Metrack yazılımı, temel çözüm yöntemi olarak geliştirilmiştir. Her müşterinin isteğine uygun olarak güncellemesi yapılarak, müşteriye özel çözüm üretilmektedir. Microsoft .NET ve Compact Framework 3.5, Windows Communication Foundation (WCF), SQL Server 2008 ve SQL Server Compact 3.5 veritabanı teknolojileri kullanılarak sistem tasarımı yapılmıştır.

Anahtar sözcükler: field force, mobil sipariş, mobil satış, saha otomasyonu, mobil uygulama geliştirme,

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CHAPTER ONE
INTRODUCTION

1.1 Project description

Actemium Supply Chain Execution implements Warehouse, Production, and Field solutions.

For Warehouse and Production solutions, Actemium uses third party software which is specially developed for communication over RF networks. Actemium has configured its own templates to implement Warehouse and Production projects easily.

For Field solutions, Actemium uses in-house developed Microsoft .NET solution. This in-house developed software has some bugs, and is not yet fully integrated with the indoor solution. Furthermore, no templates are available for Field solutions. Projects basically need to be implemented from scratch. This makes implementation time too long for the customers.

The outdoor solution is also called Field Force. It consists of standard functionality for the following target groups:

- Support for sales engineers to create orders
- Support for service engineers to register all tasks and used materials.
- Support for transport to register all tasks and delivered/received materials.

In all of these three types Proof Of Delivery is important. Furthermore, all solutions must work offline.

The project is divided into two parts:

- **Market study:** The main goal is to determine all available third party software, and its benefits to the organization.
- **Technical design:** Depending on the outcome of the market research, a technical design is needed which can be used to implement Field Force solution templates.

Actemium wants to be informed about all available third party software which can be used to implement Field Force solutions as a whole. If necessary, for different market segments, different solutions can be used.

The outcome of the market study is an advice whether to use third party software or to develop a solution in-house. This advice should include statements regarding three different market segments mentioned in this chapter. Initial requirements of the market study are;

- The third party solution must allow Actemium to configure templates themselves
- No hosted solution from the vendor. If needed, Actemium can host the solution herself for her customers
- Low pricing model

Depending on the outcome of the market research, a technical design must be made to develop the solution. This can be a system design from scratch or implementing a third party software which meets all Actemium requirements. Initial requirement is;

- The new solution must be integrated with existing Actemium solution, Metrack. This allows Actemium to implement indoor and outdoor solutions in one system.

1.2 What is Field Force?

Field Force is a synonym of mobile applications. It is mostly used for Field Services. However, in this project it is used for mobile applications. Service management is one of the Field Force implementation areas.

Mobile applications get different names when it is implemented for specific market segment such as, when it is used for sales to create orders at customers site, it gets the name “Sales Force” or “Order Force”.

1.2.1 History

Computing and networking are still in development. As a result of this development, communication possibilities increase between devices. Communication and networking timeline is shown in the following figure.

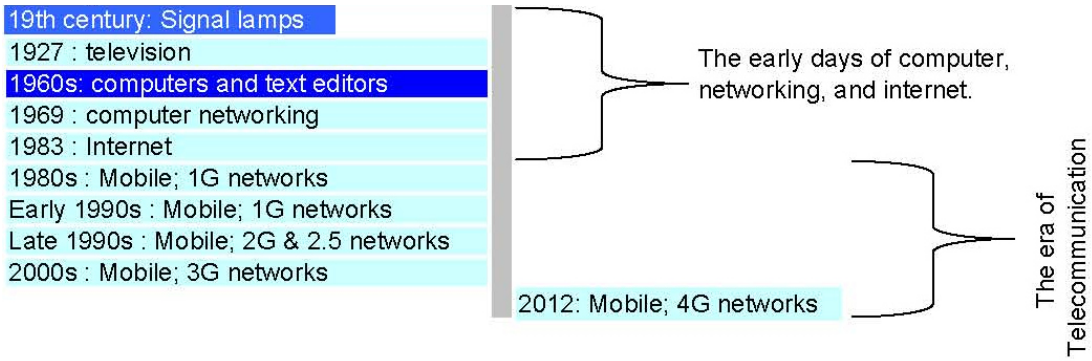

Figure 1.1 History of Communication (Timeline of communications, 2010)

In early days of computing, all information is digitalized and stored in computers. Computer networks made it possible to share this digitalized information between computers. With Internet, information is published worldwide.

Mobile networks was a big step in communication technology. It has begun with GSM networks. Only voice communication was possible through this network. In early 1990s, 2G networks became popular because of data communication possibilities. With 3G networks, data communication in mobile devices became as

fast as normal desktop communication. As a result, watching high quality TV, streaming media, video conferencing, transferring large amount of data are quite possible with small tiny mobile devices.

1.2.2 Implementation Areas

Regardless of the vertical industry segment, you will find that decision makers no longer ask the questions: "What is a mobile solution? What can it do for us? Is technology really ready for this?". Instead, most companies already have a clear and correct understanding of most, if not all, business- and technology- related aspects of mobile solutions. Some companies have already implemented mobile solutions in their business; some companies have managed to put pilot studies into production, while other companies are just about to initiate their first mobile solutions projects (Northwind Pocket Sales, 2010).

The majority of mobile enterprise applications that are either deployed or currently being developed fall into the field service or the field sales scenarios. This division is not surprising because the workers are already in the field (Northwind Pocket Sales, 2010).

1.2.2.1 Field Service

Field service involves intelligent scheduling and dispatching of multiple technicians to different locations daily, while minimizing cost and maintaining good customer service and most commonly refers to companies who need to manage installs, service or repairs of systems or equipment (Field Service Management, 2010).

In the typical mobile field service scenario, the customer contacts the call center. A call center representative enters a work order. Once the work order is processed, the job notes, billing, and parts information from the order are automatically updated in the systems dispatch and accounting applications. This information is then sent to

the relevant field technician's handheld PC, and the technician performs the work. In the case of a problem, the technician can use the handheld device to communicate with the dispatch center directly. The dispatchers thus have real-time, accurate status information about any technician or work order (Field Service Management, 2010)..

1.2.2.2 Field Sales

It provides instant visibility into back office sales data and information for managing the sales organization across the entire field sales supply chain - from the customer, sales representative, and service technician to the supplier. Field Sales helps to deliver information to the sales team when they need it most, at the point of sale.

Field Sales Representatives need the right sales information on demand, real-time while in the field. Customers expect instant and accurate responses to requests for custom orders, they want on demand sales order and inventory visibility and they demand high levels of delivery performance from their suppliers.

1.2.3 Future

First information is digitalized with computers, then it is shared with Internet. The next step is to mobilize information. Internet and communication technology will become more mobile.

The next generation of mobile networks is ready to deploy. The first 4G network is already deployed in Helsinki, Finland. It gives approximately 100Mbps bandwidth for the mobile device. This bandwidth is much more faster than average Internet user’s home connection speed. In the near future, this will be the industry standard for the communication.

Faster mobile communication and technological improvements in mobile development will cause business to go mobile faster than ever.

1.3 Actemium Supply Chain Execution

Actemium provides a total solution ranging from consultancy to implementation and maintenance for the identification, registration, and optimization of logistic processes. Actemium, with its team of employees, is experiencing stable growth thanks to its experience, know-how and enthusiasm.

Shop-floor efficiency is optimized by using real-time identification and registration based on the most up-to-date process data. The aim is to make all the applications accessible to all the employees in a user-friendly way. Customer's processes are core to the solutions. Customer's wishes with regard to the various data flows, source applications and reports are of primary importance. Actemium combines customer's wishes with state-of-the-art technology for the best result.

Provided services concern the automation of logistics processes in various sectors. Actemium emphasizes both the processes of manufacturing customers, and the internal processes of logistics customers.

Consultancy, engineering, project management and customer care services are the parts of the services provided by Actemium.

Consultancy: Actemium Consultancy provides practical, independent advice about the achievement of the client aims, and the feasibility of customer's wishes. Actemium is familiar with all disciplines.

Engineering: Software engineers team with their range of expertise, guarantees a practical, optimum solution for all business processes. From ERP integration, and MES configuration to the development of customer's own application software and the programming of the PC/PLC machine control are part of the expertise of Actemium.

Project management: Project manager handles everything from advice, process engineering and system integration to implementation and maintenance. Project manager also concludes clear agreements and has sufficient flexibility to react pragmatically to unexpected developments.

Customer care: Actemium provides the support which is needed at every stage in the life of data-collection system. From advice to implementation, for maintenance and optimization. Actemium supports the development and implementation of the system. When needed complete operational control is taken over from the customer..

Specialists guarantee the availability of the system and keep them informed of the latest equipment and any relevant developments. The aim of these unique life-cycle services is to cut costs and increase productivity.

1.4 Software Development methodology

Actemium is a project organization. Every solution or software which is developed is customer specific. Therefore, a base solution is developed for work-floor. This base solution has plenty of standard transactions implemented.

For every project the following methodology is used;

- **Functional design**
  Requirement analysis phase. All functional requirements are discussed with the customer and documented in the Functional Design document. This document must be signed off before continuing with technical design.

- **Technical design**
  Based on the functional design document, a technical design is made by the Lead Engineer. This document will be used by all Software Engineers involved in the project. All changes in the system design must also be made in this document.

- **Development**

  The Lead engineer and the Project Manager will assign modules to all software engineers working on the project. Every software engineer is responsible for the development, and unit testing of the assigned modules. The Lead engineer controls the overall development process.

- **Testing**

  The test plan will be prepared by the test engineer. Depending on the project, SAT (System Acceptance test) and FAT (Factory Acceptance Test) tests will be made. All issues found in the SAT, must be solved before the FAT by Software engineers.

- **Delivery**

  After accepting the system with the FAT, system will be installed at the customer site by a Software Engineer (mostly by Lead Engineer).

- **Transfer to Customer Support**

  If support contract is signed by the customer, the delivered project must be transferred to the service engineers by the Lead Engineer.

1.5 Summary

Mobile applications are frequently called as “Field Force” solutions. Field Force is named differently when used specifically for a sector such as Order Force when used by Sales and Marketing.

New software solution for the field is necessary for Actemium as a part of current solution called Metrack. Existing software does not meet the requirements and it is not up to date. Before developing a new solution, market research is required to find out all alternative solutions in the market.

Field Force systems are widely used in Service management and Sales activities. However, in general Field Force systems can be used for any business processes.

The following services are provided by Actemium for the identification, registration, and optimization of logistic processes:

- Consultancy
- Engineering
- Project Management
- Customer care

Software Development Life cycle that is used by Actemium is defined as ;

- Functional design made by the consultant
- Technical design made by the lead engineer
- Development by the software engineer team
- Testing by the software engineers and the test engineer
- Delivery by the lead engineer
- Support by the customer support engineers

1.6 Conclusion

Mobile computing is getting more popular every day. Actemium needs an up to date solution for her customers. To have a Field force solution, the following actions have to be taken:

- Requirement analysis
- Market research
- Selecting a solution
- System design

CHAPTER TWO
REQUIREMENT ANALYSIS

Actemium currently provides Field Force solutions to her customers as a part of Metrack solution. However, the existing solution does not cover all requirements that Actemium has. The current solution is also not up to date, and therefore has to be reviewed as a whole.

In this chapter, all requirements are gathered from all key users of Actemium. After that all requirements are categorized into components. All requirements are then prioritized by the importance.

2.1 Method

As a first step, all key users are consulted to specify all requirements in the organization. They are consulted in groups to improve the efficiency of the meeting. No information is provided to the key users before the meeting, in order to collect the ideas without effecting or limiting the minds.

Management is consulted to collect general expectations about the project. This also includes the scope, short-term and long-term strategy. The following manager is consulted

- Sander Jansen, Business Unit Manager

Sales managers are consulted to collect most important sales arguments related to Field Force solutions, including most required features of the solution, trends, and competency in the market. The following sales managers are consulted;

- Arnold Kamphuis, Partner Manager (Food & Beverage, Pharmaceutical)
- Martin Slotman, Sales Manager (Manufacturing, Logistics)

Project managers are consulted to collect all information about major problems faced during Field Force projects, customer expectations in the development and test phases;

- Haralt Tromp, Project Manager
- Dennis Hulscher, Project Manager
- Jan Roose, Project Manager

Consultants have determined all functional requirements of Field Force projects. Common questions and expectations are asked during the functional design phase.

- Danny Jacobs, Functional Consultant
- Mark Thissen, Functional Consultant

Software engineers are consulted to collect all practical information during development and test phase. During development phase software engineers can see some problems that are not covered in functional specifications. Those problems are also asked to software engineers to make requirements complete.

- Nico Vos, Software Coordinator
- Frank van Eeken, Team Leader Software Engineers
- Ronald Nab, Software Engineer (Metrack)
- Remco van Dijk, Software Engineer (ERP Integration)
- Gerwin ten Brinke, Software Engineer (Database administrator)
- Tom Kroekenstoel, Software Engineer
- Emil Cristen Software Engineer

All requirements are prioritized based on the information gathered from the key-users. After that all requirements are discussed with management to finalize this step. In the discussion, some of the requirements priorities are changed.

Each requirement is categorized in one of the following priority levels;

- **Must have;** Chosen solution must have implemented this type of requirement
- **Should have;** Chosen solution should have this requirement. In the near future this requirement should be easy to implement in the solution (with less effort).
- **Nice to have;** Chosen solution does not need this requirement.. However, it should be implemented when needed.

2.2 Functional Requirements

A Field Force system is basically a client/server system. It has a client and a server. Communication between the client and the server is also treated as a component in the system.

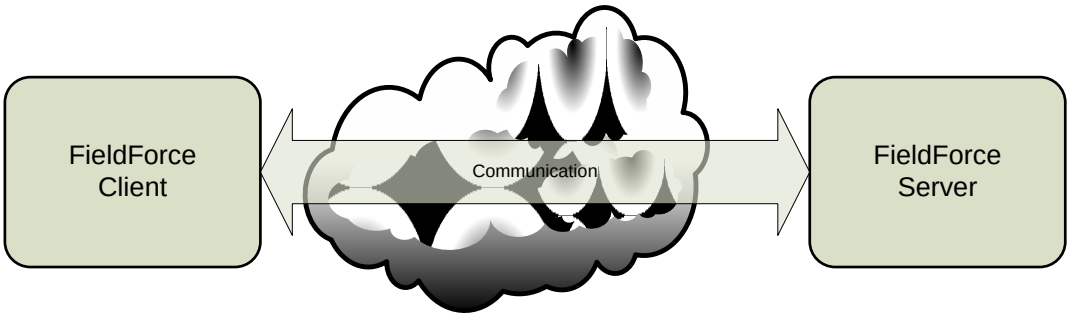

Figure 2.1 System components overview

All requirements of a Field Force system are stated and briefly explained. Some of the requirements are related with the system, not only the component. Those requirements are listed in System Requirements section. In the summary section, all requirements are listed as a table with priorities.

2.2.1 System Requirements

This type of requirement is not related with one component. These requirements are valid through the system.

2.2.1.1 Customization (Extendibility)

It must be easy to implement a new business function / procedure in the system. Actemium develops custom applications to her customers. One of the most important aspects is extendibility. Changing or adding a new functionality must be implemented quickly in a feasible way.

2.2.1.2 Scalability

Field Force system can be used by a couple of devices or by a large number of devices. Scalability is a desirable property of Field Force systems. The system must perform in a graceful manner in all cases. It has to be ready to handle larger amount of devices connected to the system.

2.2.1.3 Licensing

Actemium delivers customized applications to her customers. Licensing will be implemented to maintain system overview and scalability. Licensing can be applied to the solution in different ways. Actemium will have the licensing model for the concurrent users logged on to the server. Additionally, every mobile device that the client application is installed, will be separately licensed.

Licenses should be managed from the server side.

2.2.1.4 Rapid Application Development

Actemium is a project organization. The developed software is always customer specific. Field Force project must be customizable to implement customer specific requirements.

All projects have a budget. All changes must be implemented quickly and as soon as possible

.

All software development activities and implementing customer specific requirements need engineering hours. These hours will decide how expensive the system will be. If the changes and implementations take less time, the total price of the project will be less than expected. The solution can compete in the market with its price.

Therefore RAD (Rapid Application Development) becomes one of the most important aspects of Field Force implementation.

2.2.1.5 Testing & Debugging

Every software engineer in Actemium is responsible for unit testing. For unit testing and testing the system as a whole always require debugging. Without testing the software, it is not possible to deliver software to the customers.

Better testing will reduce the cost to solve the issues in the solution. It also reduces SAT (System Acceptance Test) and FAT (Factory Acceptance Test).

2.2.1.6 System Security

Security is one of the most important requirements for the whole system. The system must be secured as a whole. To prevent unauthorized access to the system, authentication must be implemented. Communication between client and server must have a secured communication channel to ensure nobody can sniff data through internet.

Client software must be protected for unauthorized access with using user authentication. Depending on the project/customer requirement, data in a mobile device may be saved encrypted to make it valueless in case of theft. Additional control will be added to increase system security such as, blocking device access to the server, e.g. user credentials expiration after 30 days.

To increase the security, the system should be controlled and monitored form the server.

2.2.2 Communication Requirements

Reliable communication between client and server is essential. Communication with the server can be established to send/receive data or synchronize data with client and server.

Communication can be done with;

- Web Services
- Database synchronization.

In both methods Internet connection is required. Additional controls, checks, business functions or database synchronization can be implemented when using Web Services. However database synchronization is only data synchronization.

Depending on the project requirements, one or both methods can be used. Data or user validation will be implemented with Web services.

2.2.2.1 Compression

Transferring large amount of data cost more time. Communication between client and server must be done as fast as possible. Using different compression algorithms, data can be compressed and transferred between client and server.

If communication is established through a GSM network, it costs money. Although data connections through GSM networks cost even less and becoming faster throughout time, transferring data/files using compression will reduce costs.

2.2.2.2 Encryption

Internet is used to transfer data between client and server. Whether a GSM network or a regular Internet connection is used with an unsecured communication channel, transferred data can be seen by others. Data should be meaningless for others when transferring data with encryption.

Data saved in the mobile device can be valuable for the customer. If the device is stolen, data should not be visible for the others. Encryption should be used to protect data.

Securing the mobile device is also essential. If something happens to the mobile device, it's content must remain secure.

Encryption is a "Should have" requirement which will be implemented when needed for a project.

2.2.2.3 Proof of delivery

When communicating between client and server, the sender wants to be sure that data has been sent and is correctly received by the receiver. When using asynchronous transfer method, the sender is not sure if the data is received correctly and timely by the receiver.

2.2.2.4 Paging

Paging means that data sent, will be sent in small pieces to the receiver. After receiving is successfully done, the receiver will finish processing the data and waits for the next piece. This makes communication more reliable.

Paging can be used;

- To prevent communication problems.
- For better memory usage in mobile device.

Communication problems: While sending data, communication can be broken. If data is not completely transferred, transfer must be restarted. This costs more time and money. Implementing partial data download (paging), already transferred data doesn't need to be transferred again. Dividing data into small pieces can prevent redundant data transfer, which reduces communication costs and increase communication reliability.

This requirement is a "Should have" requirement.

Memory usage : Memory of the mobile devices are limited. It is mostly not big enough to store large amount of data. Memory problems can be prevented by splitting data into small pieces. When a small piece of data is transferred and processed by the device, next piece of data can be transferred and processed.

This requirement is a "Must have" requirement.

2.2.2.5 File transfer

File transfer must be possible as well as data transfer between client and server. Transferred files can be used to update the client application or an import service can be triggered by uploading a file.

File transfer can also be used to transfer content to the client as files e.g. a PDF file for documents, or an image file for the photo's.

File transfer is necessary to implement self-updating client applications. However, this requirement is a "Nice to have" requirement. Because Actemium has a

special product developed to manage all mobile devices remotely, called MaaS (Mobility as a Service). MaaS will be used in the first place to manage the devices used in the system. If MaaS not used, File Transfer may be implemented when required.

2.2.2.6 Secured communication channel

Communication between client and server must be secured. Secured communication channel is one of the methods must be used. Using HTTPS (TCP 443) protocol will be used to secure the communication channel. Security certificate ensures the client has connection to the correct server.

2.2.2.7 Low cost

Communication between client and server will be established through TCP/IP connection. This connection can be established via regular internet connection or via GSM network. If GSM network is used to make data connection, GPRS, UMTS, HSDPA can be used. In any method, every byte that is transferred, cost money. Total communication cost must stay low for field force projects.

2.2.3 Field Force Client Requirements

2.2.3.1 GPS Support

GPS communication is widely used in logistics and service market segment. However it is less important for sales/marketing segment. Client can send the coordinates (geographic location) to the server regularly to get an overview about the locations of the clients (devices, persons, trucks or goods) in the server side.

GPS support is a “should have” requirement, because it is not essential for some implementations.

2.2.3.2 Navigation software integration

Navigation applications are one of the most popular applications in Mobile devices. There are many navigation application options to choose in the market. But this is not a mandatory functionality of a Field Force application. Depending on the project/customer requirements, integration with a navigation application can be used in Field Force projects. It will be an optional module.

2.2.3.3 User Interface scalability

User interface in mobile devices is quite important. Mobile devices have small screens and some of the devices are non-touch screen. Client application must support both screen types touch and non-touch screens. To call a function, keyboard shortcuts must be implemented. For touch-screen devices it is easier to implement UI with using rich user controls (e.g. drop-down, listbox, button). For non-touch screen devices those controls can still be used, however navigating through these controls must be arranged properly because users can not click on it.

2.2.3.4 Hardware and Mobile OS support

Mobile devices become popular in the last years parallel to technological improvements in mobile phones. Almost every mobile phone becomes a mobile computing device.

There are lots of hardware and OS available for mobile devices such as Windows Mobile, Palm, iPhone, Android and Symbian.

Actemium develops applications in Microsoft .NET development platform. All mobile operating systems that supports Microsoft CF.NET platform are in the scope of Field Force.

There may be some issues to use/access device specific hardware such as, barcode/RFID scanner, accessing e.g. an audio device or a digital camera. Depending on the project, specific hardware and hardware specific software (SDK's) can be used.

Palm, Symbian based-devices and iPhone are currently out of scope of Field Force implementation.

2.2.3.5 Disconnected working possibility

Establishing server connection is not always possible because of GSM coverage issues, high communication costs or customer/project requirements. Moreover, communicating with the server for all client interactions, most of the time slows down the application/transaction. Field Force application must be able to work in disconnected mode from the server.

When working in disconnected mode, no server connection and interaction is possible and client application must work standalone. Therefore all data needs to be saved in mobile device in a mobile database. This local database needs to be synchronized before going to work in disconnected mode.

2.2.3.6 Self-updating

Mobile client application should be able to check the application updates. Users will work most of the times on the field; they will not have much time to go back to the office to update the mobile client application. Using Remote Administration tools makes it is possible to manage the devices remotely, but to publish an update to a large number of devices will also take a lot of time. Instead of this, mobile client application can detect the updates, i.e. checking the latest application version, and if necessary can automatically download the update. The logged on user will get a message about the update, in an appropriate time that is chosen by the user, and the update will be installed automatically. This will help the system administrators to

spend less time to distribute an update; and this is also desired by the Software Engineers of Actemium.

Actemium uses MaaS (Mobility as a Service) technology for managing mobile devices remotely. This solution is capable of remotely updating applications that are installed on mobile devices. By definition all Field Force projects should have MaaS installed. Therefore this requirement is a “Nice to have” requirement

2.2.3.7 Barcode support

Barcodes are not necessary for every Field Force project. For example for an inspection application, bar coding is not essential. But it may be needed for a sales application. However, all projects that Actemium delivers are barcode enabled. Therefore barcode support is a “Must have” requirement for Actemium.

2.2.3.8 RFID support

RFID is a “Nice to have” requirement for Actemium. Because, not every project requires RFID support. Moreover, Actemium decided to stop researching on RFID. RFID support will be implemented for Field Force projects if needed.

2.2.3.9 General printing functionality

Printing is not a mandatory requirement of the system. But some of the projects need printing functionality such as printing receipts for a sales order. It will be implemented as an optional module.

2.2.3.10 Multi-language support

All of the applications that are developed by Actemium have multiple-language functionality. Field Force application should also be implemented with a multi-language user interface.

This is a “Should have” requirement for Actemium.

2.2.3.11 WLAN / GPRS / ActiveSync (WMDC) support

The idea behind Field Force application is to extend business processes to the field. Therefore a mobile internet connection is necessary, but not for all types of Field Force implementations. Some of the projects always require Internet connection; some of them need it when synchronizing data with the server. All of the communication methods must be supported in the Field Force application. The communication method is not important as long as it is possible to communicate with the server and complete all the tasks necessary to work.

2.2.3.12 SMS/Phone support

If a Field Force project uses GSM communication, it is also possible to send an SMS or to make a phone call. A Field Force application can support text messaging and making phone calls as well.

This is a “Nice to have” requirement which will be implemented when needed for a project.

2.2.4 Field Force Server Requirements

2.2.4.1 System monitoring

It is not easy to decide how detailed the system will be monitored for administrative purposes, for example, listing log files, system status, connected users. In general, a dashboard is needed to monitor the system. Depending on the project or customer requirements, existing dashboard functionality can be extended.

2.2.4.2 Integration with other systems

Almost all of the companies have their own systems ranging from simple applications to large ERP systems. It is an important aspect of Field Force projects to extend existing (enterprise) applications to outside of the company borders, to the field, to the mobile devices.

It is important to integrate Field Force application to an ERP system, or the system used by the customer.

Actemium has its own WMS (Warehouse Management System) application called Metrack. Field Force application can work standalone, integrated with an ERP system or integrated with Metrack system.

2.2.4.3 E-Mailing

E-mailing is used mostly to interact with the customers or to confirm some actions. E-mailing is a "Should have" requirement for Actemium. When needed, it will be implemented e.g. automatic confirmation mail can be sent to the customer after placing the order in the server. Another example is to send an e-mail to the customer when the goods are sent from the warehouse.

2.2.4.4 Push Data

Data transfer is mostly initiated by the client. When the client needs to get or send data, it will request it from the server, or it will start a session to send data to the server. Pushing data is not initiated by the client, it is initiated by the server e.g. when a new service order is created in the server, this order will be automatically sent to the client that is located closest to the customer.

This is a "Should have" requirement for Actemium. It will be implemented when needed.

2.2.4.5 XML & other file formats support

XML is a widely used file format to exchange data between parties. XML or other file types must be supported for exchanging data. This requirement will be used to interact with other systems to increase interoperability.

Every format has its own advantages and disadvantages. i.e. XML is a structured format but it makes data larger in size. If the communication is not fast enough, exchanging data requires more time and increases costs. Plain text formats are relatively small in size and reduces cost, however well-structured data makes it more complex and increases readability.

Depending on the Field Force project and data complexity different file formats must be supported.

2.2.4.6 SaaS – Software as a Service

Actemium does not deliver generic products for her customers at the moment. All delivered solutions are customer specific, which is not suitable for Software as a Service. However, some implementations always require the same requirements. In this case, there is no need to develop a customer specific solution. Instead of this, a generic solution can be developed and used by more than customer at the same time.

This requirement is a “Nice to have” requirement at the moment.

2.3 Business requirements

Field Force solutions have many implementation areas for different market segments. However, Actemium wants to deliver solutions mainly for the following implementation areas:

- Sales

- Service
- Transportation

There are two major approaches for developing a solution for these implementations;

- Data collection solutions
- Business process implementation solutions

Data collection solutions are basically filling forms and sending the results to the server, such as inspections, evaluations, and surveys. This type of implementation can be automated completely. All data that needs to be collected can be defined in the server side and sent to the mobile device with synchronization. Those data will be collected in dynamically created forms in the mobile device with basic validation. After completion collected data will be sent back to the server, again with synchronization.

Business process implementation solutions are basically implementing a business process in mobile devices such as creating a sales order based on stock information in the client. This approach requires more complex client application such as rich user controls that are depending on another field value, cross field or form navigation, extra validation.

The total cost of the system is also one of the most important business requirements. Normally a software solution has the following costs;

- License
- Implementation
    - Development hours (including project management and documentation hours)
    - Test
    - Delivery & Installation

- Support

License cost must be paid in any condition. Depending on the solution selected, extra license costs can be applied such as license cost for Sybase SQL Anywhere may have to be added in the total costs.

Implementation costs are affected by the hours spent for the development and project management. Testing and installation hours are also added to the implementation cost. ROI (Return of investment) must be aimed for 3 years. Actemium is a subsidiary of Vinci Energies. This requirement is used as a standard by Vinci Energies.

Depending on the selected solution, additional training for the software engineers may be necessary. This will increase the total costs and has a negative effect on ROI. Rapid Application Development reduces implementation cost with quick development.

2.4 Summary

Typical Field Force system consists of three major components; Server, Client and Communication. All requirements mentioned in this document are categorized by these components. Some of the requirements are part of the system requirements instead of a component. Those requirements are listed at the bottom of the table.

All requirements are assigned with a priority as follows:

- **Must have;** Chosen solution must have implemented this type of requirement
- **Should have;** Chosen solution should have this requirement. In the near future this requirement should be able to be implemented easily in the solution (with less effort).
- **Nice to have;** Chosen solution does not necessarily has to have this requirement. However, it should be implemented when needed.

In the following table all requirements mentioned above, is listed as a table with priority and the component type.

Table 2.1 Requirement Analysis results

	Description	Must have	Should have	Nice To have
System	Customization (Extendibility)	**X**		
	Scalability	**X**		
	Licensing		**X**	
	Rapid Application Development	**X**		
	Testing & Debugging	**X**		
	Performance	**X**		
	Self hosting	**X**		
	System security	**X**		
Communication	Compression			**X**
	Encryption	**X**		
	Proof of Delivery	**X**		
	Paging – Communication problems		**X**	
	Paging – Memory usage	**X**		
	File transfer			**X**
	Secured Client communication	**X**		
	Low cost	**X**		
Client	GPS Support		**X**	
	User Interface Scalability	**X**		
	Hardware & Mobile OS support	**X**		
	Disconnected working	**X**		
	Self-updating			**X**
	Barcode scanning support	**X**		
	RFID scanning support			**X**
	Printing		**X**	

	Navigation integration		**X**	
	Multi-Language		**X**	
	GPRS/UMTS/WLAN/ActiveSync/WMDC support	**X**		
	SMS/Phone support			**X**
Server	System monitoring	**X**		
	Integration with other systems (Compatibility)		**X**	
	E-mailing		**X**	
	Pushing data to clients		**X**	
	XML/Plain text other file formats	**X**		
	SaaS (Software as a Service)			**X**

2.5 Conclusion

The main goal of this requirement analysis is to define and describe all mandatory functionalities for Field Force projects. This will help to compare software solutions available in the market. After a market research these requirements will be used to choose the best for Actemium.

Always customer specific solutions are delivered by Actemium. Therefore, customization (extendibility) is one of the most important requirements. Each Field Force project is unique and has its own requirements. There are sufficient engineering experience and knowledge to customize an existing solution or develop custom solution.

Actemium is a project organization and develops no out-of-the box software products. Base solutions are developed and maintained by the engineers. These base solutions are customized for the customer requirements, and the final solution is developed, compiled and delivered to the customer. Every step/phase has its own budget in hours. Each step and phase must be accomplished in time. Therefore Rapid Application Development (RAD) is one of the most important requirements. This ensures quicker implementation, faster customization, better maintaining the budget.

Mobile devices have less memory, slower CPU and less storage in comparison with normal desktop or portable computers. Applications developed for the mobile devices must always consider performance issues in design, development phases and at run-time. Field applications are used at field. Application runs in mobile device and when working in connected mode, communication with the server takes place additionally to exchange data. Faster and efficient server communication increases performance. When working in disconnected mode, no server communication is needed because all data necessary to work is stored in local database. Application makes database connection to get data from the local database. Efficient database communication also increases performance.

Main focus of Actemium Supply Chain Execution is not Field Force applications. Experience in this field is limited with a few implementations. Because of limited experience in Field Force solutions, it was not easy to specify all requirements that a typical Field Force system must have. All mentioned requirements will be used to develop Field Force solution in the first place. In the future, depending on the technological improvements and market trends, these requirements will be reviewed.

CHAPTER THREE
MARKET RESEARCH

Software development for the mobile devices is getting more popular in the last years, parallel to improvements in handheld and telecommunication devices.

The main goal of the market research is to find out all possible solutions that meets all requirements of Actemium with an acceptable cost. Market research will also provide an overview about the market to see what is possible and what is not.

3.1 Method

Software vendors are searched via Internet. All possible information is gathered from the website of the vendor. When required, the vendor is consulted to get more information about the product and the possibilities.

All possible solutions that can be used by Actemium are discussed with the management team to decide the best solution to continue with.

After gathering all information, a matrix will be prepared to compare all vendor solutions with an ultimate solution, own development.

If a product can be found that meets all requirements, that product will be used by Actemium to develop Field Force projects.

All “Must have” requirements must be pre-implemented in the selected solution. If one or more “Must have” requirements are not implemented in a solution, and if majority of all other requirements comply with Actemium requirements, the vendor will be consulted again to find out whether the vendor is willing to close the gaps between the solution and the requirements. If all gaps can be closed, that solution will be selected by Actemium.

“Should have” and “Nice to have” requirements will not be implemented in the first place. However, they will be used to evaluate the alternative solutions with less priority.

All business requirements are “Must have” requirements. Therefore the selected product must also comply with the business requirements.

3.2 Research

There are mainly three types of software companies found in the research;

- Providing out-of-the-box solutions
- Providing RAD platform for customer specific solutions
- Providing customer specific solutions

Vendors, providing out-of-the-box solutions, use their own method to deliver mobile solution. Lawson (Enterprise Mobility), Abecon (On-the-Road) have developed their solutions. These solutions are mostly inherited from a base solution and customized as a separate solution for different market segments.

Vendors, providing Rapid Application Development platform for customer specific solutions are mainly not a solution for the business. Software companies must develop their own solutions for the customers. Datamax Software Group and Sybase are the most popular RAD tools to develop customer specific solutions.

Vendors, providing customer specific solutions use mostly the same infrastructure and technology provided by RAD tools. Those vendors added their own expertise in the solution. Mobile Data Force, Navara and Omnimove have developed their own solutions based on Sybase iAnywhere platform. In the background SQL Anywhere is used as database and communication model between client and server.

Sybase iAnywhere and RFGen are also added in the comparison. Both products are available on the market. Any software company can buy those products and develop its own software.

There are many software companies available on the market which have developed their own solution with their own requirements. Those companies are out of scope of this report, because those companies are the competitors of Actemium not the partners.

3.2.1 Abecon

Mobile solution is called “On-the-Road” to help the customers to realize the following;

- Better communication with people on the road
- Having same employees as office automation support
- Assignments optimal plans, even in emergency cases
- The quality of business processes such as customer service and even more can raise the financial settlement (Abecon On-the-Road, 2009)

Reduce the risk of errors and improve the schedule by one time data entry, including via mobile terminals and automatic tracking of GPS coordinates. With Abecon On-the-Road planners and field workers can easily and quickly exchange information. This solution is widely used by transportation and service, both stand-alone and linked to the main Microsoft Dynamics NAV system (Abecon On-the-Road, 2009).

Mobile solutions ensure that activities of foreign resident workers optimally be included in the business. To facilitate matters as planning, time tracking, order entry, action lists, communications, routing and tracking and tracing. On the basis of accurate information planners, drivers and service staff always take the right

decisions. You save time and money and increases productivity (Abecon On-the-Road , 2009).

Key features:

- Integrated with Microsoft Dynamics. Possible to integrate with other ERP systems like SAP, AFAS. (Service Organizations PDF, P4)
- Web Services, SQL Integration services, ACSII Import & Export are possible to integrate the solution with other systems.
- Own solution developed with Microsoft .NET framework.
- Out of the box solution. Salable by resellers.
- Back office application makes possible to make planning, for the workers at field.
- Application is customizable to realize customer specific requirements.
- All customizations must be made by Abecon. Source code is not available for the partners (Abecon On-the-Road PDF, 2009)..

3.2.2 Navara – RAM Mobile Data

The Navara Mobility Suite is a middleware solution that extends the reach of any application onto a variety of mobile devices. Navara can integrate to any application including Oracle, Remedy, SAP, Service Desk Express as well as any other application using our ODBC, XML, or SOAP adapters (Navara Proof of Concept., 2009).

Powerful Design Center provides a robust and flexible interface for creating mobile interfaces that are used on virtually any popular mobile device including BlackBerry, Windows Mobile and soon, iPhone (Navara Proof of Concept., 2009).

The solution has the following components;

- Server; is a Windows application to define mobile forms.

- Client; is used to run/execute mobile forms defined in the server.
- Communication; is the component used to replicate data between client and server.

Key features (Navara Factsheet, 2009):

- Solution doesn't rely on any other software than Microsoft .NET framework.
- Off-line application. During the synchronization based communication, all data is synchronized with the back-office system. After synchronization, the software works without network coverage.
- Any TCP/IP network (GPRS, UMTS, HSDPA, WiFi, Bluetooth) can be used for synchronization.
- Many adapters to back offices. Navara supports all important industry standards (xml, web services, soap, odbc, file, http, Remedy) and can therefore connect to any back-office. The back-office adapters include wizards to generate the Navara form with all required fields.
- Connections to external applications. For example navigation and barcode-scanning. Navara interacts with external programs by making use of Active-X controls and Jscript.
- Easy User Interface. The design center has a drag- and drop interface that allows a very fast and easy way to modify the mobile application. By making use of Jscript, workflows and business rules can be implemented.
- Application is very flexible and easy to manage. In the Administration center the users are divided in Groups and in Divisions. A new call can be sent to a single user, a few users, a Group of users or a complete Division. Also a call can be withdrawn from one or more users.
- Navara Server supports Oracle and SQL Server for its internal database. SQL server 2000 with SP3a or later or SQL Server 2005 with SP2 or later. Oracle 9i, 10g.
- The client software runs on a wide variety of clients:
    - Navara X86 Client (Windows NT, Win 2000 and XP)
    - Navara Pocket PC/Windows Mobile Client

    - Navara Windows CE - Navara BlackBerry client
- Solution is always subject to be customized for customer specific requirements. All customizations have to be done by Navara.
- Source code is not available for the customers or partners. Solution will be sold as a out of the box product.

3.2.3 Mobile Data Force

MobileDataforce PointSync Mobility Platform Version 4.0 offers a complete platform for mobile application design, development and deployment (Mobile Data Force, PointSync 40, 2009).

- PointSync Developer is used to create simple, to very complex mobile applications
- PointSync Manager is used to control users, devices, databases, data synchronization and more
- PointSync Mobile is used to support the Windows family of mobile and server operating systems

Deploying advanced mobile applications for handheld computers can provide increased productivity and short term ROI. The challenge is bringing many parts together to work as a complete system that can provide data to field workers when needed, and move data collected in the field to your organization's database systems without adding costly steps to the process. Point-Sync simplifies the design, development and deployment of mobile workflow management, service orders, inspections and asset management applications. Companies can more efficiently dispatch data and work to mobile workforces using the PointSync 4.0 Mobility Platform deployment (Mobile Data Force, PointSync 40, 2009).

PointSync is a set of software components that together provide a complete mobility platform. Begin with PointSync Developer to convert paper processes into a mobile application that can run on Windows Mobile devices, or on a Windows

Tablet PC or notebook computer. Mobile applications you create can save and display data in the field, and then synchronize with your enterprise data systems when a connection is available (Mobile Data Force, PointSync 40, 2009).

PointSync Manager is the software application you will use to configure the way data synchronizes with mobile devices, and sets links between the PointSync system and your enterprise data. This point-and-click configuration can eliminate months from your development project by generating synchronization scripts and installing them on the PointSync Server automatically (Mobile Data Force, PointSync 40, 2009)..

The PointSync Mobile runtime engine is software that provides functionality to field users for collecting data, synchronizing information to and from mobile device databases and validating input on the device. These PointSync Mobility Platform components can help you get any paper-based business process mobilized. Start saving your company money by reducing and eliminating data re-entry, translation errors and delays in data transfer to your internal systems with a mobile system provided by Mobile Data Force (Mobile Data Force, PointSync 40, 2009).

Key features (Mobile Data Force, PointSync Data Sheet, 2009):

- Based on Sybase iAnywhere platform. SQL Anywhere is running as a database & communication (replication) server
- Device skins makes it easy to see how your application will look/work in the chosen device
- Robust Application Flexibility take your application to advanced levels with mathematical calculations, data validation, rules-based branching, hardware control, time/date, if-then-statements, variables, system variables and more
- 220+ Built in Functions Speed up development times while giving developers maximum control over their mobile Application

- Full Set of Screen Controls Build robust screens with common controls such as buttons, checkboxes, radio buttons, labels, text boxes, drop lists, list controls, signature capture and more
- Built-in Hardware Integration Allows developers to control hardware such as barcode readers, GPS, RFID readers and digital cameras
- Code-Free, Tree Based Design Tree-based development environment is easier to learn and uses property sheets and right-click to present context sensitive options
- Code Debugger Built-in debugger helps developers locate programming errors quickly
- Data Mapping Wizards Quickly map Drop Lists and List Controls to data exposed in PointSync Manager
- Built-in Sync Library Gives developers full control of synchronization schedule, rules and messages
- AppClips Decreases future development time by saving pieces of code or entire pages

3.2.4 Datamax Software Group

RFGen is designed to maximize the productivity of the development staff when creating wireless and mobile applications. Applications can literally be created in minutes using our intuitive screen "painting" methods along with our point-and-click and drag-and-drop development environment (RFGen Software, 2010).

The RFGen Framework enables companies to transform how their employees work by enabling real-time, on-demand access to mission critical data. Whether it's a factory floor worker, engineer, service technician, salesperson, or executive, the RFGen Framework ensures that the information they need to be successful is always at their fingertips. The RFGen Framework is designed to be the proven foundation for any group that is interested in designing, deploying and supporting custom wireless and mobile solutions (RFGen Software, 2010).

With the RFGen Framework, even complex wireless and mobile applications can be created in days instead of weeks or months. RFGen significantly increases developer productivity by allowing them to focus on what they want to accomplish rather than on the mechanics of how to make it work (RFGen Software, 2010).

Design Once – Deploy Anywhere: The RFGen Framework's Integrated Development Environment - "Programmers Assistant" - allows developers to design their application once and deploy it to a broad range of mobile devices, including PDA's running Pocket PC, Windows CE, as well as laptops, tablets and fixed station computers. Using an intuitive, built-in design environment, developers can rapidly "paint" multiple screen layouts using simple point-and-click and drag-and-drop methods to create extremely functional applications with a compelling user interface (RFGen Software, 2010).

RFGen is designed to maximize the productivity of your development staff to create new applications, as well as to simplify the management and maintenance of those transactions over their life-cycle. Utilizing industry standards, the RFGen development environment is so easy to use that many customers have been able to take complete ownership of their systems without the need for any formal training. Using our integrated development environment – Programmers Assistant – new mobile and wireless applications can be rapidly created and deployed, while maintenance of existing applications is greatly simplified (RFGen Software, 2010).

RFGen uses an intuitive drag-and-drop approach to designing the data collection applications that will appear on your wireless and mobile devices. Once RFGen is configured to one or more data sources, it is easy to link an application's input / output fields to that source. Doing so allows RFGen to do all of the reading and writing to the data source behind the scenes and does not require the programmer to write any code. In the case of our web service and enterprise connectors, the available business functions from the connected system are displayed, and the desired ones chosen for use. RFGen then has the ability to download the business functions schema and dynamically generate the code required to interact with the

selected business process. With this intuitive code generation feature the programmer does not need to focus on the mechanics, only the desired results (RFGen Software, 2010).

Some of the ‘built-in’ design features include automatic table validation, scrolling lists, default values for input fields, validation edits for fields, error message properties, automatic SQL statements, ActiveX routines and access to .NET libraries. Using these features, many of our customers have experienced productivity enhancements in excess of 90% savings in terms of development, testing, and post-installation support requirements (RFGen Software, 2010).

VBA.NET and VBA Classic Scripting Support: In another significant boost to development productivity, RFGen includes a fully functional version of Visual Basic for Applications. Through the use of VBA.NET or VBA classic scripting, and the RFGen framework’s built-in features, even beginning programmers can easily create fairly complicated, mobile and wireless enabled data collection applications. To facilitate this development process, we have also enhanced the standard VBA environment to include a number of new VBA ‘language extensions’. These extensions relate specifically to the mobile and wireless application environments and are targeted to simplify such tasks as complex data validation or queries, transaction updates, label printing, data transfer / synchronization, and much more (RFGen Software, 2010).

Why use VBA.NET or VBA classic scripting in RFGen projects? Visual Basic for Applications (VBA) scripts allow technical personnel to provide additional functionality to RFGen data collection forms by responding to events using Visual Basic programming statements (scripts). VBA Scripts allow the developer to enhance the capabilities offered by standard RFGen forms and other objects. In fact, developers may take total control over the client device by responding to field/system events, handling all data display functions, and even sending direct commands through the various RFGen data connections. It is this built-in support for VBA that lets developers "step outside of the box" (RFGen Software, 2010).

Key features;

- Open Architecture – step “out-of-the-box” using VBA.NET or VBA classic
- Open Connectivity – connect to multiple data sources and share users
- Open Hardware – deploy on the hardware that best suites your needs
- Open Systems – seamless integration with existing system(s)
- Drag and Drop Design – quickly and easily create your automated data collection forms
- Event Driven – respond only to events you want, let RFGen handle the rest
- Language Independence – support all languages including DBCS based
- Well-known solution for the engineers of Actemium

3.2.5 Lawson Warehouse & Enterprise Mobility

Enterprise Mobility software solutions for field service, sales, operations, route accounting and delivery forces. Lawson Enterprise Mobility is a set of leading edge mobility solutions for field service, sales, operations, route accounting and delivery forces. Enterprise Mobility is both tightly linked to other elements of the M3 (Make, Move, Maintain) suite and also a best of breed standalone solution (Lawson - Enterprise Mobility, 2009).

Enterprise Mobility is built on Windows Mobile Pocket PC Phone Edition & Windows Server and uses its own sophisticated TCP/IP replication engine to provide rapid, efficient and secure wide area wireless communications. The Enterprise Mobility architecture is mature and robust covering the entire mobility equation. Deployment, version control, remote installation, replication, process delivery, transaction processing, customization, configuration and scalability are just some of the features contained within the solution (Lawson - Enterprise Mobility, 2009).

Lawson Enterprise Mobility software offers leading edge mobility solutions for

- Sales
- Service
- Maintenance
- Route
- Delivery
- Sales automation.

Key features;

- Client application is developed with C++
- Solution is based on Java platform.
- Client application is compatible only with Windows Mobile. Windows CE devices are not supported.
- Lawson has its own communication model.
- TCP/IP connection is used for connection between client and server. WiFi, cradle (docking), Ethernet, GPRS, CDMA, GSM are supported.
- Based on M3 – Make, Move, Maintain
- Out of the box application, not suitable for customization.

3.2.6 Omnimove Mobile Solutions

Omnimove Mobileforms specializes in mobile solutions for field operations. Omnimove offers a standard solution for inspection, services, construction, transport, fashion, security and sales (Omnimove, 2010).

Omnimove Mobileforms helps to organize all paper-based processes into a digital workflow in three easy steps (Omnimove, 2010).

- Create forms through web portal.
- Fill the forms in PDA and send to web portal
- See the report in web portal

Key features (Omnimove Factsheet Mobileforms, 2010);

- Based on Sybase iAnywhere.
- .NET solution with SQL Anywhere
- Mobileforms is the base solution. For different market segments different products are developed. But these products are always subject to customize for the customer specific requirements.
- Integration with other systems is possible through FTP, XML and SOAP (Web Services)
- Omnimove Mobileforms lets you design your own digital forms
- Omnimove Mobileforms is user friendly. You don't need any technical knowledge to design your own forms
- You can use xls and xml files as data source and as export files
- It can track users with Google maps
- It supports your workflow with email functionality
- On the web portal you control the users, groups, maps and completed forms
- All completed forms are available in PDF format
- Omnimove Mobileforms has its own authorization module
- Over the air distribution of new or changed forms
- Over the air synchronization of data
- The database on the device is offline and online available
- Omnimove Mobileforms interacts with the navigation software Navigon Mobile Navigator 7
- Works on all mobile devices with Windows Mobile 5 or higher
- Supports xls and xml import and export
- It supports data import and export through web services
- Data synchronization is supported by Sybase iAnywhere
- GPS support

3.2.7 Sybase iAnywhere

Pocket Builder is a rapid application development (RAD) tool for building mobile and wireless applications running on Microsoft PocketPC and Windows-Mobile™ based devices. It empowers you to build data-driven applications to run your business in just hours! Deliver critical information to your mobile users, wherever they are, whenever they need it (Sybase Pocket Builder, 2009).

PocketBuilder provides mobile application developers with a feature-rich, thoroughly efficient, and easy-to-use development environment. Its core features and capabilities are tried-and true as they are the fundamental components of PowerBuilder, Sybase's RAD 4GL application development tool. PocketBuilder has hundreds of built-in functions and many ready to-use components. The GUI environment includes painters that let you graphically build your objects and application components with one-button deployment into emulators or actual Pocket PCs. With the powerful and robust object-oriented scripting language, you can easily add complex business rules, custom logic, calculations, and validation to applications. Utilize inheritance, polymorphism, and encapsulation to rapidly build rich, data-intensive applications for mobile deployment, and quickly address the information needs of your business. Whether you're building new complex applications, migrating an existing mission-critical application, or presenting enterprise data to mobile users in a completely new way, PocketBuilder is your key to mobile RAD (Sybase Pocket Builder, 2009).

DataWindow® Technology: Sybase's DataWindow technology gives you RAD data access, data manipulation, and sophisticated data presentation for mobile devices—all without coding. Build complex SQL queries, define validation rules, filter, sort, and manipulate data with point-and-click ease. Put your enterprise data into the hands of your mobile users when they need it, where they need it, and in slick formats, including free-form style, graphs, grids, complex grouping, or a tabular structure. PowerBuilder developers can now redeploy their existing DataWindows to mobile platforms (Sybase Pocket Builder, 2009).

Data Synchronization, Simplified: PocketBuilder offers tight integration with SQL Anywhere® Studio for developing data-driven, mobile enterprise applications. The Adaptive Server® Anywhere database component of SQL Anywhere Studio ensures unmatched reliability and power, with rich enterprise functionality, including full transaction processing, referential integrity, stored procedures, triggers, row-level locking, automatic event scheduling, and automatic recovery. The MobiLink synchronization component provides bi-directional synchronization for secure, server based data transfer between your mobile applications and the most popular enterprise databases—including Sybase, Oracle®, IBM®, and Microsoft®. The synchronization technologies are optimized for both occasionally connected and near real-time environments and support data transfer for mobile users over a wide variety of synchronous, asynchronous, wireless, dial-up, and Internet protocols. Both client- and server-initiated (pushed) synchronization options are available. And a free developer copy of SQL Anywhere Studio is included with PocketBuilder (Sybase Pocket Builder, 2009).

SQL Anywhere® is a comprehensive package providing data management and data movement technologies that enable the rapid development and deployment of database-powered applications. Anywhere offers enterprise caliber databases that scale from 64-bit servers with thousands of users down to small handheld devices PocketBuilder (Sybase SQL Anywhere, 2009).

Anywhere's data movement technologies extend information in corporate applications and enterprise systems to databases running in mission-critical frontline environments. Design and management tools within Anywhere enable developers to implement and deploy frontline applications and equip administrators to easily manage and support them. With Anywhere developers can more easily architect an application's underlying data management, synchronization, security, and remote support using technologies that handle the complexities of frontline environments. As a result, developers can focus more attention on building applications to suit the

specific needs of their customers, while reducing implementation time(Sybase SQL Anywhere, 2009).

SQL Anywhere Server is a high performing and embeddable relational database-management system (RDBMS) that scales from thousands of users in server environments down to desktop and mobile applications used in widely deployed, zero-administration environments (Sybase SQL Anywhere, 2009).

UltraLite™ is a database-management system designed for small-footprint mobile devices such as PDAs and smartphones (Sybase SQL Anywhere, 2009).

Designed for small-footprint mobile devices, the UltraLite database management system provides full transaction processing support, referential integrity, a choice of development models, strong encryption, and built-in synchronization with enterprise data stores through Anywhere's MobiLink synchronization solution (Sybase SQL Anywhere, 2009).

Broad Platform, Tool and Data Access Support : UltraLite provides several object-based programming interfaces for straightforward access to data from different programming environments. Integration with popular development tools eases development for programmers looking to create dynamic data-driven applications. UltraLite database applications can be developed and deployed for a range of handheld platforms, including Windows Mobile, Palm OS, and Symbian OS (Sybase SQL Anywhere, 2009).

Robust Data Management: Data captured on small devices in the field should be treated with the same respect as data stored in enterprise databases within the walls of an organization. UltraLite ensures enterprise data integrity by bringing the robust data management benefits of enterprise databases—such as transaction processing, referential integrity and security—to small devices (Sybase SQL Anywhere, 2009).

Security for Small Devices : UltraLite provides user authentication as well as local data store and communication stream encryption for devices operating outside corporate offices and firewalls. User authentication and strong local data encryption protect information—even if the device is lost or stolen. Communications encryption protects the confidentiality and integrity of packets as they pass between the mobile device and the database server (Sybase SQL Anywhere, 2009).

MobiLink™ is a highly-scalable, session-based synchronization technology for exchanging data among relational databases and other non-relational data sources. Customers use MobiLink to synchronize tens of thousands of users with a single enterprise system, yet the server's compact size and the simplicity of its deployment means it can operate in remote sites and one or two user scenarios (Sybase SQL Anywhere, 2009).

Advanced synchronization logic ensures the transactional integrity of the databases in the event a network connection is lost, and offers sophisticated strategies for the resolution of data change conflicts. MobiLink's synchronization capabilities include (Sybase SQL Anywhere, 2009).:

- Bi-directional database synchronization
- Synchronize over TCP/IP, HTTP, HTTPS, Palm Hotsync, ActiveSync
- Subset data by rows and columns
- File transfer
- Server-initiated synchronization
- Push-based notification
- Advanced conflict detection
- Programmable conflict resolution in SQL, .NET or Java
- Priority-based synchronization
- Data encryption
- Broadcast downloads

MobiLink provides a high level of integration capabilities. It supports many enterprise databases out of the box, and its object-based data flow API can be used to synchronize with non-relational data sources such as application servers, ERP systems such as SAP, Web services, XML files, or other third party relational databases. MobiLink provides out of the box support for (Sybase SQL Anywhere, 2009).:

- SQL Anywhere Server
- Sybase ASE
- Oracle
- IBM DB2
- SQL Server

Q Anywhere™ facilitates the development of robust and secure store-and-forward mobile messaging applications (Sybase SQL Anywhere, 2009).

SQL Remote™ technology is based on a store and forward architecture that allows occasionally connected users to synchronize data between Anywhere databases using a file or message transfer mechanism (Sybase SQL Anywhere, 2009).

Design and Management Tools: Anywhere includes a powerful suite of tools to assist in the design and development of data-driven applications and to simplify the management of database, synchronization, and mobile messaging environments (Sybase SQL Anywhere, 2009).

3.3 Summary

There are mainly three types of software companies found in the research;

- Providing out-of-the-box solutions
- Providing RAD platform for customer specific solutions
- Providing customer specific solutions

Out of the box solutions are specifically designed for generic requirements such as;

- Lawson Enterprise & Warehouse Mobility
- Abecon On-the-Road.

RAD platforms provide a framework to implement customer specific solutions such as;

- RFGen from Datamax Software Group
- iAnywhere from Sybase.

Customer specific solutions are divided into two groups. Some of the solutions are developed with using RAD platforms available on the market such as

- Mobile Data Force solution is based on Sybase iAnywhere.
- Omnimove Mobileforms is based on only SQL Anywhere from Sybase.
- Mobile solution that Navara has developed is not based on any RAD platform.

3.4 Conclusion

There is too much competition in Field applications. Many companies have their own Field solution, or extension to an existing solution. Actemium needs to decide for the best solution to take her part in the market. There are many software companies that develop mobile applications ranging from simple to most advanced applications. Each vendor is specialized in one or more Field Force implementation areas, such as for marketing & sales (Order Force, Sales Force) or Service engineering.

Most of the companies have a base solution for all segments. This solution is adapted to meet specific requirements of a specific segment. An adapted solution is

called a product with a specific name such as, sales application is called as Sales Force or Order Force, service application is called as Field Force.

Almost all vendors are open for customizations to implement customer specific needs, although they have developed an out-of-the-box product.

Most of the companies have developed their solutions for the end-customers, not for the business except RAD platforms. Basically they all are competitors of Actemium. However they are ready to work together in terms of partnership at different levels.

Although the companies are ready to work together for the customizations, they do not want to release the source code. All changes that will be made in the solution, must be done by themselves.

CHAPTER FOUR
SELECTING THE SOLUTION

Competition in the market over Field solutions is quite high. Therefore Actemium needs to find a solution to compete with other vendors. Almost every software company has a product or a solution for the employees working in the field. At least there is an extension module to extend the application for the field.

The best solution for Actemium will be chosen in this chapter.

4.1 Selection criteria

The best solution, that Actemium will choose, must comply with all “Must have” requirements and all business requirements. All “Should have” requirements must be implementable with less effort.. “Nice to have” requirements are not used to evaluate the solution.

There are two possible options for Actemium.

- Choosing an existing complete solution that meets all requirements
- Developing own solution

The main concern of Actemium is to keep the cost as low as possible. Short term vision is “to develop a Field solution for the SMB’s at a reasonable price” and “not” to compete with the vendors which have strong market position.

Total cost depends on the following as described in business requirements.

- License costs, which the customer must pay
- Training costs, to develop a “customized” product for the customer, Software Engineers must be able to know all technical details about the chosen solution

- Customization costs, which consists of engineering hours that are spent by Software engineers. Customer specific requirements must be easy to implement in the solution to keep the total implementation cost low.

All vendors selected from the market research will be evaluated with these criteria. If there is no complete solution found, then the best solution is to develop own Field Force solution herself. Developing an own solution allows all functional and business requirement to be implemented.

4.2 Compare solutions

All alternative solutions will be compared on component level, not as a whole. “Nice to have” requirements will not be used in the selection. However they will be shown in the list to have the complete overview.

The requirement type is shown in the first column. The following letters present the following requirement type

- M- Must have
- S- Should have
- N- Nice to have

If the solution meets the requirement, it will be marked with a “X”. If it meets partially or with a condition, it is marked with “P” and described after the comparison.

Table 4.1 System requirements comparison

Description	Req. Type	Abecon	Navara	Mobile D. F.	Datamax	Lawson	Omnimove	Sybase	Own dev.
Customization (Extendibility)	M				**X**			**X**	**X**
Scalability	M	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Licensing	S	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Rapid Application Development	M		**P**	**P**	**X**		**P**	**X**	**X**
Testing & Debugging	M		**P**	**P**	**X**		**P**	**X**	**X**
Performance	M	**X**	**X**		**X**		**X**	**X**	**X**
Self hosting	M		**X**		**X**		**X**	**X**	**X**
System security	M	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Rapid Application Development, and Testing and Debugging are partially supported by the Navara, Mobile Data Force and Omnimove solutions. In these solutions it is possible to develop mobile forms in the server side. Developed forms will be pushed to the mobile clients. This can be seen as Rapid Application development.

Table 4.2 Communication requirements comparison

Description		Abecon	Navara	Mobile D. F.	Datamax	Lawson	Omnimove	Sybase	Own dev.
Compression	N								**X**
Encryption	M			**X**			**X**	**X**	**X**
Proof of Delivery	M	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Paging – Communication problems	S			**X**	**X**		**X**	**X**	**X**
Paging – Memory usage	M			**X**	**X**		**X**	**X**	**X**
File transfer	N	**X**		**X**			**X**	**X**	**X**
Secured Client communication	M	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Low cost	M	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Sybase products are used in Omnimove (only SQL Anywhere) and Mobile Data Force solutions.

Table 4.3 Client requirements comparison

Description		**Abecon**	**Navara**	**Mobile D. F.**	**Datamax**	**Lawson**	**Omnimove**	**Sybase**	**Own dev.**
GPS Support	S	**X**		**X**			**X**	**X**	**X**
User Interface Scalability	M		**X**		**X**	**X**		**X**	**X**
Hardware & Mobile OS support	M	**X**	**X**	**X**	**X**	**P**	**P**	**X**	**X**
Disconnected working	M	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Self-updating	N			**X**	**X**		**X**	**X**	**X**
Barcode scanning support	M	**X**		**X**	**X**	**X**	**X**	**X**	**X**
RFID scanning support	N				**X**				**X**
Printing	S		**X**		**X**				**X**
Navigation integration	S						**X**	**X**	**X**
Multi-Language	S			**X**	**X**		**X**	**X**	**X**
GPRS/UMTS/WLAN/ActiveSync WMDC support	M	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
SMS/Phone support	N					**X**		**X**	**X**

Omnimove and Lawson solutions have support for only Windows Mobile based devices. Windows CE based devices are not supported.

Table 4.4 Server requirements comparison

Description		Abecon	Navara	Mobile D. F.	Datamax	Lawson	Omnimove	Sybase	Own dev.
System monitoring	M	**X**	**P**	**P**	**X**	**X**	**P**	**P**	**X**
Integration with other systems (Compatibility)	S	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
E-mailing	S						**X**	**X**	**X**
Pushing data to clients	S	**X**	**X**	**X**			**X**	**X**	**X**
XML/Plain text other file formats	M	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
SaaS (Software as a Service)	N	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Security	M	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Navara, Mobile Data force, Omnimove and Sybase allow users to define mobile application fields on the server side. The defined content (forms and field) will be synchronized to the client.

4.3 Choosing a solution

Requirement analysis shows that Rapid Application Development, customization and performance are the most important requirements for Actemium. In the first place, possible solutions must be analyzed. If not found, a suitable component must be found. If there is no suitable component found, own development remains as the last option.

Out-of-the-box solutions do not meet the “Customization” requirement. These products are designed for generic requirements, not for customer specific requirements. Therefore, the following solutions are not suitable for Actemium.

- Lawson Enterprise Mobility
    - Based on C++ and Java. Actemium is using Microsoft .NET

Customer specific solutions may be suitable for Actemium. These solutions are developed for all customer specific requirements. However, the most important requirement for Actemium is, to implement these requirements by herself. Source code is needed to be provided by the vendor.

Some of the solutions are based on RAD tools. These solutions are also not suitable for Actemium. Those vendors have developed their own solution. Deploying the solution to the customer always requires license costs of RAD platform plus the value added by the vendor. Actemium has sufficient experience to implement such a solution for her customers.

- Abecon
    - Source code is not available for the partners.
    - All changes must be implemented by Abecon
- Navara
    - Source code is not available for the partners.
    - All changes must be implemented by Navara
- Mobile Data Force
    - Source code is not available
    - Not properly organized in Europe. Communication problems prevent working together.
- Omnimove
    - Source code is not available for the partners.
    - All changes must be implemented by Omnimove.

A RAD platform can be a solution for Actemium. This type of solution can comply with all requirements of Actemium. This solution is fully customized for customer requirements. However, Sybase platform is completely new for Actemium and her software engineers. All engineers must be trained to develop a successful solution. On the other hand, RFGen RAD platform can also be chosen, because this

platform is well-known in the organization. It will be implemented much faster than Sybase iAnywhere platform.

Using Sybase products in Field force solutions will increase the cost for developing the system. Software Engineers must be trained about the technology and development platform.

***The best solution for Actemium is to develop its own Field Force solution*.**

The same development method should be used like Metrack solution. A base solution should be developed, and this solution should be customized for different implementation areas and for different customer needs.

Developing an own software has the following advantages;

- **Sufficient knowledge & experience in-house.**
  Actemium already develops its own solution for Supply Chain Execution. Moreover, a couple of successful Field Force projects are delivered to the customers already
- **Not depending on another company.**
  Actemium does not have to wait for another company to improve the solution provided to customers.
- **Using well-known technology.**
  Microsoft .NET Compact Framework will be used to develop for the mobile devices and .NET Framework will be used to develop for communication and server side.

    - Client : MS CF.NET 3.5, SQL Server CE 3.5 for database.
    - Communication: MS .NET 3.5 Windows Communication Foundation
    - Server: MS .NET 3.5, SQL Server 2008 for database

- **Additional training is not required.**
  There is no need to organize a training for Software Engineers.
- **Own requirements, own solution.**
  Actemium will be 100% free to add, modify, and remove the requirements/functionalities at any time. Standalone components can be embedded in the solution.
- **Flexible ROI.**
  Actemium will decide about ROI. “Should have” and “Nice to have” requirements can be implemented when needed for a project.
- **Develop & Enhance in time.**
  Not all requirements will be developed immediately. Actemium will decide itself when to extend or enhance the solution.

CHAPTER FIVE
SYSTEM DESIGN

Actemium needs a base Field Force solution which will be used for all Field Force projects.

This system design covers all “Must have” requirements specified in chapter two. The design will be used as a base solution for all Field Force projects.

This solution has all components implemented. However, the functionalities which can be customer specific, will not be implemented in this design.

Actemium has its own development conventions and guidelines to improve productivity and readability. These conventions and guidelines is used in the system design.

Not every design details are included. These details will be documented in technical design document by the software engineer.

5.1 System Overview

Solution will be used as a template for all Field Force implementations. Sample business process transaction for the client and the server component will be provided for the software engineers for other business transactions.

Communication component will be used as “as is” by the engineers unless different functionality is necessary in the project. This results in less development time.

Management application will be designed with limited functionalities. The reason is that, every project has its own requirements for the management application.

Depending on the project requirements, management application will be customized for each project.

The new solution will be integrated with Metrack solution that Actemium has. Both systems is integrated with Business Layer component. All business process logic is used directly from Metrack solution. All logic is implemented in the Business Layer component which taken from that solution.

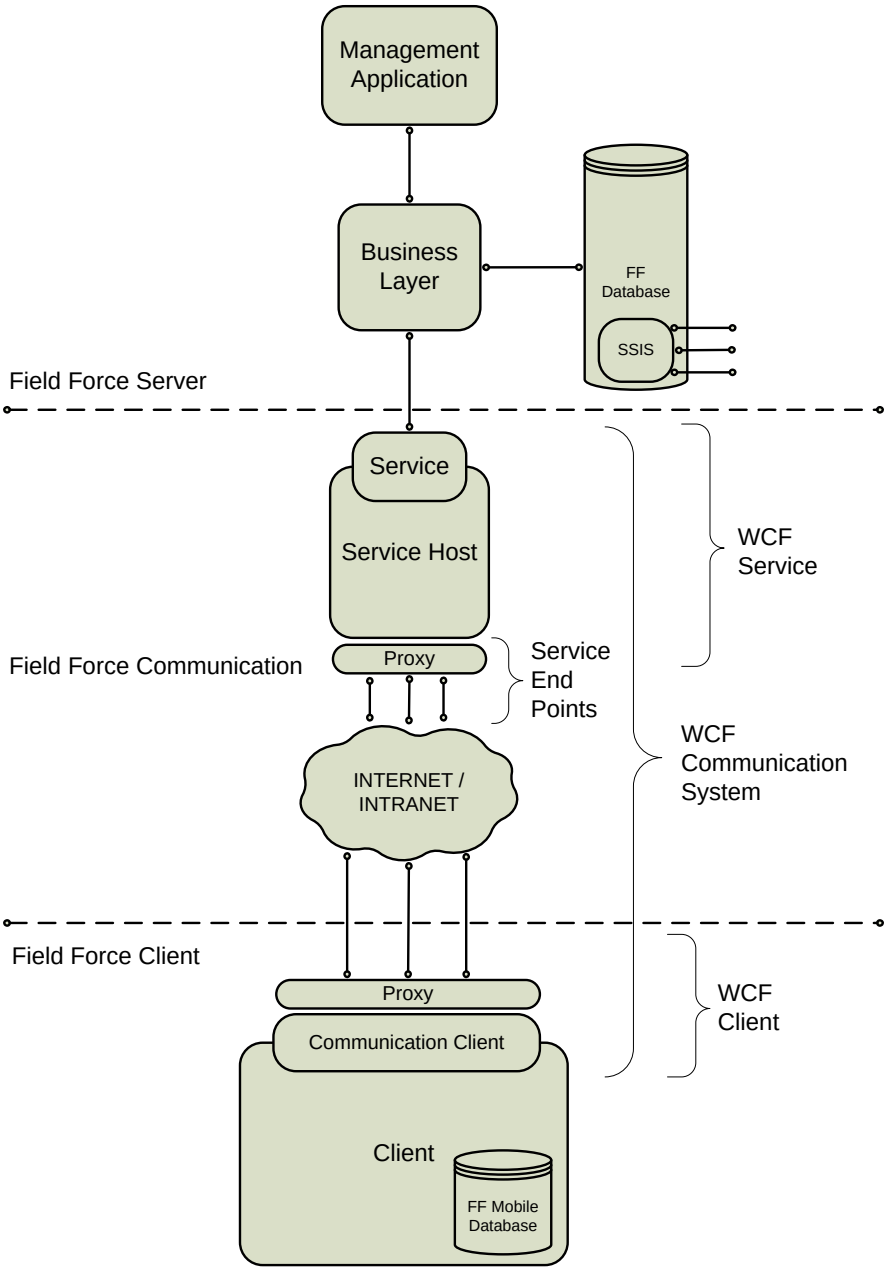

Figure 5.1 Field Force system overview

Components used in figure 5.1 is briefly explained in table 5.1. Each component detailed design of each component is made later in this chapter.

Table 5.1 Components used in the system

Component	Description
Management Application	Web application to manage the system such as user, device management, event log.
Business Layer	DLL assembly for all business logic implementations used in Metrack
FF Database	SQL Server 2008 database for data storage
SSIS	SQL Server Integration Services for integration with other systems.
Service	WCF service to wrap all business functions\processes defined in Business Layer.
Service host	WCF service host. IIS will be used for hosting.
Proxy	Proxy classes to create communication channels between WCF service and the client.
Client	Client application running on Windows Mobile-based device.
Communication Client	Part of the client application which arranges all communication with the server.
FF Mobile Database	SQL Server Compact 3.5 database for data storage.

Integration with ERP/Other systems design depends on the system that will be integrated. If the other system can consume a service, a WCF service will be created to provide data in desired format. If not, SQL Server Integration Services will be configured to integrate with other systems at database level.

Mobile devices are the primary clients of the system. However, other types of clients such as Windows clients, can also use the system. If those clients are located

in the same network, nettcpbinding can be added as additional endpoint to improve the performance of the communication.

Different endpoints can be defined in the future to support type of clients such as iPhone or Google Android devices which are currently out of scope of this project.

5.2 Field Force Client model

Microsoft .NET Compact Framework is used in the client application design. Microsoft SQL Server Compact 3.5 database is used as data source.

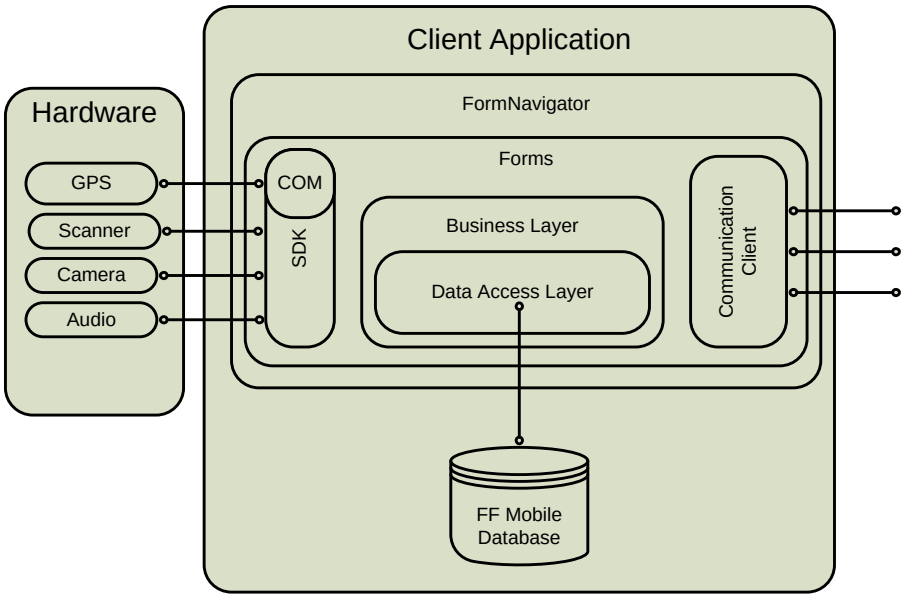

Figure 5.2 Field Force Client application overview.

Table 5.2 Components used in Field Force Client model

Component	Description
Form Navigator	Interface to manage navigation between forms
Forms	Windows Mobile Forms to interact with the user
Business Process	Business process is implemented in this class/assembly
Data Access Layer	All database communication is arranged by this class

Communication Client	All server interactions is established by this assembly
FF Mobile Database	Mobile database for data storage
HW specific SDK's	A wrapper class to use specific hardware in the application such as GPS, Scanner (barcode), Camera and audio
FF Mobile Database	SQL Server Compact 3.5 database for data storage

5.2.1 Form Navigator

Form navigator is a framework to navigate simply through all forms. This is done by generating a stack with loaded forms. This makes it possible to switch between the forms. It is also possible to switch to the forms which are loaded deep in the stack.

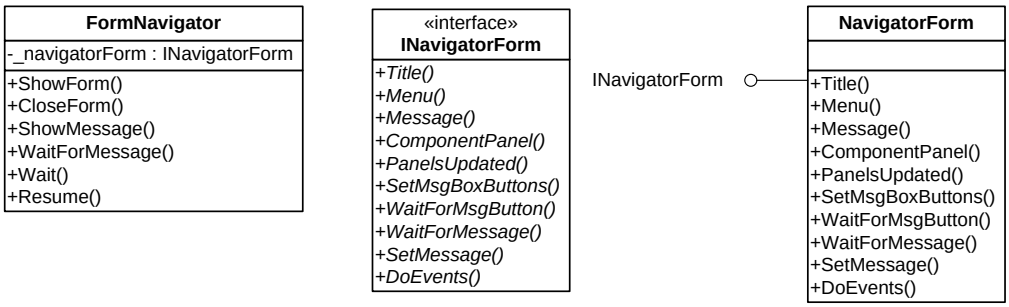

Figure 5.3 INavigator, Navigatorform and FormNavigator class diagram

`INavigator` interface is implemented by `FormNavigator` to load, switch and close other forms.

5.2.2 Forms

All forms implemented `IForm` interface which consists of `init()`, `DeInit()`, `Activate()` and `DeActivate()` methods. When server interaction is needed in the form, communication client `_wcf` is used and used in the form. Basic class diagram for base forms are shown in the following figure.

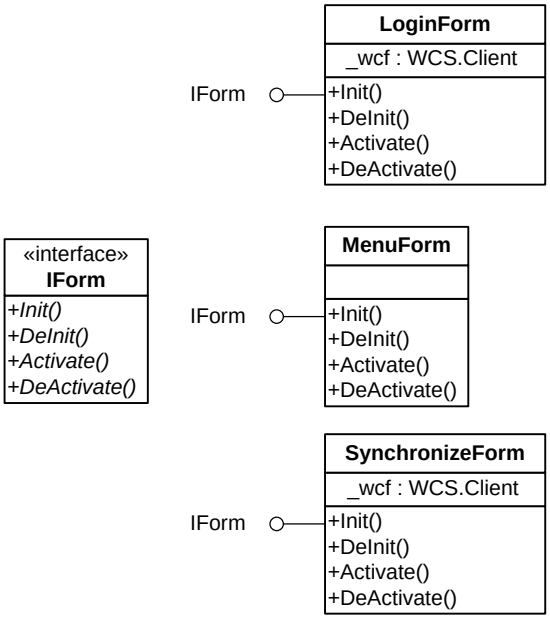

Figure 5.4 IForm interface and Form definition

5.2.3 Business Layer

All business transactions is implemented in this assembly. This class uses Data Access Layer to get data from mobile database and is used in Forms as shown in the following figure.

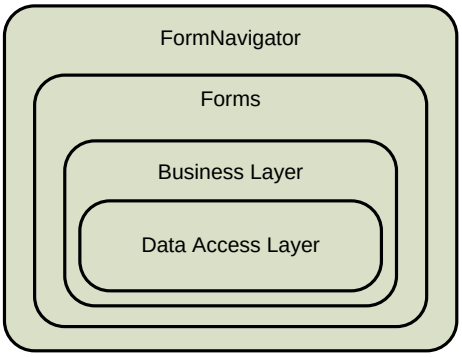

Figure 5.5 Client application class structure

Business Layer has its own hierarchical structure in the name space as shown in the following hierarchy;

- Business Layer (BL)

- User
  - GetUser()
  - Login()
  - GetParameter()
  - GetParameters()
  - Block()
- Sync
  - SendData()
  - ReceiveData()
  - SendAndReceive()

When implementing an order module in the solution, the following class will be added in Business Layer;

- Business Layer (BL)
  - Order
    - GetOrder()
    - GetOrders()
    - Create()
    - Update()
    - Delete()

All business procedures related with orders will be added in this class.

5.2.4 Data Access Layer

Data Access Layer is responsible for all database communication. It provides data for business layer. This class has a static database connection (_dbConn) object which is used in all methods defined in this class. In the following figure class diagram is shown as an example. All methods defined in data access layer are publicly accessible.

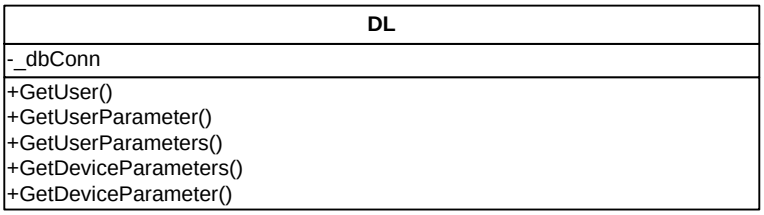

Figure 5.6 Data Access Layer class diagram example

5.2.5 Communication Client

Depending on the action that has to be taken in the server side, a web service can be consumed (called) in synchronously or asynchronously. When calling a WCF service synchronously, there are two options;

- **Proxy**
  Proxy is used in WCF to be able to share the service contract and/or entities with the client. If the client is external to the system, such as API, it makes sense to use a proxy, because it makes sharing the contract easier by giving a code file rather than a DLL.
- **Channel factory**
  When a common service contract DLL is shared between the client and the server, the ChannelFactory class will be used. The idea is to package the service contract interface and the entities in a library, that would be implemented by the service and used by the client. (Using ChannelFactory Vs. Proxies in WCF, 2009)

When a proxy class is generated by using svcutil.exe, it's doing almost the same thing as ChannelFactory behind the scenes, with the difference that the Interface is inferred from the metadata from the WCF service.

Proxy classes will be used in communication client to invoke the methods in the server. For creating the proxy class svcutil.exe will be used with the following line of code;

```
svcutil.exe /language:cs /out:generatedProxy.cs
/config:app.config
http://localhost:8000/ServiceModelSamples/service
```

For calling a web service asynchronously, the following callback events will be created for each asynchronous service calls;

- `RequestProcessed()` for successfully processed calls
- `RequestFailed()` for failed calls
- `ApplicaionError()` for application errors
- `Cancelled()` for cancelled calls

One of the events will be called back after the result comes from the asynchronous web service call. In the client necessary actions are taken in corresponding events.

Event-driven asynchronous calling model is not supported with ChannelFactory method. It is mentioned to be used with synchronous calling method. However proxy method is used in this solution, therefore, both of the calling methods can be used depending on the actions that has to be taken in the server side.

5.2.6 Hardware specific SDK's (Software Development Kits)

Wrapper classes are created to access hardware specific functionalities such as accessing audio, GPS, barcode scanner devices. Wrapper classes are chosen to be able to abstract hardware specific SDK's from the implementation. When other type of hardware (mobile device) is used, changes in the application will remain minimum.

5.2.7 FF Mobile database

Only needed database object are created in mobile database. Mobile database is a file based database and has limited functionality.

Relations between the objects are support in mobile database, however it reduces the performance of the database. For performance issues some data is can be saved redundant instead of creating relation between the objects. Database indexes including primary key definitions are important to perform better. Database normality is not preserved in database design.

Basic Mobile database data model is shown in the following figure:

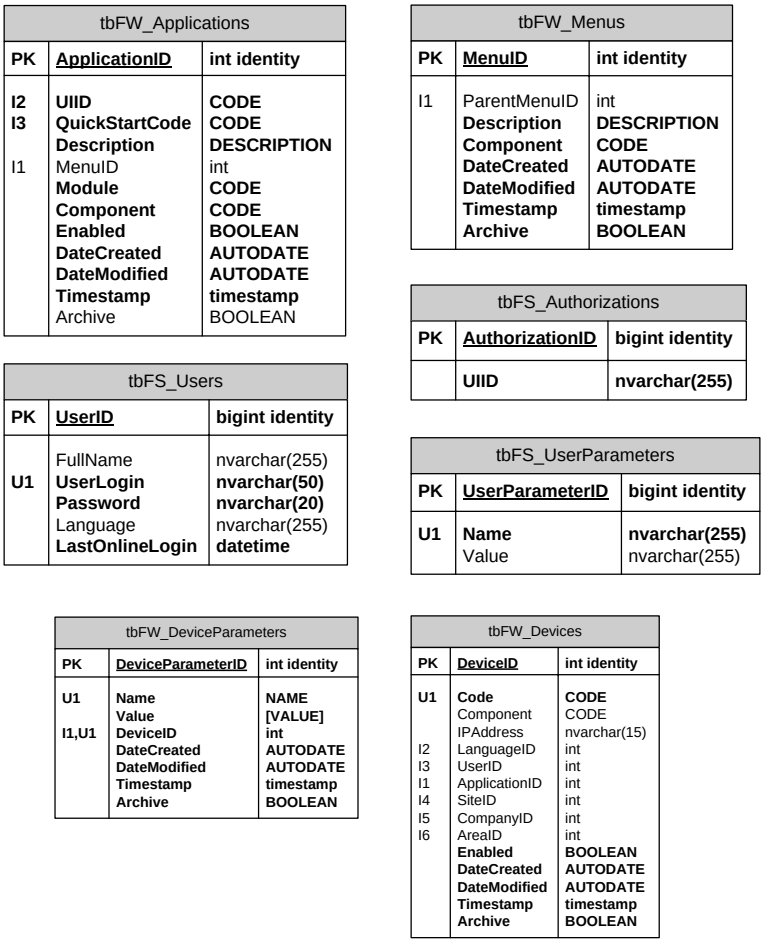

Figure 5.7 Field Force Mobile database data model.

5.3 Field Force Server Model

Microsoft .NET Framework is used to design the server component. Server component will be used to implement business processes. Microsoft SQL Server 2008 database will be used to save data.

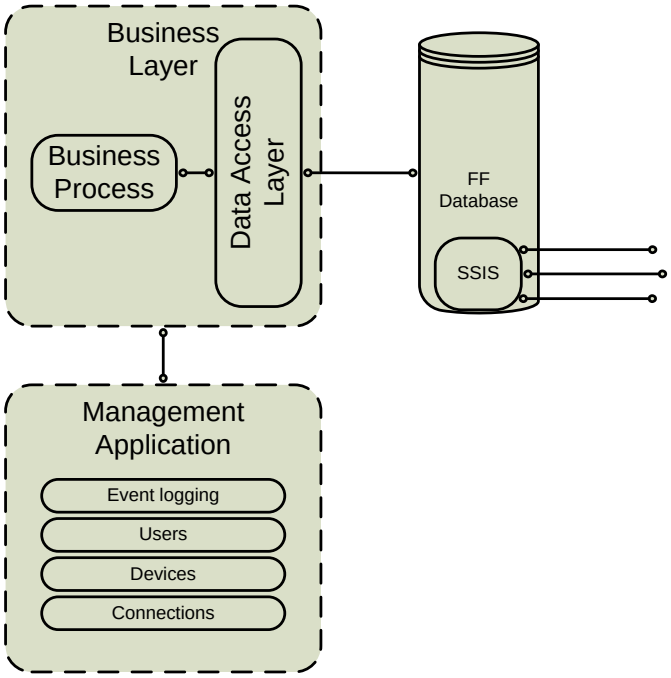

Figure 5.8 Fundamental architecture of WCF implementation.

Table 5.3 Components used in Field Force Server model

Component	Description
Business Layer	All business logic is implemented in this assembly from Metrack solution/
Management application	User, device and system monitoring application.
FF Database	SQL Server 2008 Field Force database for data storage
SSIS	SQL Server Integration Services for integrating the solution with other systems like ERP systems.

5.3.1 Business Layer

This assembly is taken from Metrack solution. Business layer consists of two components; Business processes and Data Access Layer. Business logic is implemented in Business processes and the data is provided by Data Access Layer.

5.3.2 Management application

System management and monitoring are the most important features. It is designed as a secured web application. Users must logon to the system to use this application.

It is developed with ASP.NET technology and hosted in Internet Information Services. The main reason to choose web platform is to make system management and monitoring tasks location independent and easy to use. The only application needed is to have an Internet browser to run this application.

Main features of this web application are:

- *User management*
    - Adding, deleting users, update user information
    - Blocking/unlocking users in the system.
    - User specific parameter management
    - User group management
    - User and User group application authorizations
- *Device management*
    - Managing all devices attached to the system
    - Device specific parameter management.
    - Blocking/unblocking devices
- *Application management*
    - Enabling/disabling applications
    - Application specific parameter management

- *System configuration*
    - Configuration parameter management .
    - Client configuration files creation
- *System monitoring*
    - Event viewer
        - Analyzing all events happened in the system with event types
    - System usage
        - Monitoring online users

5.3.3 Field Force Database

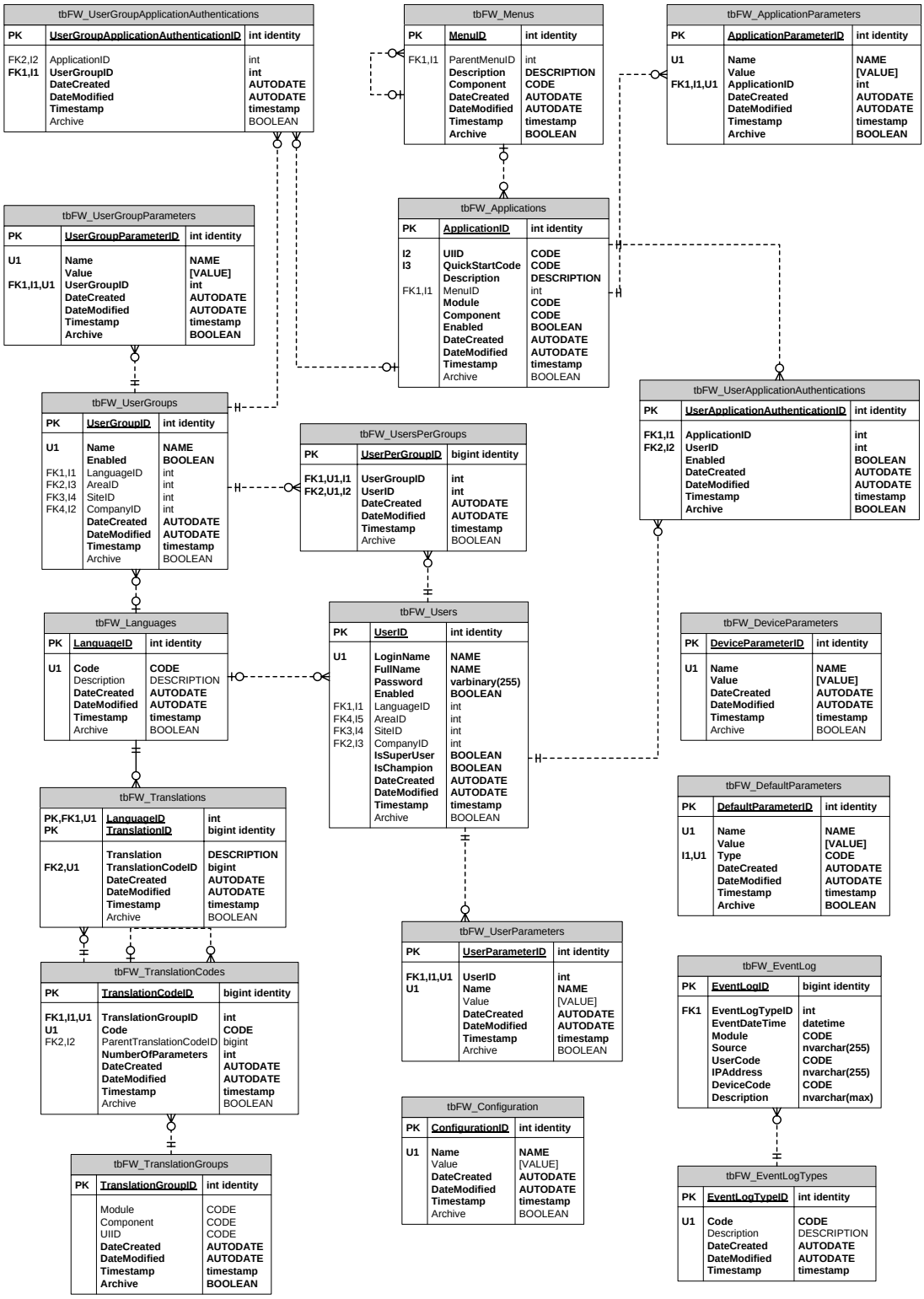

Figure 5.9 Field force server data model

The following pattern will be used for all object notations;

<Database Object type><Module Name>_<Object name>

The following modules can be implemented in Metrack solution.

Table 5.4 Metrack module names

Module prefix	Module name
FW	Framework
WS	Warehouse Suite
PS	Production Suite
FS	Field Force Suite

When creating custom objects in the system, “C” will be added to specify that it is customer specific object. For example, if sales organizations must be saved in a database table, it should be defined as tbCFS_SalesOrganisations.

5.3.4 SSIS

Designed solution can work standalone. However, in most of the cases the solution must interact with other systems. This feature will be implemented when needed for a project. The most common interaction method between the systems is XML file format. Therefore, Field Force XML file support will be implemented in the solution.

SQL Server 2008 is used as database in the solution. SQL Server Integration Services (SSIS) is suitable to integrate with other systems. Integration Services will be configured as in the following figure;

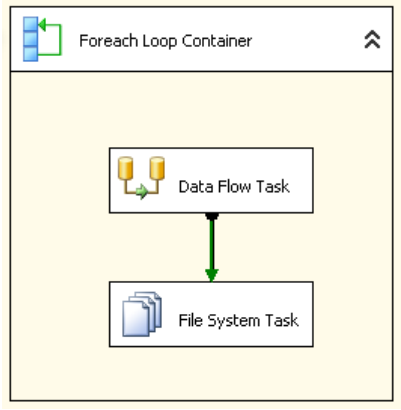

Figure 5.10 SSIS Package design

"Foreach" loop container will check specified directory constantly. When a new XML file is found in the directory, it will be processed by the data flow task as shown in the following figure:

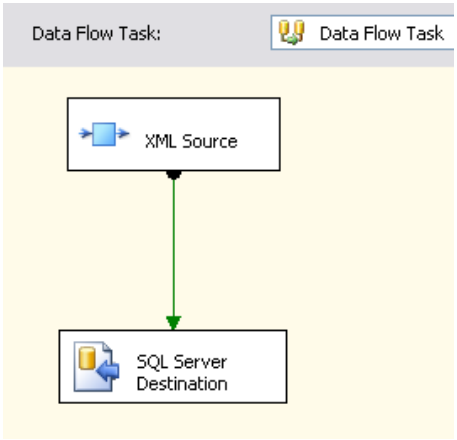

Figure 5.11 SSIS Data flow task details.

XML file will be parsed and the content will be mapped to the specified database table, specified in "SQL Server Destination" object.

Exporting data to the other systems always depends on the system that will be used. This system design will be used as a base solution for all Field Force projects. Therefore, export functionality will not be designed.

If the destination system supports consuming web services, existing WCF services will be extended to import and export data into the system. In this case, business

logic and import/export rules (mapping data to the correct database fields) will be implemented in “Business Layer” server component.

5.4 Field Force Communication Model

Windows Communication Foundation (WCF) provided by .NET Framework 3.5 SP1 is used to design Communication component of the solution. WCF support is improved after releasing the first service pack for .NET framework. WCF has the fundamental architecture as shown in Figure 5.12.

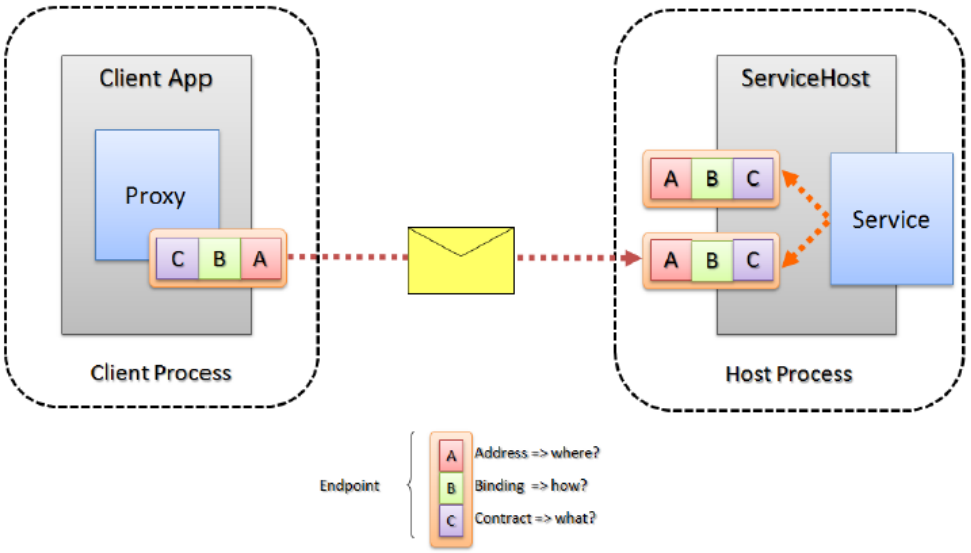

Figure 5.12 Fundamental architecture of WCF implementation. (Chappel, 2007).

All communication with a Windows Communication Foundation (WCF) service occurs through the endpoints of the service. Endpoints provide clients access to the functionality offered by a WCF service.

Each endpoint consists of four properties:

1. An address that indicates where the endpoint can be found.

   The address uniquely identifies the endpoint and tells potential consumers of the service where it is located (WCF Endpoints, 2009).

- A *Uri* property, which represents the address of the service.
- An *Identity* property, which represents the security identity of the service and a collection of optional message headers. The optional message headers are used to provide additional and more detailed addressing information to identify or interact with the endpoint.

2. A binding that specifies how a client can communicate with the endpoint.
   The binding specifies how to communicate with the endpoint. This includes (WCF Endpoints, 2009):

   - The transport protocol to use (for example, TCP or HTTP).
   - The encoding to use for the messages (for example, text or binary).
   - The necessary security requirements (for example, SSL or SOAP message security).

3. A contract that identifies the operations available.
   The contract outlines what functionality the endpoint exposes to the client. A contract specifies (WCF Endpoints, 2009):

   - What operations can be called by a client.
   - The form of the message.
   - The type of input parameters or data required to call the operation.
   - What type of processing or response message the client can expect.

4. A set of behaviors that specify local implementation details of the endpoint
   You can use endpoint behaviors to customize the local behavior of the service endpoint. Endpoint behaviors achieve this by participating in the process of building a WCF runtime. An example of an endpoint behavior is the ListenUri property, which allows you to specify a different listening address than the SOAP or Web Services Description Language (WSDL) address. (WCF Endpoints, 2009)

Different binding methods will be used when necessary for the project. All services will be hosted in a web server, Internet Information Server (IIS) from Microsoft. HTTPS (standard TCP port 443) protocol will be used to secure the communication channel.

This solution will not be an open system. All clients must be pre-configured to use the system. Therefore communication between client and server can be implemented as WCF to WCF communication. With this type of communication, TCP binding is used instead of HTTP and "Binary message encoding" is "used instead of text message encoding" as shown in the following figure;

When working with WCF services, securing communication between the client and the service is very important. Transfer security is concerned with guaranteeing the integrity and confidentiality of WCF service messages as they flow from application to application across the network. Use encryption to enforce confidentiality and protect your messages from eavesdropping (Message and transport security, 2009).

Transfer security in WCF is achieved through the use of either transport security or message security. Transport security will not be used in this solution because of the following disadvantages (Message and transport security, 2009):

- Security is applied on a point-to-point basis, with no provision for multiple hops or routing through intermediate application nodes.
- It supports a limited set of credentials and claims compared to message security.
- It is transport-dependent upon the underlying platform, transport mechanism, and security service provider, such as NTLM or Kerberos.
- (Message and transport security, 2009)

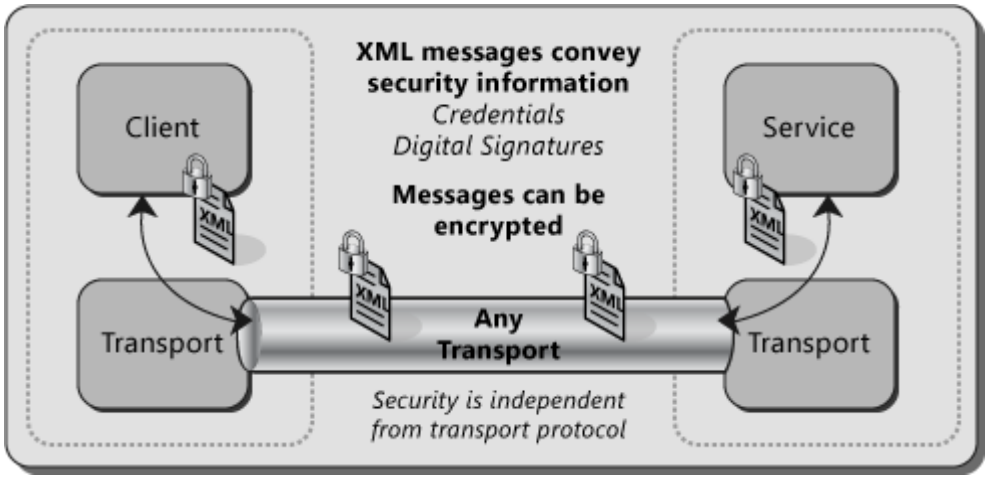

Figure 5.13 Message security (Message and transport security, 2009)

Message security offers the following advantages (Message and transport security, 2009) :

- It provides end-to-end security. Because message security directly encrypts and signs the message, having intermediaries does not break the security.
- It allows partial or selective message encryption and signing, thus improving overall application performance.
- Message security is transport-independent and therefore can be used with any transport protocol.
- It supports a wide set of credentials and claims, including the issue token that enables federated security.

CHAPTER SIX
CONCLUSION

In-house development is chosen as best solution. Actemium has sufficient knowledge and experience to develop a software solution. To be able to compete with other solutions, development of the solution should be separated in long term. The main goal is to develop the best solution for SMB with minimum investment, and a reasonable price, The main advantage of own development is to control the total investment on the solution.

A base solution should be implemented to achieve the main goal. This base solution will have only fundamental requirements. The other requirements should be implemented on a project basis.

Actemium always delivers customer specific solutions. When a requirement is needed to be implemented in a project, that requirement can be embedded in the base solution later with a reasonable cost. This advantage makes the total costs less than expected. In long term, it is possible to have a base solution that meets all requirements.

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