EMGT 835 FIELD PROJECT

# Rapid Application Development

# For

# Small and Medium Businesses,

# A Case Study

By

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# Acknowledgments

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# Acronyms

| | |
|---|---|
| SMB | Small and Medium-sized Business |
| IT | Information Technology |
| ROI | Return On Investments |
| CEO | Chief Executive Officer |
| CTO | Chief Technological Officer |
| RAD | Rapid Application Development |
| TCO | Total Cost of Ownership |
| OSS | Open Source Software |
| MVC | Model View Controller |

# Executive Summary

This field project is based on developing a web application model for a hypothetical small business –“Beverly Flowers.” As a small business, it did not see the need for a web presence in its initial years of operation. However its latest marketing analysis has revealed that its existing customer base wants the convenience of shopping from home. The company would like to develop a web application rapidly to gain maximum benefits; however the company lacks Information Technology resources due to budget constraints.

In the current age of fast pace commerce, every Small and Medium sized Business (SMB), without e-Commerce or a Web presence is faced with similar challenges. This field project focuses on how SMBs can embark on a new initiative to build a web presence rapidly, efficiently, and cost effectively by using an industry proven open source software such as the Spring framework.

The field project focuses on the benefits that small and medium companies can gain by rapidly developing web application using the open source model. There are many successful organizations that have adopted this method and have implemented successful applications. This has resulted in tremendous cost savings and increase in customer satisfaction for those companies. This field project also includes a small software development model – a prototype, to build the required web presence for Beverly Flowers using Spring framework.

# Chapter 1 - Introduction

Small and medium sized businesses (SMBs) are organizations with strength of less than 500 employees. According to the 2007 US Census (Census, 2007), these establishments occupy a 76% market share in the United States. With such a huge concentration of competitors, these businesses have to make strong and aggressive moves to differentiate their products and services from their rivals and hence strengthen their position in the market. One such strategy is to have a website which can be utilized to market and sell their products and services. An online presence helps businesses to be more accessible to potential customers, business associates and product manufacturers, which in turn creates new relationship opportunities.

Investing in Information Technology is not an easy decision for many SMBs. These companies have to make smart investments in order to yield a good return on investments to ensure success of the firm. The variation in resources between SMBs and large companies can be particularly noticed in IT projects. SMBs typically have fewer financial resources, have lower IT expertise, have CEOs who are more involved in operational decisions, need their employees to be multi-skilled as they carry on multiple/contradictory roles, and they frequently have a “production mode” focus at the expense of strategic planning (Haug, 2011). SMBs have the same complex IT needs as those of large enterprises, but enterprise software selection is often a big monetary investment for them. The

larger competitors with abundant budget, capacity, and expertise can afford to take such risks. A decision to select open source software (OSS) can help the SMBs to reap the benefits of developing a web application without spending significant funds on purchasing proprietary software.

Small and medium sized companies also cannot afford to spend years developing business applications. There is a need for greater productivity and reduced complexity in the area of web application software development and implementation. This is the underlying theme behind “Rapid Application Development.” Rapid Application Development (RAD) is the process of creating software rapidly. The idea is to create a prototype and make improvements to the software in an iterative manner.

This field project focuses on how businesses have used open source software supporting the 'RAD model' to develop their web applications. The open source software researched in this project is '*Spring*'. The primary research in the field project is done to create an application model for a hypothetical SMB ‘Beverly Flowers’ using *'Spring MVC'*.

# Chapter 2 – Literature Review

This is a study of how open source software such as ‘Spring’ can be used to help businesses develop web applications rapidly.

## *Rapid Application Development (RAD):*

RAD is a concept through which products can be developed faster and of higher quality through:

- Gathering requirements using workshops or focus groups
- Prototyping and early, reiterative user testing of designs
- The re-use of software components
- A rigidly paced schedule that defers design improvements to the next product version
- Less formality in reviews and other team communication. (Berry, 2000)

The RAD model can be equally beneficial to large businesses. The traditional model of developing applications follows the linear approach where each phase of the software development lifecycle is implemented in a sequential manner. The method is time consuming and often makes the applications obsolete before completion. The projects frequently become worthless by the time they have reached the deployment phase because of rapidly evolving technologies. This is one of the primary reasons for the growing popularity of the RAD model.

Businesses of all sizes can benefit from the RAD model, which works best with projects sharing the following characteristics: standalone applications, narrow customer usage, minimal scope, and small size (Custom, RAD). The success with RAD is best achieved with smaller teams, consisting of less than seven, versatile, experienced and motivated developers working closely with management and end users.

SMBs can use ‘Open Source Software’ (OSS) that facilitates rapid application development throughout the different phases of the software development life cycle. SMBs can reduce their IT costs significantly by saving the license fees that goes into purchasing proprietary software.

## *Open Source Software (OSS):*

According to a report published on Gartner (Browning, 2011), midsize businesses (those between 100 and 1000 employees) will spend approximately $900 billion on IT in the year 2012. These companies are going to spend money on the latest information technologies such as desktop virtualization and cloud computing. SMBs usually have the constant battle to deliver IT services with a small staff and limited IT skills; however they still have to start allocating a budget for future IT investments in order to be competitive in the marketplace. The article published on Gartner (Browning, 2011) suggests that companies need to develop IT solutions that allow incremental investment and implementation as time, resources and budget permit.

'Return on Investments' and 'Total Cost of Ownership' are significant financial metrics for SMBs. These companies prefer IT investments that minimize TCO and have a well-defined ROI. One of the solutions is to use Open source software. Gartner estimates that by the year 2013, 90 percent of Global 2000 enterprises will include OSS as business critical elements of their IT portfolios - and by the year 2016 that number will increase to 99 percent (Driver, 2010).This indicates that Open Source is the growing trend of the future.

ROI, is the net present value of costs over a given time period for example, the benefits of using OSS software versus the costs over a five- year period,

discounted to today's dollars (Driver, 2010). All adopters of OSS would expect significant ROI advantages from open source technologies, yet most find that results vary from project to project. Gartner recommends the approach of open-source investments with a full-fledged ROI analysis, which addresses not only potential cost savings, but also increased business value.

Apart from ROI and TCO, one of the other significant metrics for many businesses is ‘Customer Satisfaction’. Businesses implement various strategies to attract and sustain customers. Customers are attracted to those businesses that meet their demands. Among other things; convenience is one of the main features that an average consumer is looking for. A flexible, well designed, secure, and robust web application can put any business in a good market position. The key is to quickly adapt their web applications according to the market and customer demands, and hence sustain their competitive advantage in the marketplace.

## *DevOps*

The growing inclination towards the open source RAD model can also be attributed to an emerging concept called “DevOps.” DevOps is the practice of aligning an organization's developmental environment more closely with its operational environment, so developers will better know what changes to make to an application, based on feedback from administrators (Jackson, 2011).

DevOps help to establish a tight feedback loop between developers and operations, allowing organizations to quickly develop and refine their applications. This collaboration leads to designing and building applications with reliability and scalability built in. It also helps to increase the speed of application development.

The rise of DevOps (Jackson, 2011) could be attributed to the emergence of large-scale Internet services, such as Google, Amazon and Twitter, all of which have embraced the principles behind DevOps. These companies are fiercely competitive and cannot spend months on implementing a new feature to meet the demands of the consumers. They need to implement new features as rapidly as possible to sustain their competitive advantage. Such companies (Jackson, 2011) also tend not to use prepackaged software from third-party software vendors, and instead rely on open-source programs that their in-house developers and engineers can expand upon and tweak for their own specific environments.

This research indicates that businesses of various sizes are approaching the RAD model using OSS. The benefits of using this approach would depend on the nature and complexity of the projects.  Many successful companies have faced similar information technology challenges at some time and have overcome them by switching to the RAD model.

## *Business Reasons for Adopting the RAD Model*

Businesses have the following reasons to move towards a rapid application development model:

- **Financial resource constraint**

  SMBs, particularly startups lack financial resources and hence cannot afford to spend months developing applications. '*Aegon*' is a Web 2.0 startup company based in Orange County, California which develops Enterprise Social Software solutions. Rob James, the CTO of the company was worried about the time constraint "The more time we take to build an application, the more it costs, and that is prohibitive for a startup. The challenge for us was to try and build a product that was competitive in the marketplace, while keeping to budget and time limitations." (Spring Source, Aegon).

- **Sustain competitive advantage**

  There are companies whose business strategy is to keep people connected. 'TheLadders.com' is one such business that caters to professionals looking for $100 k+ job listings in one place. To remain competitive in the market place there was a need to release new versions of their application every two weeks. Due to the lack of a more agile platform, they were unable to maintain this tight release cycle. According to Kyriakos Sarantakos, manager of the Core Architecture Team at

TheLadders.com, “It was very difficult to add new content and functionality to the website. The application did not respond well to change. Small changes in the application, such as adding a feature, would cause significant maintenance issues” (Spring Source, Ladders)

- **Customer Satisfaction**

  The strategy of several companies is to use Customer Service as their sustainable competitive advantage. Such companies could benefit by developing applications whose objective is to make the customer happy. ‘Wired.com’, the online version of Wired Magazine is a cutting-edge guide covering how technology is changing the world. Wired.com recently introduced a new standalone section of the website, called Product Reviews, allowing readers to search, explore and compare new technology products on the market. Because the Product Reviews section provides a more interactive experience than other parts of Wired.com, the website’s development team needed a flexible approach to building the related applications, which included the user-facing site and a dynamic administration tool for editors (Spring Source, Wired). The idea is to review the feedback from customers related to their products and services and be able to ramp up the product in a very short interval.

The above study shows that businesses are mainly looking for an application development method that is feasible and within the allocated budget, help them

gain a competitive edge compared to their rivals, and keep their customers satisfied. They all needed an application which could be developed rapidly and at the same time would be flexible, easy to maintain and developed within an allocated IT budget. These businesses chose the ‘Spring’ method of rapid application development. The literature further shows the key success factors that businesses have attained by choosing this method of application development.

## *Spring Framework*

'Spring' is one of the most popular open source application development frameworks used to develop rapid high quality web applications. Spring is an open source framework, originally created by Rod Johnson and described in his book 'Expert One-One: J2EE Design and Development' (Walls, Craig).The focus of the remaining sections of the literature review is on companies that have adopted 'Spring' as their rapid application development software. The literature demonstrates the key success factors achieved by these companies by using Spring.

**Key Success Factors Achieved by Using the Spring Approach to RAD:**

- **Reduced Development Cost and Lower Cost of Resources**

  The open source model has helped many businesses to build reliable and secure applications with a low economical cost. The rapid application method enables businesses to develop applications quickly with fewer resources. The model is particularly beneficial for startup businesses that want to develop a marketable product quickly. 'Aegon', a startup that was constrained by financial resources built a web product using Spring with all the features they wanted to offer to their customers with a team of only 4 people. The company took just six months to develop this application. Aegon's CTO asserts (Spring Source, Aegon) ,"To produce the same level of functionality in the same timeframe, in traditional Java, we would

have had to ramp up the team size by 3x, and consequently add much more cost". As this example shows, smaller sized companies adopting this lower cost model can maintain smaller and more productive teams

- **Increased Productivity**

  'www.SpringSource.com', an online reference tool for Spring has many technical resources, reference materials, and documentation that can help developers to quickly come up to speed with Spring. Using this resource can increase the productivity of the developers working on the application. All he reference materials and tutorials are in one place .Without SpringSource, TheLadders.com would have to develop their own training in house, according to Kyriakos Sarantakos, who is the manager of the Core Architecture Team at TheLadders.com(Spring Source, Ladders) . In addition, SpringSource training gives developers new ideas on how to improve applications and optimize their development process.

  The Spring framework reduces the number of lines of code that need to be written by developers to build an application. This means that less time is needed to spend on maintaining and developing code. The company can spend more time on focusing on business operations and customer satisfaction. This helps to increase worker productivity. According to Sarantakos ,(Spring Source, Ladders) "Without Spring, we would have to develop our own MVC layer and other infrastructure. With Spring, I don't

have to spend my time building frameworks. Instead I can solve our business challenges."

- **Accelerated Development and Rapid Release Cycle:**

  Fiercely competitive companies have to meet aggressive timelines in order to sustain their competitive advantage. Some companies have to constantly improve and enhance their applications over a period of couple weeks to meet the aggressive customer demands. The Spring model gives businesses the ability to make changes to existing applications rapidly. A new application was built by the developers at a pharmaceutical company called Anda in just two months (Spring Source. Anda). Steve Hiller, a senior programmer/analyst in Spherion's Candidate Group, says, "By using Spring, we have reduced our development time by at least 30%." (Spring Source, Spherion).

- **Greater Application Quality**

  Testing and troubleshooting applications is much easier with the Spring Framework. This motivates developers to write more unit tests upfront which reduce the number of bugs on the application. It also helps to strengthen the quality of the applications. A better quality application will lead to fewer customer issues and will take fewer resources to maintain the application. This will help to increase the profitability of the business. As Hiller from Spherion says, "Application quality is much better because

of the additional testing. We have had significantly less bugs on the application we built in Spring, compared to before" (Spring Source, Spherion) .

- **Customer Service**

  Customer Satisfaction is one of the most important metrics for many businesses. Businesses that focus on customer service should have tools and resources to be able to quickly make changes to their products to meet the demands of the consumers. The amount of code written in Spring is far less compared to a traditional Java framework. Tracing and debugging customer issues become far easier. Fisher from Wired.com (Spring Source, Wired) explains "It is much simpler to find solutions to a problem or support an application when we only have to go through one or two files with 50 lines of code, instead of searching through 300 lines of code in 18 different files." Solving a customer issue within an extremely small window keeps the customers happy. This helps the business gain a significant competitive advantage over its rivals, results in customers with a durable bias towards the company, and ultimately leads to repeat trade.

  Spring has enabled many businesses to be more responsive to customer needs. The application developers can deliver the new features rapidly and productively. This enables the business to focus more on customer

service, user experience, and other issues that directly impact the company's bottom line. The extra time and resources can be spent in extra research regarding advancement of the sites and on a long-term strategy to grow the business.

# Chapter 3 – Procedure and Methodology

The Literature Review suggests that ‘Spring’ is a popular rapid application development framework and is adopted by many successful businesses. The primary research of this field project is to create a web application model for ‘Beverly Flowers’ using the ‘Spring Web MVC’ framework. A study was done to verify if the applications could be built just as rapidly as the secondary research suggests.

‘Beverly Flowers’ can be used as a model for any SMB that is looking to have a web presence in order to provide its customers the ability to shop from any place at any time.

The following steps were followed to proceed with the study:

## *Step 1: Identify the requirements*

‘Beverly Flowers’, a hypothetical company located in Kansas needs a web presence to provide its customers the convenience of ordering flowers from home.  In addition to displaying the catalog of flowers to its customers, the application should also provide a portal for employees. The purpose of this portal is to enable employees of Beverly Flowers to review customer orders and take the necessary next steps to fulfill the respective orders.

# *Step 2: Architectural Decisions:*

## Web framework

The online point of sale application requires a light weight web container to host the application, which would be scalable in the years to come and also assist in rapid application development.

The following approaches were considered:

1. Struts framework

2. Spring framework

Spring framework was the web framework of choice for the following reasons:

Spring

- Is more than just a MVC framework, it also provides other components such as JDBC templates for persistence management and Security for authentication/authorization.
- Supports dependency injection which eliminates programmatic coupling of dependencies.
- Provides REST support
- Provides multiple view resolution such as Tiles and JSON.
- Easier handler mapping, which also supports annotation based controllers.

## Persistence layer framework

The application requires access to a database which will be the system of records for all transactions and the product catalog.

The following approaches were considered:

1. Hibernate
2. Spring JDBC template

The Spring JDBC Template was selected as the persistence layer framework for the following reasons

- Hibernate was found to be slow for certain SQL operations that required multiple joints.
- The Spring JDBC Template was simple to use as it provided a wrapper around standard SQL.

## Business Component Architecture

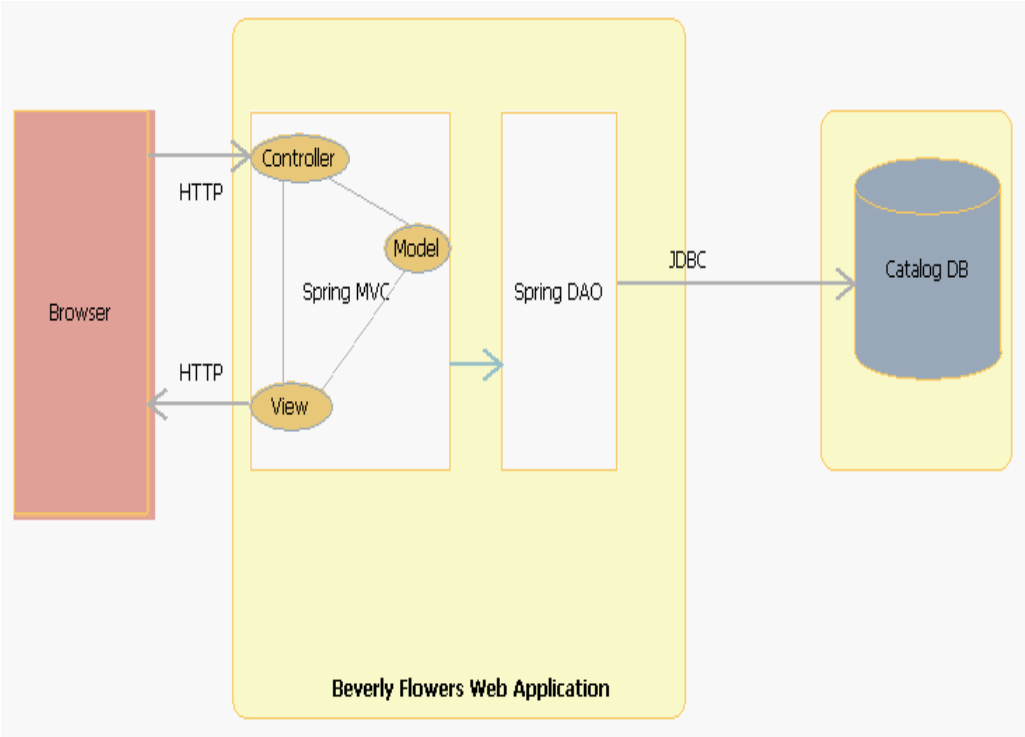


**Figure 1: Component Architecture Diagram**

The business component architecture depicts the components required to build the web application.

- The Model View Controller is built using ‘Spring MVC’.
- The persistence framework is built using Spring Data Access Object (DAO).
- The application will be accessed using a web browser such as Internet Explorer or Firefox.
- A database will be used as system of records to store product catalog, sales data and customer information.

## *Step 3: Setting up the environment*

- The Spring Source website 'www.springsource.com' has a wealth of technical documentation and reference materials that can help an application developer get started with 'Spring'. This includes the different features that 'Spring' encapsulates and also has several sample applications and tutorials.
- The 'SpringToolSuite'(STS) was downloaded from the following link 'http://www.springsource.com/developer/sts'. STS provides the best Eclipse-powered development environment for building Spring-powered enterprise applications.
- The SpringSource site has a variety of sample codes that can be downloaded to suit the requirements of a business. For the purposes of this study, the 'petclinic' project was downloaded from the trunk (https://src.springframework.org/svn/spring-samples/) using subversion and maven. Subversion is the open source tool used for configuration management.
- Apache Tomcat 6.0 was chosen as the server to deploy this web application. Tomcat is a widely used open source application server.
- The downloaded 'petclinic' application was deployed on the tomcat server. The application was then tested to verify how it works. The different components of the application were studied in order to gain an understanding of how they were all wired and configured together.

## *Step 4: Generate Use Cases*

A ‘Use Case’ model describes the functionality of the web application that is to be built. The use case diagram below depicts the features that will be built into the application.

The user cases were created from the customers as well as the employee’s perspective.

1. **Customers of Beverly Flowers:** The customers should be offered the following features on the application:

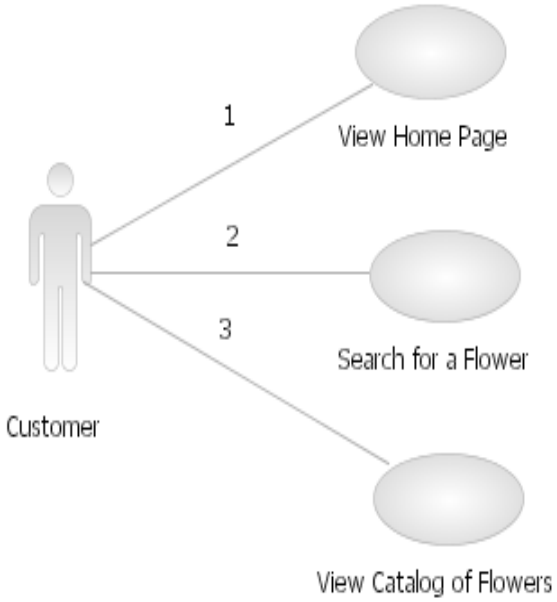


**Figure 2: Use case diagram for Customer**

- **View Catalog**: The customer should be able to view all the flowers that Beverly Flowers offers.
- **Search**: The customer should have the option to search for a flower.
- **Home Page**: This is the main page which gives the customer the option to either ‘View’ a catalog or ‘Search’ for a flower.

2. **Employees of Beverly Flowers:** The employees should be offered the following features on the application:

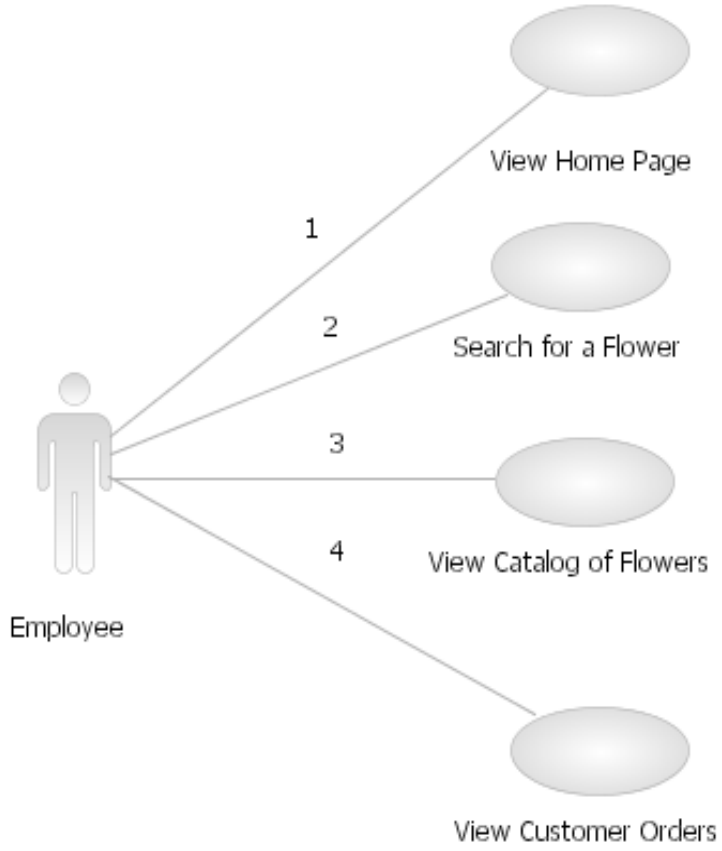


**Figure 3: Use case diagram for Employee**

- **View Catalog**: Employees should be able to view all the flowers that Beverly Flowers has to offer.
- **Search**: Employees should have the option to search for a flower.
- **View Customer Orders**: Employees should be able to view the Customer orders
- **Home Page**: This is the main page which gives the customer the option to either ‘View’ a catalog ,r ‘Search’ for a flower, or ‘View’ the customer orders.

For the scope of this study, the following three user cases for the employee were selected:

- Home Page
- View Catalog of Flowers
- View Customer Order

The next step was to formulate and exercise the model.

## *Step 5: Formulate and Exercise the Model*

The different components of the sample ‘petclinic’ application were studied carefully and then a working model was created using Spring MVC for the three user cases.

**Use case 1-** Home Page:  This is the first page that displays when an employee enters the application

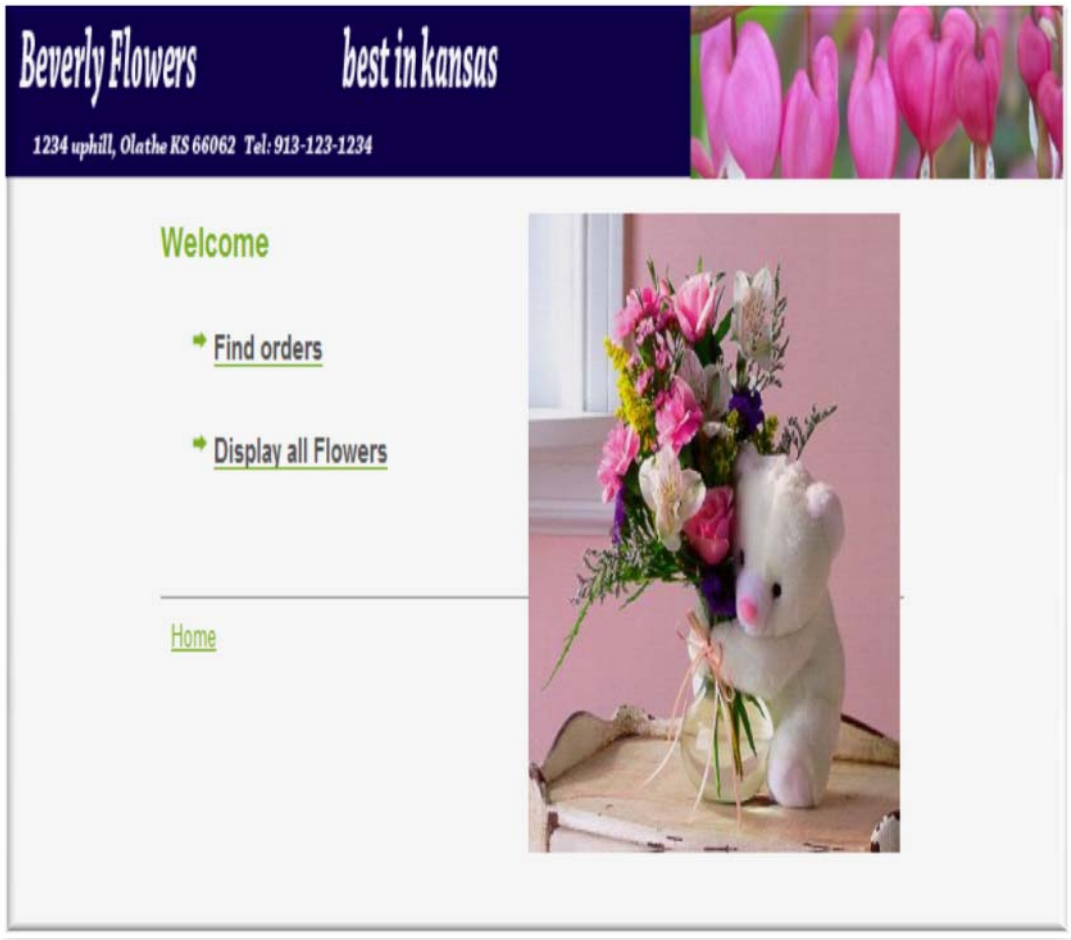


**Figure 4: Home page UI**

**Use case 2-** View Catalog of Flowers: This is the page that displays when an employee clicks on '*Display All Flowers'*

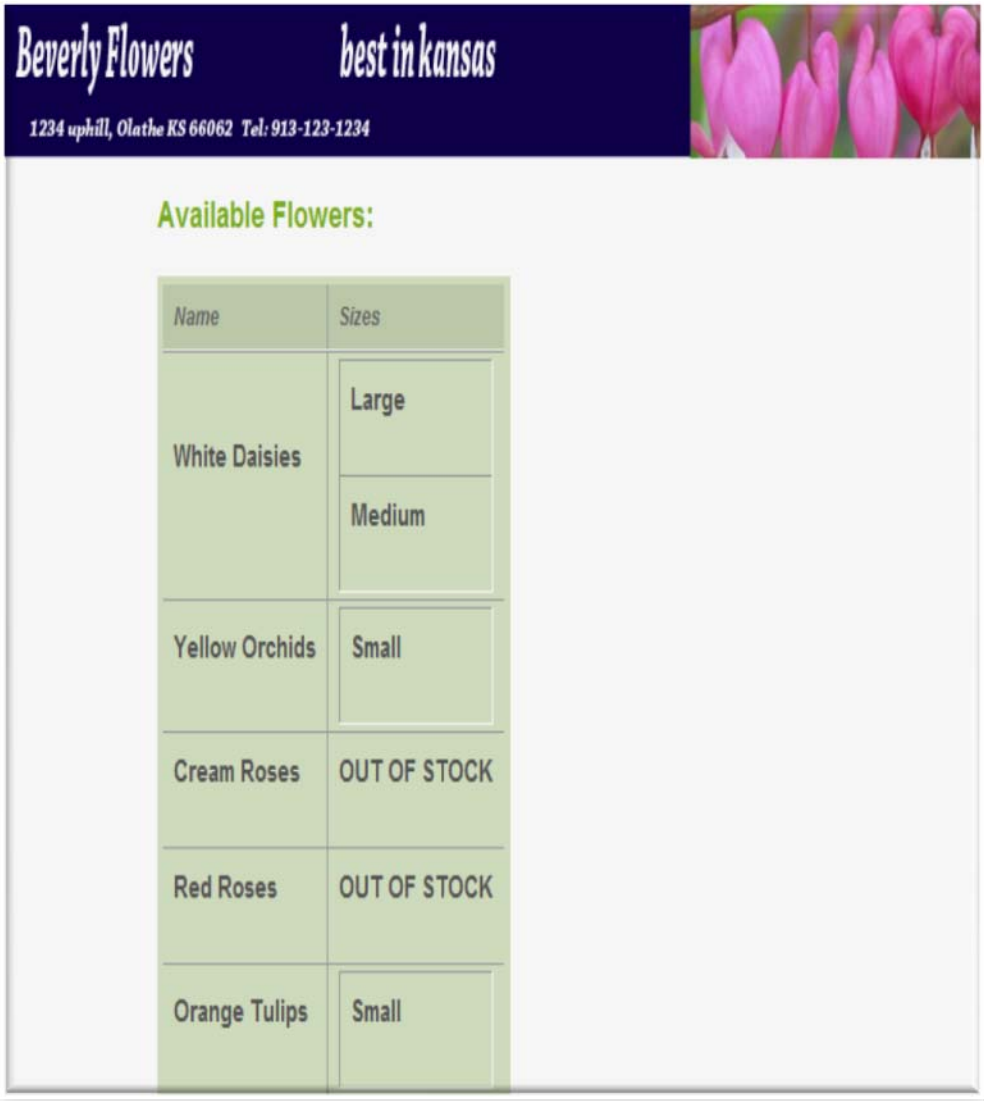


**Figure 5: Catalog page UI**

**Use case 3-** View Customer Orders:  This is the page that displays when an employee clicks on '*Find Orders* '

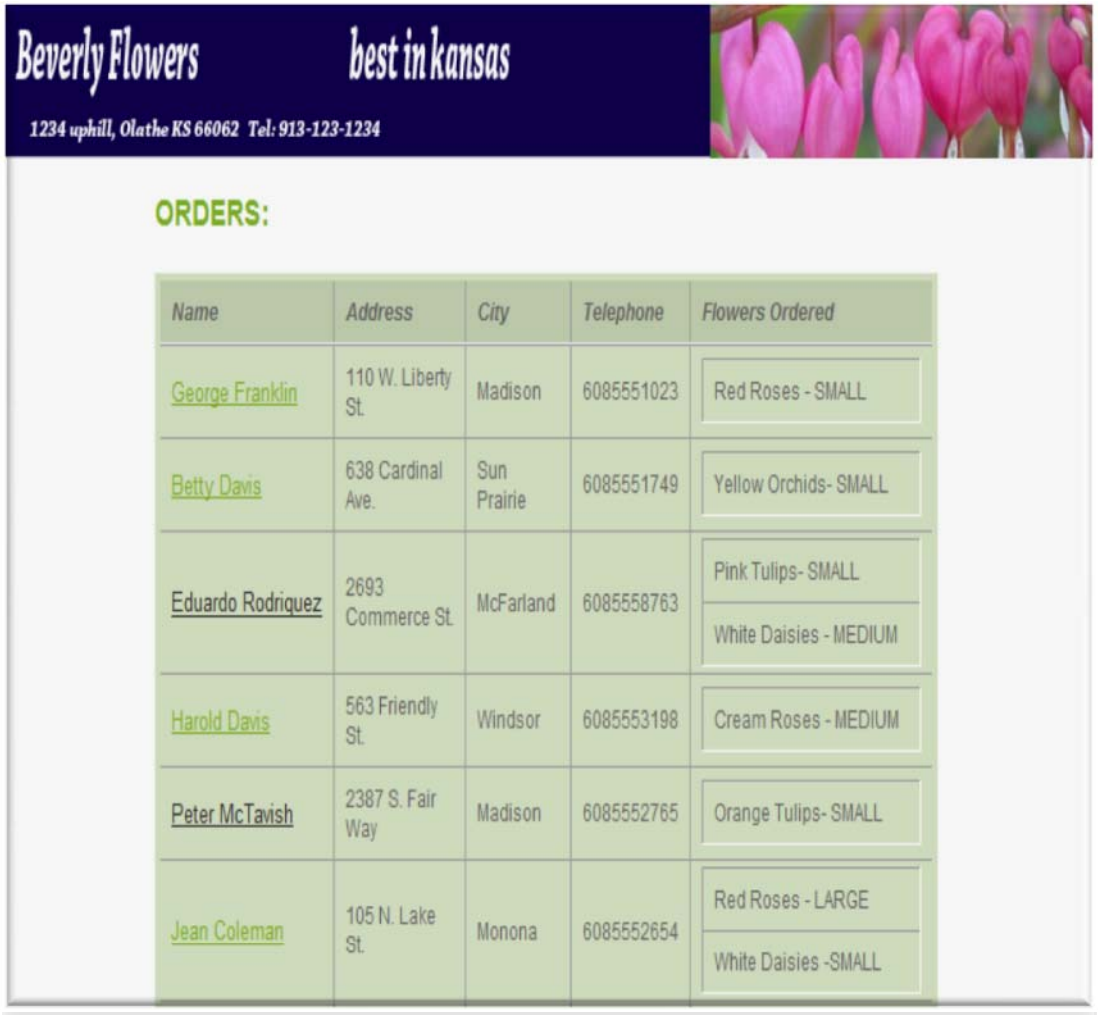


**Figure 5: Customer Order page UI**

# Chapter 4 - Findings and Discussion

The web application model created for ‘Beverly Flowers’ using the Spring MVC approach for the three user cases discussed above was developed by one technical java developer and was accomplished within 8 days. The developer had to spend 4 days reading the related technical documentation and also understanding the different components of the downloaded application. This was a key step before starting to develop the required application.

The application model developed needed far less code written as compared to the other MVC frameworks such as Struts. The reduction of code was particularly noticed in the persistent framework. A lot of repetitive and boilerplate code which is usually written to connect to the database is dramatically reduced by using Spring JDBC. This reduces the time developers need to create web applications.

The working model was created by one developer in 8 days. This could mean that the developer could take 30 days to implement a fully working application. The research showed that far less code was needed to develop the model as compared to plain Java applications.  If the Spring approach to RAD was not chosen, then the company would have to hire at least one more developer to complete the work in the same amount of time. An average java developer charges $50 an hour and the company would have to spend $12,000 on one extra resource. This can be a significant cost saving for an SMB.

The author found that a developer who is new to Spring MVC should have a technical background. Also a developer with prior experience with developing Java applications can quickly come up to speed with Spring MVC. The ‘SpringSource’ site has lot of reference materials for the developer to get started and learn more. Once the developer gets the basic understanding of how the sample application works, it is fairly easy to take that as a template and create new applications.

# Conclusion

Small and medium businesses have to implement strategies that will help differentiate them in the global competitive market. In order to grow and meet the demands of technically savvy customers, it is not sufficient for SMBS to only concentrate on their businesses. It is essential for these companies to also have an IT presence.

SMBs lack financial resources as compared to the larger organizations and have to do a thorough cost benefit analysis before allocation to any IT budget. The key is to be able to deliver a balanced IT solution that is affordable, easily maintainable, productive, increase customer satisfaction, and reduce the total cost of ownership.

Open source rapid application tools can help the SMBs have a web presence within a low budget. Spring MVC is one method that can be adopted by SMBs to rapidly develop web applications. This can be a very productive and efficient way to help these businesses to be on the cutting edge of technology in an extremely cost effective manner.

# Suggestion for additional work

This field project only focused on the Spring MVC method of rapid application development. It would be beneficial to also study ‘Groovy Grails’ which is another project that runs on the Spring framework and it is becoming increasing popular.

The application lifecycle has various categories like requirement gathering, configuration management, software development, software testing, and software implementation. The scope of this field project was on using open source software in the software development category to increase the cost effectiveness of an SMB. It would be beneficial to study what tools and software could be used in the other categories of the application lifecycle.

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