

**Implementing Meteor JS to Create a General-Purpose Website for
SMEs**



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Abstract

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ABSTRACT

Meteor Js core components, principles of Meteor Js, and both the advantages and disadvantages of Meteor Js were well discussed and studied in this thesis. Meteor Js has a higher number of the development community as well as available resources on the official website which gives essential information. The ready-made environment for development and available packages from the core and third-party packages makes the whole web development process seamless.

In this modern era, it is important for every SME to have online awareness to drive growth. Web and mobile applications are mostly used but can be costly due to the limited resources of SMEs. The traditional web development process was discussed briefly and flooded the market with Full-stack frameworks. The use of frameworks enables developers or trainees to facilitate the development process by making it easier and quicker to deploy.

A complete general-purpose website was built with Meteor Js to show how to utilize Meteor Js effectively. The practical aspect of development such as functionalities such as routing from page to page was described in the last part of the report. The files are hosted on GitHub and tested locally.

Keywords Web application, Meteor JS, Blaze, MongoDB, NodeJs.

Pages 42 pages

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Glossary

DDP	Distributed data protocol is used for querying and updating server-side database. It was created by Meteor team.
Node.js	Node.js is a open source, cross platform JavaScript runtime environment built on Chrome's V8 engine.
NPM	Node package manager is online repository for open source Node.js packages and projects.
UI	A user interface is visual part of a software and with-it humans interacts with computer.
MongoDB	Document-oriented database management system. Documents are stored in BSON-format (binary JSON). Maintained and developed further by MongoDB Inc
JavaScript	A high level dynamic loosely typed programming language developed originally by Netscape Communications for creating rich content on the web, maintained now in co-operation by Mozilla foundation and Ecma international.
NoSQL	NoSQL (originally referring to "non SQL" or "non relational") database provides a mechanism for storage and retrieval of data that is modelled in means other than the tabular relations used in relational databases.

1 Introduction

In the modern era of technology, SMEs (Small and Medium-sized Enterprises) often have a long list of technical requirements to support their day-to-day activities. The most common requirement is to set up a website and which can be complicated (Wilson, 2013, p. 110). Primarily web development was based on LAMP(Linux, Apache HTTP Server, MySQL, PHP/Perl) which represents an essential layer of the stack, Java(Enterprise, Spring), and a whole lot of programming languages (Owens, 2006, p. 324) Meteor Js simplifies the web development process by shrinking the scope of requirements.

Meteor Js is one of the modern full-stack cross-platform web, and mobile applications with the solution of different libraries, packages (Node. js), etc. Meteors fundamentals are reactivity, Real-time syncing of data which handles a low data connection to the server through the Distributed data protocol (DDP). The installation process uses a set of simple commands through the terminal that all or most any advanced Linux or Windows users should sail through in a short period. (Hochhaus, 2016, p. 210).

Managing SMEs' resource which are limited is to sign up for an affordable technology solution with low development cost. A technology with all tools required to build and deploy website in good time. Such technology tools acts as a thriving ecosystem of packages and building manager. This thesis focuses on studying the effectiveness of Meteor Js as an option for small and medium-sized companies to create a general-purpose website. It studies the advantages and disadvantages of creating a simple website with a real-time-based application using Meteor Js.

The following research questions were considered.

- What is Meteor Js, and its possible implementation for Small and Medium-sized companies?
- How to utilize Meteor Js effectively for creating websites by SMEs?

2 Web Development Overview

Web development in general is the process involved with building a web application and it focuses on interacting with the browser. The traditional web development involves setting out what the problem is, mocking -up the solution, users' engagement and deciding on tool to be used. This chapter focuses on the technologies related to web development and describe them to understand the practical aspects of the thesis work.

2.1 Traditional Web Development

The LAMP stack is a popular software bundle with open source and basis for web development since the late 1990s, it's one of the oldest and most utilized software methods, supplying all building blocks required to develop , deploy and also maintain the web page.

According to IBM Cloud Learn Hub, 80% of the internet uses open-source programming and software. Commercial competition is enabled through LAMP stack's efficiency and its flexibility. (Education, 2019).

LAMP stack is used worldwide as one of the most common software stacks for web developers. It provides everything needed to run a modern application such as data security, database management, content management and scalability. (Cannon, 2014, p. 62)

LAMP stack is mostly used due to multiple reasons. All LAMP technologies are open source resulting lowest cost of building web applications. LAMP stack efficiencies allow web developers to prioritize development and also concentrate on building the application instead of the process. (Amazon Web Services, Inc., 2022). LAMP stack source codes and technologies are constantly updated and reviewed to retain relevancy and security through its global community. The stack architecture specifies the software components for each layer and developers can replace them as they see fit because its reliable and flexible. For example, they can use another operating system besides Linux as the stack foundation. (Amazon Web Services, Inc., 2022).

LAMP stands for Linux (operating system), Apache (web server), MySQL (database server), and PHP (programming language) are technologies that operates together behind the scenes to develop and deploy a working website.

Linux is the host (Operating System) system and tons of different websites, applications runs on it. Linux is highly different from Windows systems because it possesses powerful and versatile features. (Maxwell, 2016, p. 5). Linux is a modern, stable, multiuser, and multitasking computer environment – provides support to a range of applications and programs that enhance productivity. Its unequaled power, versatility and portability give it great networking capabilities. Linux is compatible with Microsoft and Mac OS, and it comes with free programming tools and languages which enable developers to create their own computer applications or write codes without extra cost (Maxwell, 2016, p. 6)

Linux has a reputation for being very reliable which has evolved into one of the most stable operating systems in the world due to it continuous development by huge network of programmers. The system programmer assigns classes of permissions such as read, write, and execute all to protect Linux file system. (Vardy, 2016, p. 81)

Apache is the most popular HTTP client that enables content through the internet. Developed in 1995, Apache has the legacy of being the initial growth engine of the internet. Many developers ceased this opportunity to build, configure, improve, and refurbish their own modules. (Hernandez, 2019). Apache modular functionality at its core makes it easy to scale even with its enormous amounts of traffic can still be handled with minimal configuration, and unwanted modules can be removed to make Apache more lightweight and efficient. Apache can be deployed on Linux, MacOS and windows accompanying unique features like loading dynamic modules, load balancing, URL rewriting, FTP connections, support HTTP/2, Session tracking, Geolocation based on IP address, http access, Auto-indexing etc. (Hernandez, 2019).

Database Server is used to store and manage databases that are stored on the server and to provide data access for authorized users. This type of server keeps the data in a central location that can be regularly backed up (Grasdal, 2003, p. 53). As it is the machine running database software dedicated

to providing database service which makes it a crucial component in the client-server computing environment. Database servers have several uses such as dealing with enormous amounts of data regularly, managing the recovery and security of the database management systems (DBMS). In addition, it provides concurrent access control allowing many users simultaneously while maintaining security and hiding the DBMS from the clients.

There are many well-known and widely used databases servers such as MySQL, PostgreSQL, Microsoft SQL Server, SQLite, MS Access, SAP HANA, MariaDB, Oracle etc. For instance, Oracle-owned MySQL (Structured Query Language) is regarded as the most open-sourced and most standardized database management system. Its key attributes of speed, connectivity, security, scalability, and usability makes it a preferred option. It functions smoothly alongside other applications. (MySQL, 2022).

PHP Is a prevalent and broadly utilized programming dialect utilized for site improvement, exceptionally strong and experienced programming dialect. It was initially released in 1995 and has developed to turn into one of the favored dialects for site advancement. PHP runs on the server side and is exceptionally secure. Now that it's out in the open, most facilitating organizations give PHP their facilitating bundles. (Goldstein, 2015, p. 7)

PHP stands for Hypertext Preprocessor. It is server-side scripting language which is designed to operate when an event happens withing web pages like, signing up a form. PHP is very powerful, efficient, widely used, cross-platform (runs on Linux, Windows, Mac OS X etc.). it is easy to learn than any other fully featured language like C, Java o Perl. PHP can allow developers to achieve so many like, generating dynamic page content, create open, read, write, delete, and close files on the server, collate form data, send, and receive cookies, control user-access, encrypt data and so much more. (Goldstein, 2015, p. 8)

2.1.1 Developing Web application

Web application generally enables both the server-side and the client-side to interact. This allows the display of result on the client-side whilst programming and storage functions are performed on the server-side. Online purchase, training, bookings are common examples. (Kohan, 2022).

There are two main categories of coding/programming for creating web applications:

1. Client- side development
2. Server-side development.

Client-side development also known as front-end development is used to build the layout, design, interactivity of a website. Client-side development is what is seen and used such as visual aspect of the website, text, drop down menus, filling out form field etc. it does not need interaction with the server hereby reduces load on the server's processing unit. (Saternos, 2014, p. 54). As client-side rendering, there is little to no buffering time for loading a page, time is saved also making the page markedly responsive.

Client-side programmers writes source code for the browser to interpret and there are multiple different types of source code files as listed below (Saternos, 2014, p. 55):

Hypertext Markup Language (HTML) is the universal language of the World Wide Web, which is underneath every website either responsive or static. As a technology standard, HTML has been constantly evolving ever since its introduction in 1993 by Tim Berners-Lee, the original "web developer" and the latest public release is HTML5 (Hartl, 2017, p. 7). HTML source is plain text, which makes it ideal for editing with a text editor of choice. (Hartl, Learn Enough HTML To Be Dangerous, 2017).

Cascading Stylesheet (CSS) and is used for styling and designing of a website making it look gorgeous. The latest version of CSS is CSS3 with different modules which add new features or extends capabilities of features, each module can be developed separately at a different pace. Some

advanced properties allow for more fanciful styling of website such as adding transitions and animations (Chan, 2015, p. 25).

JavaScript is an interpreted programming language, built on the ECMAScript standard. The language is defined as a procedural language based on prototypes, imperative, and dynamic. JavaScript is mainly used as a client-side programming language used as part of web applications, it an improved way to implement user interface and dynamic features. (Blumenthal, 2017, p. 6). JavaScript has lots of merit such as easy implementation, load content into document as at needed, high response interface that improves user experience, test for Principles of unobtrusive JavaScript and help fix browser problems etc. (Blumenthal, 2017, p. 9) .

Large-scale websites make use of **server-side** code to instantly display pre-stored data from a database. This is done via codes such as HTML and JavaScript. This also gives developers opportunity to customize website for individual users. It is sometimes called back-end development. (MDN, 2022)

Server side provides better functionality by storing information and preferences. An example is filling a contact form for continuous use, send notifications and updates through any channel of choice, verification of user's authentication, implementing content management systems, and data security. (MDN, 2022). There are many programming languages, including:

Python is a widely used high-level programming language created by Guido van Rossum in the late 1980s. The language places strong emphasis on code readability and simplicity, making it possible for programmers to develop applications rapidly. Python code resembles the English language which computers are unable to understand. (Chan, 2014, p. 8).

One of the features of Python is its simplicity for beginners to learn, most Python programs require fewer lines of code to perform the same task compared to other languages. In addition, Python comes with an extensive collection of third-party resources that extend the capabilities of the language. As such, Python can be used for a large variety of tasks, such as for desktop applications,

database applications, network programming, game programming and even mobile development. (Chan, 2015, p. 9).

Ruby on Rail is an open source under the permissive MIT License and its cost nothing to use, it effectively creates a domain-specific language for developing web applications. Rails owes much of its success to its elegant and compact design by exploiting the malleability of the underlying Ruby language. (Hartl, 2013, p. 12). Ruby on Rails serves as a foundation for domain specific languages. It can be implemented across all platforms, and has large numbers of plugins, a rich variety of informative sites, and a cornucopia of discussion forums and IRC channels. There is a hundred of open-source contributors, well-attended conferences, and enormous benefits from an unusually enthusiastic and diverse community. (Hartl, 2013, p. 14).

2.2 Meteor a JavaScript Full-Stack Framework

Full stack framework is referred to the entire set of software solutions and technologies deployed to build a website or an application. These frameworks offer a broad range of prewritten components, code snippets, and complete application templates to ease the work of web developers. It basically provides standardized development and design arrangements that can be applied and modified to fit the requirements of your website. (Northwood, 2018, p. 47).

Full stack is both client-side (front end) and server-side (back end) that includes libraries, dependencies, and tools to deploy an effective website. It is beneficial to both developers and companies because they are cost-effective, flexible, fast to develop and deploy. (Hernandez, 2019). There are several frameworks available in the market such as the ones listed below:

- Django (Python Framework)
- Angular (JavaScript Framework)
- React Js (JavaScript Framework)
- Node JS and Express.js (JavaScript Framework)

Meteor (JavaScript) is designed to have a consistent JavaScript API across client and server with a focus on real-time, reactive applications, rapid prototyping, and code reuse. It is powerful and has an unparalleled element of simplicity and elegance (Hochhaus, 2016, p. 3). Meteor allows developer to meet high expectations because it provides all the infrastructure functionality like data subscriptions and user handling, allowing you to focus on implementing business functionality. (Hochhaus, 2016, p. 4).

2.2.1 Meteor Js

Meteor Js is an open-source platform for creating rich web applications entirely in JavaScript. It bundles and provides all required pieces under one umbrella. It consists of Node.js, MongoDB, the actual application code, and a powerful CLI tool that combines the power of npm and make. (Hochhaus, 2016, p. 30). It entails server processes and libraries that allows reactive and powerful web or mobile applications.

Meteor Js contains software and libraries required to create web applications from scratch and are bundled in the shape of smart packages such as reactive UI library (Blaze) etc. Meteor leverages the full power of the event loop which uses a concept called fibers behind the scenes (Hochhaus, 2016, p. 34).

Meteor Development Group started Meteor in the year 2011 and continues to develop, update, and improve it constantly. Furthermore, there is an active community of Meteor.Js developers. In the context of modern web applications, it is state-of-the-art. Using established, proven development design patterns, Meteor takes all the mundane parts of building an app and does them all for you. Therefore, you get to focus on building a solid application without getting bogged down with the usual time-wasting activities, such as writing yet another database interface or learning a new templating engine. (Strack, 2015, s. 12).

2.2.2 Principles of Meteor Js

Meteor Js is for both beginners and experts, it provides all necessary tools to build and deploy web applications hassle free and much faster than other alternatives stacks. It allows same methods to access databases from the client and the server, and all layers from database to template update itself automatically when necessary. (Hochhaus, 2016, p. 121).

Meteor Js is flexible and requires less code (fewer bugs), principles of Meteor Js are as below (Gray, 2015, p. 39). Publication and subscriptions form a WebSocket connection to the server on the page and allows data transfer as at when needed. Once client subscribe to data source, the server sends all documents matching the publications and server watches source for changes to send any matching documents, updates, or deletion documents to the client.

It is possible to develop with One language. JavaScript is one of the most popular programming languages in the world with many use-cases. Meteor allow JavaScript both on server and client which allows context switching. (Meteor Cloud Guide, 2022).

Meteor synchronize both MongoDB on the server as well as MiniMongo in the browser making changes on data happen to database locally, furthermore it uses same transparent API to access the database from client or the server (Meteor Api Docs 2.7, 2022).

Latency compensation feature enables immediate screen update after users change. Client uses prefetch and imitation model allowing communication with databases much faster and gives user additional speed.

Changes on data are automatically saved and reflected everywhere on the app without the need for additional callbacks. All components used update in real time because codes are written in imperative style. (Hochhaus, 2016, p. 39). Meteor ecosystem easily integrates all of it components that are necessary for developing and deploying applications. It unites with all other open-source tools, libraries, databases, and frameworks. (Meteor Api Docs 2.7, 2022). Meteor has a good

documentation and large community, a great place to introduce project and get help on any technical topics or issues. (Meteor Api Docs 2.7, 2022).

2.2.3 Features of Meteor.js

Meteor uses universal JavaScript such as allows the DRY (don't repeat yourself) rule. Same code on the front-end can also be used for the back-end- from the client to the cloud. it handles installation and configuration of libraries, APIs, drivers etc., The power of JavaScript is fully utilized hereby reducing code length and complexity which eventually saves production time. (Hochhaus, 2016, p. 260).

The Custom package Manager features the necessary NPM functionalities, by also keeping incompatibilities to a minimum to avoid breaking chunk of code unnecessary. Meteor's official repository of Meteor packages named as atmosphere.js features more than 2,600 smart packages. (Hochhaus, 2016, p. 263). This built-in package comes with requisite packages for other popular frameworks jQuery etc., which manages pre-processing and custom user authentication for Email, Twitter, Google etc.

Meteor has an attractive good user authentication called Accounts which has powerful built-in support for login using password, Facebook, and other oauth providers. Accounts is tightly coupled with core meteor services to provide great level of security. It can quickly add a user accounts system to any project with just a couple of commands. For example, the following command adds user account

Command 1 Meteor command to add user account

```
Meteor add accounts-ui.
```

Isomorphic APIs that support communication between front-end and back-end makes it possible to run an application's core business logic especially across the model layer and handling both client-server management and server-session management. (Hochhaus, 2016, p. 31). Deploying project is

extremely easy to stage through its efficient cloud platform 'Galaxy', it doesn't just deploy but monitor client applications. Galaxy is a distributed system that runs on Amazon AWS and most large Meteor apps runs on Galaxy because it saves lot of time and trouble. To deploy to Galaxy a sign up for an account and MongoDB database are required. (Meteor Cloud Guide, 2022).

2.2.4 Meteor resources

Meteor community is rapidly developing day by day as well as the available resources and the official website gives essential information. The official Meteor documentation contains documents, tutorials, and references. The tutorial section entails latest Meteor standards and principles, and it covers both web application and mobile application development. (Meteor Api Docs 2.7, 2022).

The robust Meteor discussion forums and Slack responsive community of Meteor users provides active support to its massive extension library. There are free online resources on the web such as book on Meteor JS, YouTube channels, articles, online code playground, where Meteor code can be edited, ran and results shown instantly etc. In addition to the official website, there are other resources by senior developers that helps anyone build from scratch.

2.3 Core components of Meteor JS

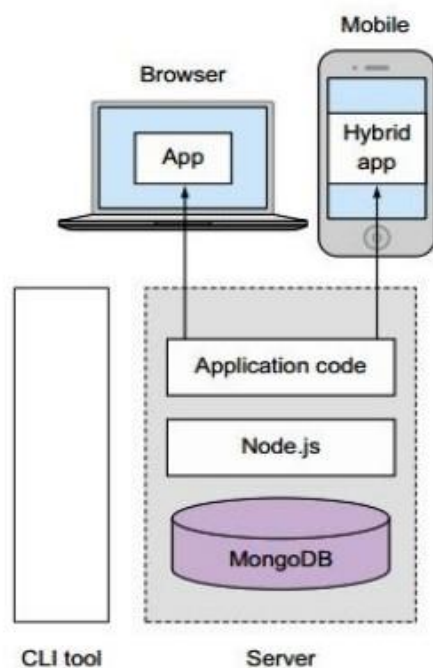
Meteor combines both old and new tools, libraries, standards, services, to provide an entire ecosystem for developing web and mobile application that are a delight to use. It allows the use of common code for both sides (server and client) as well as specific for each (Hochhaus, 2016, p. 131).

Regarding the server side, its specifics are application code, Mongo (DB), a powerful CLI tool that combines the power of npm, and NodeJS (see Fig 1 below). Applications code runs sequentially (top to bottom) and can as well take advantage of many packages that provide functionality, such as OAuth logins, reactive UIs, and request routing (Hochhaus, 2016, p. 368).

CLI tool manages the package (Adding and removing packages) and the entire building process. It gathers and compile source files such as mapping, minification and resolving dependencies. CLI tool runs Meteor stack in the background, app deployment and other common tasks. (Hochhaus, 2016, p. 368).

“NodeJS is an open-source and cross-platform JavaScript runtime environment. It uses a single thread to avoid unnecessary multithreaded environments. Set of asynchronous I/O primitives in its standard library prevents JavaScript code from blocking. The libraries in Node.js are written using non-blocking paradigms, making blocking behavior the exception rather than the norm” (Node JS Dev, 2022).

Figure 1. Meteor stack application powered by smart packages on Node.JS and MongoDB (Hochhaus, 2016, p. 368).



2.3.1 Server

As seen from Figure 1 above. The server is where Meteor JS is installed on top of Node.js. Meteor JS, on the server, is connected to MongoDB that is the default database for the framework. Code to be executed on the server-side of the application and to initialize the MongoDB data are contained in the server. Server creates publication and handles data management setting data to be publicly available for client-side (Jebin, 2015, p. 56).

MongoDB is an open cross-platform document-oriented DBMS. it's a NoSQL database and the only main data storage for Meteor. NoSQL database contrasts with relational (SQL) database. Each record is a document. A set of documents is called a collection that is equivalent to a table in a SQL database (Jebin, 2015, p. 15). MongoDB is JSON-based which makes it extremely fast and scalable. When the server starts, a dedicated database server also starts that listens on port 3001 (Hochhaus, 2016, p. 332).

MongoDb document has support for primitive data types boolean, number, and strings and other common data types such as dates, timestamps, regular expressions, and binary data. Mongo object is used to declare new database collections (MyCollection) and it must be announced:

Command 2: To declare a new database collection

```
MyCollection = new Mongo. Collection("mycollection")
```

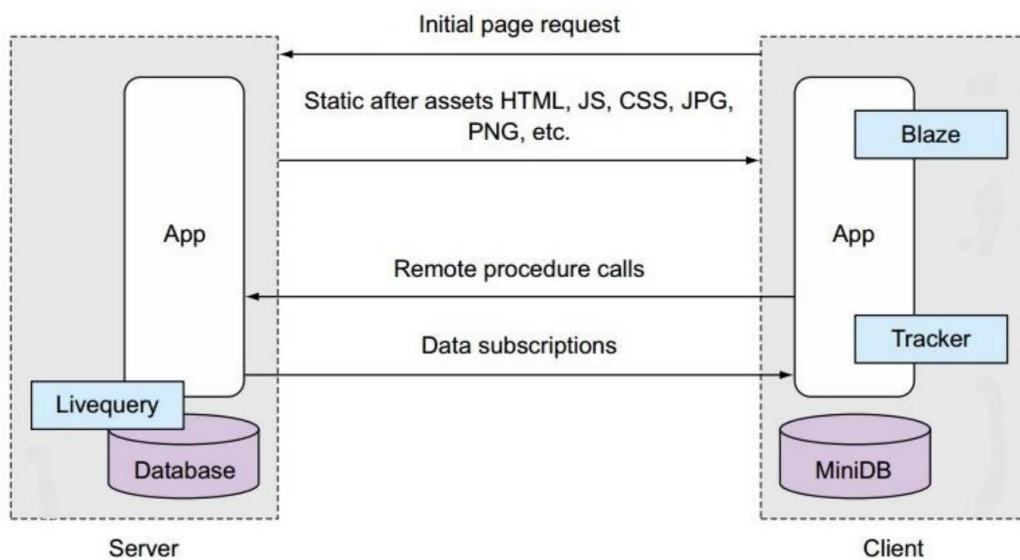
Meteor need a way to push changes initiated by one client to all others without needing a refresh button. According to Figure 2 below, live query detects changes in the database and pushes all changes out to the clients currently viewing affected data. Live query knows when to poll the database as all the write operation to the database go via Live query.

Communication occurs when data is transferred between the server and the client through a standardized protocol called Distributed Data Protocol (DDP). Applications running on both client and server rely on this to exchange data.

DDP is a key property of Meteor. It forms the basis for reactive functionality i.e., it helps to send data over web sockets bidirectionally with additional requirement of encapsulating documents. It is a standard approach to solving the biggest problem facing client-side JavaScript developers: querying a server-side database, sending the results down to the client, and then pushing changes to the client whenever anything changes in the database. (Hochhaus, 2016, p. 15).

DDP not only provides a transport layer but a full solution for communication in both directions. it supports remote procedure calls and subscribing to set of documents where server continuously keep the client updated

Figure 2. Communication channel between the server and the client (Hochhaus, 2016, p. 14)



2.3.2 Client

Data Management solution are given across client side of every application, code loaded for the client is executed in the browser or any other device. Client acts as more of a display to the user. Some of the Meteor principles uses prefetching and model simulation on the client through MiniMongo, Tracker, Blaze. (Hochhaus, 2016, p. 16).

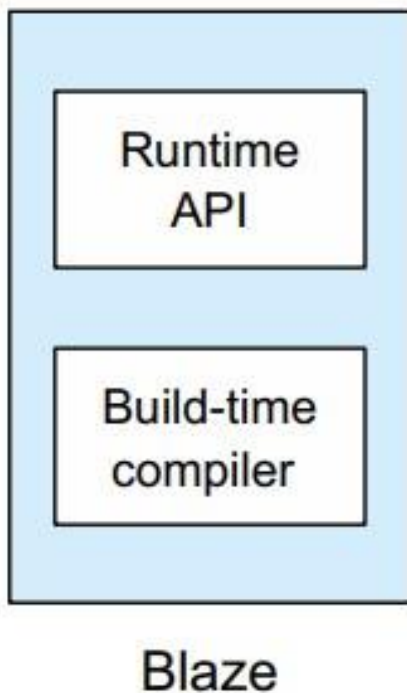
MiniMongo perfectly emulate a subset of MongoDB where CRUD (insert data, remove data, search, sort, update) with the MongoDB APIs. It is temporary data storage at the client-side which prevents providing client-server communication. Generally, MiniMongo is used to create collection which is a cache of the database. All changes made are reflected on the browser or UI based on the data in MiniMongo. (Jebin, 2015)

Tracker is a simple convention that grants reactive data sources (database), it achieves reactivity by setting up a reactive context with dependencies between data and functions, invalidating the given context whenever data changes and re-executing functions (Strack, 2015, p. 50). The foundation of platform's security lies on the tracker package to build, track dependencies, and manage computations. Meteor rerun templates and other computations when session variables and other queries changes through tracker package.

Blaze is built-in reactive rendering library and one of its parts is the templating language spacebars. The official documentation describes Blaze as a "reactive jQuery," a powerful library to update the DOM (Hochhaus, 2016, p. 39). Blaze re-renders only small fragments inside a template and not the entire page when content changes. It is responsible for processing templates and is an important part of what's often referred to as the magic of Meteor. (Hochhaus, 2016, p. 78).

Blaze consists of two major components: A runtime API and A build-time compiler. As shown in Figure 3, the function of runtime API is to render elements, keep track of their dependencies and update them through their complete life cycle as changes occur. The build-time compiler deals with HTML directly and both components work separately and quite possible to bypass the build-time compiler (Hochhaus, 2016, p. 54).

Figure 3. The Blaze components. (Hochhaus, 2016, p. 78)



2.4 SME Definition

Small and medium-sized enterprises (SMEs) have been defined by European Commission as entities engaging in economic activities with headcounts greater than 10 and lower than 250. They are classified into micro, small and medium, depending on set criteria. (European Commission website, 2021)

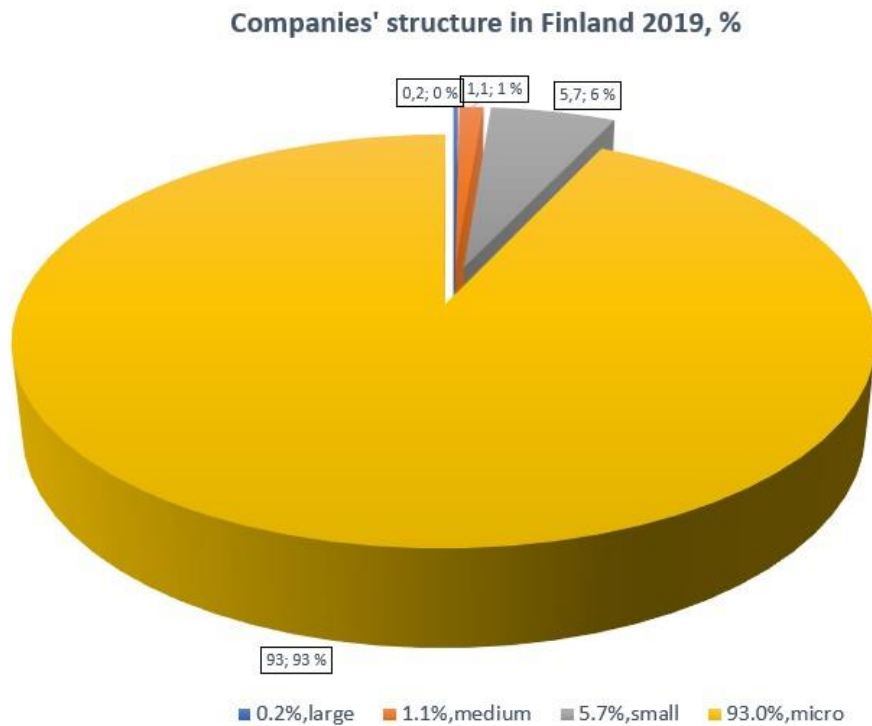
The classification of micro, small and medium-sized enterprises (SMEs) is shown in Table 1. it is made up of enterprises that employ less than 250 headcounts and have an annual turnover of not more than EUR 50 million. the annual balance sheet total not exceeding EUR 43 million According to the extract of Article 2 of the annex to Recommendation 2003/361 EC. (An initiative of the European Union, 2022). The number of employees is based on the number of full-time workers employed over the course of the year. Other employees like seasonal workers or part-time employees considered proportionately while trainees or interns are not considered. (European Commission website, 2021).

Table 1. Classification of SMEs

Company category	Staff headcount	Turnover or Balance sheet total	
Medium-sized	< 250	≤ € 50 m	≤ € 43 m
Small	< 50	≤ € 10 m	≤ € 10 m
Micro	<10	≤ € 2 m	≤ € 2

According to the Statistics of Finland, 2019, as shown in figure 4, the largest share of companies (93%) belongs to micro-enterprises with (1-9 headcounts), small business (5.7%) with (10-49 head counts), medium sized companies (1.1%) with (50-249 head counts) and lastly, large companies (0.2%) with over (over 250 head counts).

Figure 4. Companies' structure in Finland (Kokoshyna, 2022).



Examples of Finnish SMEs are Conmio Oy with last funding of 1.4M EUR, NonStop Games with last funding of 2.2M EUR. (Helsinki Partners, 2013).

2.5 Requirement for SMEs website

SMEs Websites are used as a form of advertising and poaching potential clients or customers to know more about the companies' services or products. To ensure website produces results, there are qualities and requirements to be considered such as (Thelwall, 2013).

The goal of **web visibility** is to get SMEs website ranked in the main search engines like google, Yahoo or Bing. These three search engines account for over 80% of the entire search engine traffic. Attention to details and use of simple language in SMEs web content will help search engines identify SMEs web and rank it at the top and tends to increase brand awareness, generate more traffic, sales, and growth rate. (Schmuck, 2015).

The **ease of use** is an integral part of seamless experience resulting visitation satisfaction, and this can be achieved through simplicity, consistency, guidance, direct feedback, valuable information architecture. Content must be well laid out and information should be easy to follow. The Navigation menu should not be overwhelming with many options. (Schmuck, 2015).

The **design quality** should be appropriate to the goal of SMEs. Logos, stylistic choices of brand messages should not be contradicting, inferior quality images/photos, uncoordinated colors should also be avoided. The best designs should align with SMEs brand, create positive impression for customers.

SMEs website needs to be checked regularly for issues, mistakes and keep-up on relevant information. This needs to be done on a consistent basis to keep website healthy, encourage continued traffic growth, and deliver positive user experience. (Schmuck, 2015).

Designing and developing SMEs website should not only consider the quality of website, but also the requirements to develop a website that delivers SMEs goals such as wooing potential customers, domain name, Web hosting, Business email address, Web Development tools and deployment process. (Thelwall, 2013).

SMEs starting up and appearing on the internet needs a **domain name** which are linked to respective IP addresses. It is equivalent of a physical address which help users find SMEs website easily instead of using its internet protocol (IP) address. Domain name consists of a name and an extension are a key part of the internet infrastructure.

A well thought out domain name will communicate SMEs business in a way that aligns with the brand and mission of the SMEs. A memorable domain name and relevant keywords will positively impact SMEs search engines as mentioned earlier, it also allows SMEs create unique and professional email accounts. (Balanco, 2022).

Web Hosting is an online service that allows SMEs to launch their website on the internet, this service allows SMEs rent space on a physical server to store all of its files and data. Finding a dependable provider and choosing a hosting plan is crucial to the success of SMEs internet appearance, because this web hosting service makes sure that SMEs website content is successfully transferred from the server to the website while also safeguarding the data from any potential malware attacks. Choosing the hosting type depends on factors such as the SMEs budget, level of technical knowledge, cloud hosting etc. (Balanco, 2022).

Web Development Tools is also known as DevTools and are programs that allows SMEs developer to build, test, debug their code on web development projects. It allows developers analyze the performance of code and make necessary improvement on website. Choosing DevTools, developers need to consider factors such as scalability, ease of use, security, functionality, and budget etc. (Sebastianz, 2022). There are tons of web developer tools such as Vue, Ruby on Rails, Ember, Meteor Js, Angular, Atom, TypeScript etc.

Deployment is the process of deploying code from choice of DevTools from source to hosting platforms. Web deployment enables developer package SMEs web site content, configuration. This process can either be manual or automatic but preferably automated to eliminate human error. Web deploys included key features like, package web site and applications, delegate deployment tasks to non-admins and simplify deployment for administrators, (Microsoft, 2022).

3 Effectiveness of Meteor Js to SMEs

Out of all DevTools available to developers, considering the cost, scalability, ease of use, security, functionality, budget, and effectiveness of such is essential to SMEs. Meteor Js can be an extraordinary boon for SMEs because it is based on the principle of distributed application platforms which is of great benefits (Hochhaus, 2016, p. 14).

Meteor offers all tools required to build applications for different platforms and its regarded as one-stop shop for developers and makes it much easier to get started with than any other frameworks and more are listed below. (Hochhaus, 2016, p. 44).

3.1 Advantages of utilizing Meteor Js

SMEs do not need to employ back-end and front-end developers separately because Meteor Js developers can develop both sides of code by themselves since the server and client both share the same code. Costs can also be saved through time spent on less code which is easy to refactor or fix the code. (Gray, 2015, p. 27). Meteor Js renders quality, stability, and elegance in coding with the use of a single language that permeates the entire platform. Web site built with Meteor Js requires lesser code resulting to fewer bugs and offers higher quality results (Meteor Api Docs 2.7, 2022).

Meteor's communication is based on WebSocket, it gives the real-time effect and makes it suited for real time chats, online games, or power the internet of things. Full stack enables changes made to appear across the database, style templates and immediate update are visible on user interface without the page being refreshed. (Hochhaus, 2016, p. 45).

Meteor Js frameworks uses a single language across the entire application stack, a protocol designed for data exchange, a simple unified APIs, an efficient and robust ecosystem of packages which removes the need for additional JavaScript frameworks such as AngularJS and this translates to development speed. (Hochhaus, 2016, p. 30)

The official solution for packaging which is built into the CLI tool makes the meteor packing system different altogether from the rest of the frameworks. There are tons of package's systems which makes it easier and quicker to achieve SMEs results. SMEs time and resources can be saved through the conveniences offered through built-in-packages. (Hochhaus, 2016, p. 23).

Open-source: Meteor Js being an open-source offers freedom and flexibilities in developing SMEs web applications. SMEs can use Meteor JS platform free of cost and choose best solution for SMEs vision or idea. (Meteor Api Docs 2.7, 2022).

3.2 Disadvantages of Meteor Js

Meteor Js is yet to prove itself in production environments in respect to search engine rankings. It lacks server-side rendering facility, which is much needed for search engine optimization tasks, server-side rendering is needed to improve the page load time. (Hochhaus, 2016, p. 179).

Meteor Js officially supported database is MongoDB and selecting data from different collections and joining it to other particular property will require external package tricks from community packages and this makes the development process more time consuming. (Hochhaus, 2016, p. 22).

Various clients libraries useful for different projects are used for compensation due to the absence of native widget library. Bootstrap is an example of this. (Covetus the soft impact, 2022). Processing intense applications: Meteor Js cannot manage an application which relies on heavy processing such as data-crushing extract, transform and load (ETL) jobs. Meteor Js is built on NodeJS which process is single-threaded is harder to take advantage of fast multiprocessor capabilities. (Hochhaus, 2016, p. 21).

4 Meteor Implementation

Meteor Js is also known for its command-line tool, and a self-contained installation which does not require any other software to be installed. All that is needed such as NodeJS and MongoDB will be placed in the right section. Below are currently supported platforms for Meteor JS (Meteor Api Docs 2.7, 2022)

- Mac OSX 10.6 and above
- Linux (86 and x86_64 systems)
- Windows

The following are useful command lines for implementing Meteor projects:

Command 3: To get help from the Meteor command line

```
Meteor help
```

Command 4: To run the Meteor application

```
Meteor run
```

Command 5: To create a new Meteor project

```
Meteor create
```

4.1 Development Environment

The practical part of this paper is to demonstrate Meteor's features and development process for general-purpose website for SMEs and create presence online for prospects and customers. This website project is named sm-oy, an agricultural consult helping food companies and organizations navigate trends and modern technologies. It entails home page for all service rendered by sm-oy, about page and contact us page.

The first step is to set up the development environment by installing necessary tools such as PhpStorm, Meteor Installer, Git Version control etc., on Windows 11 Home edition, as the development progresses, the required packages will be installed and lastly it will be evaluated and

save on Git. The PhpStorm (student version from JetBrains site) text editor will be installed to write source code while Git version control to control the different version projects.

At the beginning of the development, Windows CLI will be used to create the project, run the project before transferring to the code editor. The latest version of Meteor, version 2.7.3 is downloaded from the official site while referring to Meteor documentation for guidance.

4.2 Creating Meteor Projects

After setting up the environment, a Meteor project was created which was simple and fast to implement. As shown in Figure 5, a project named sm-oy shows the initial stage of creating and launched using the terminal. During the creation, a boilerplate application was set up by Meteor which can run without any further setup. The figure 5 below shows the application is running on the local machine at <http://localhost:3000/> and can also be stopped typing Control-C twice.

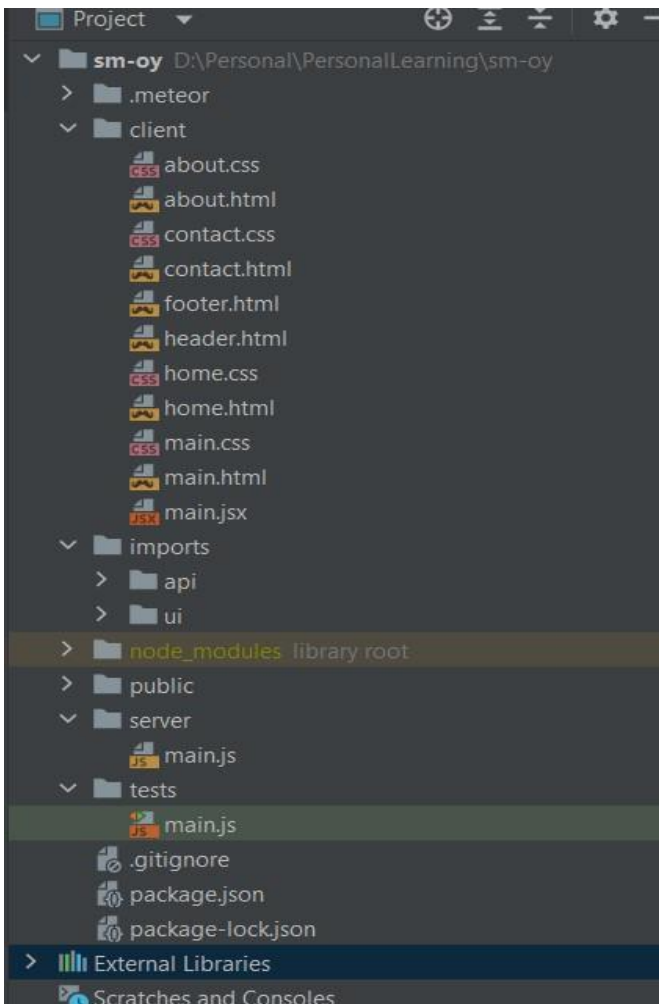
Figure 5. Creating a meteor project called sm-oy

```
1 C:\Users\Enny\Desktop\sm-oy>meteor create sm-oy
2 C:\Users\Enny\Desktop\sm-oy>cd sm-oy
3 C:\Users\Enny\Desktop\sm-oy\sm-oy>meteor run
4 [==== C:\Users\Enny\Desktop\sm-oy\sm-oy ]====
5 => Started proxy.
6 => Started HMR server.
7 Browserslist: caniuse-lite is outdated. Please run:
8   npx browserslist@latest --update-db
9   Why you should do it regularly: https://github.com/browserslist/browserslist#browsers-data-updating
0 Browserslist: caniuse-lite is outdated. Please run:
1   npx browserslist@latest --update-db
2   Why you should do it regularly: https://github.com/browserslist/browserslist#browsers-data-updating
3 => Started MongoDB.
4 => Started your app.
5
6 => App running at: http://localhost:3000/
7   Type Control-C twice to stop.
8
9
```

4.2.1 Application Structures

Meteor application has a default file structure, Figure 6 below represents the structure of sm-oy project which contains HTML, JavaScript and CSS files, the imports and public folder are also created by default once Meteor Js is installed. Images, logo that are used in sm-oy projects are stored in the public folder both on client and on the server. The import folder contains subfolders such as API, LIB and UI. The lib folder entails the router that enables interactive between home page and others. HTML, JavaScript files are housed by Ui and CSS files are in the client folder. Figure 6 shows the overview of sm-oy website structure.

Figure 6. Overview of the application structure of sm-oy project.



4.2.2 Packages

Meteor functionality extends to the use of thousands of packages which is available through its community all through the development stage. A package or package.js file consists of three sections – basic description, package and test definitions. (Meteor Api Docs 2.7, 2022).

The package server entails both core packages which are created by the Meteor Development Group (MDG) and community packages contributed by other organizations or individual developers. Most of the packages have a prefix that identifies the maintainer such as twbs, prefix as this are community packages, while those without prefix are provided and maintained by the MDG. The command `meteor add packagename` adds different meteor core packages to meteor project and `meteor add packagename thirdPartyName` (community packages). Examples are bootstrap, iron router from community etc., shown in Figure 7 below list of packages in the application, command line used was `meteor add twbs: bootstrap`.

Figure 7. list of packages added to sm-oy project.

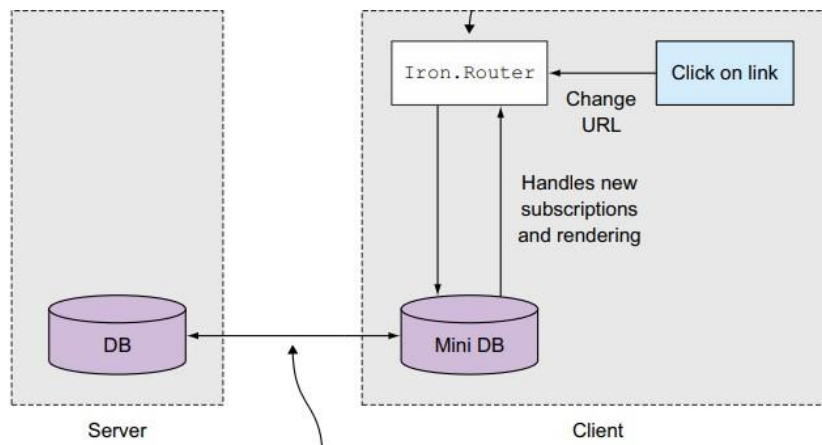
```
D:\Personal\PersonalLearning\sm-oy>meteor list
autopublish          1.0.7 (For prototyping only) Publish the entire database to all clients
blaze-html-templates 2.0.0 Compile HTML templates into reactive UI with Meteor Blaze
bootstrap            1.0.1 Front-end framework from Twitter
ecmascript           0.16.2 Compiler plugin that supports ES2015+ in all .js files
es5-shim             4.8.0 Shims and polyfills to improve ECMAScript 5 support
hot-module-replacement 0.5.1 Update code in development without reloading the page
insecure             1.0.7 (For prototyping only) Allow all database writes from the client
iron:router          1.2.0 Routing specifically designed for Meteor
meteor-base          1.5.1 Packages that every Meteor app needs
mobile-experience    1.1.0 Packages for a great mobile user experience
mongo                1.15.0 Adaptor for using MongoDB and Minimongo over DDP
react-meteor-data    2.5.1 React hook for reactively tracking Meteor data
reactive-var         1.0.11 Reactive variable
shell-server         0.5.0 Server-side component of the 'meteor shell' command.
standard-minifier-css 1.8.1* Standard css minifier used with Meteor apps by default.
standard-minifier-js 2.8.0* Standard javascript minifiers used with Meteor apps by default.
twbs:bootstrap       3.3.6 The most popular front-end framework for developing responsive, mobile first projects on the web.
typescript           4.5.4 Compiler plugin that compiles TypeScript and ECMAScript in .ts and .tsx files
```

4.2.3 Routing

Routes is the best way to handle the publications and other dynamic experience from page to page. Iron.Router is a community package maintained by Chris Mather and Tom Coleman (Hochhaus,

2016, p. 176). Figure 8 below describes the router handling all functionality and exploring different pages on our application.

Figure 8. Iron.Router listens for changes in URL and performs actions defined. (Hochhaus, 2016, p. 177).



The interface for configuring the router from home page, contact page and about page are seamlessly set out. As shown in Figure 9 below, routes are created for the client and will run in the browser such that when user navigates to the url '/' the route will render template named 'home' onto the page. The next route will automatically render a template named about to the page etc.

Figure 9. Multiple pages router.

```
1 import React from 'react';
2 import { Meteor } from 'meteor/meteor';
3 import { Router } from 'meteor/iron:router';
4 import { render } from 'react-dom';
5 // import 'bootstrap';...
6
7 import ...
8 Router.configure({
9   layoutTemplate: 'masterLayout'
10 });
11
12 Router.route('/', {
13   name: 'home'
14 });
15
16 Router.route('/about', 'about', {
17   name: 'about'
18 });
19 Router.route('/contact', 'contact', {
20   name: 'contact'
21 });
22
23 Meteor.startup(() => {
24   render(<App/>, document.getElementById('react-target'));
25 });
```


5 Results

One of the objectives of this paper was to utilize Meteor Js framework effectively by creating websites for SMEs, its possible implementation of functionality, and providing a responsive web application within SMEs resources. SMEs resource are limited and so an alternative to developing a native application is needed. Meteor Js is a great platform offering good tools to develop websites for SMEs such that SMEs can employ an intern to take up the development. The environment support with all that a trainee will need to develop quickly and deploy.

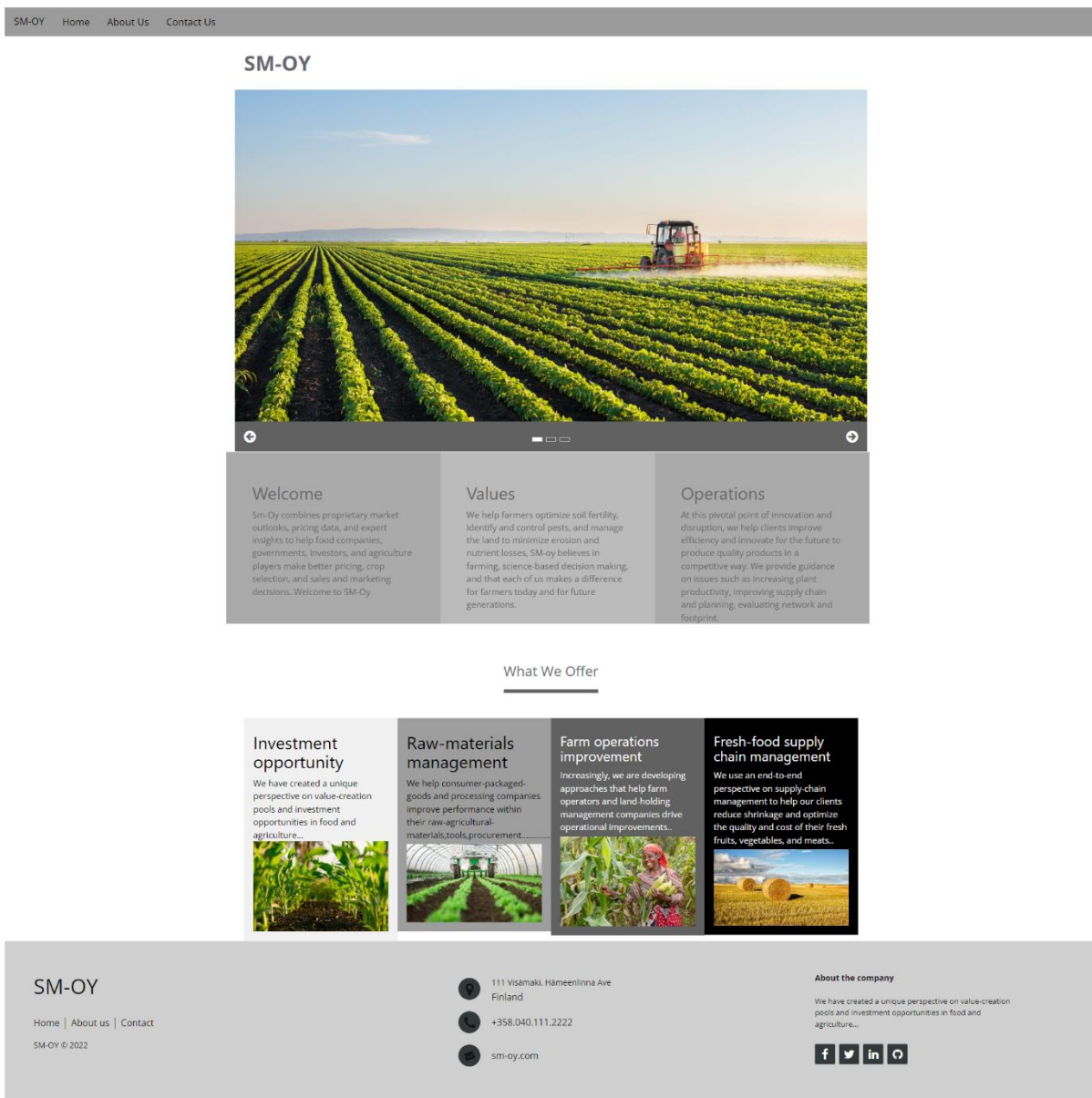
Meteor Js provides an environment that support both trainees and an experienced developers to attain development process quickly, the latest technologies and file structure offers swift development and reliable end-product. Packages from both Core or Community(third-party) such as bootstrap, iron router makes both front-end, back-end and user experience achievable. MongoDB a NoSQL database makes data storage fast and scalable for Meteor Js. All these technologies and advantages of Meteor Js as explained in sub section 3.1 makes Meteor Js a better option for SMEs.

SMEs and trainees can take the opportunity of saving cost on employing a full-stack developer and later hands get dirty by gaining experience needed for future. The use of different technologies embedded in Meteor Js framework increases the cost savings, saves time as against developing such quality website in traditional deployment tools.

Finally, Meteor Js framework needs few improvements in respect to its server-side rendering which will allow more adaptation by developers. There are roadmap showing that someday Meteor Js framework will support SQL database (Hochhaus, 2016).

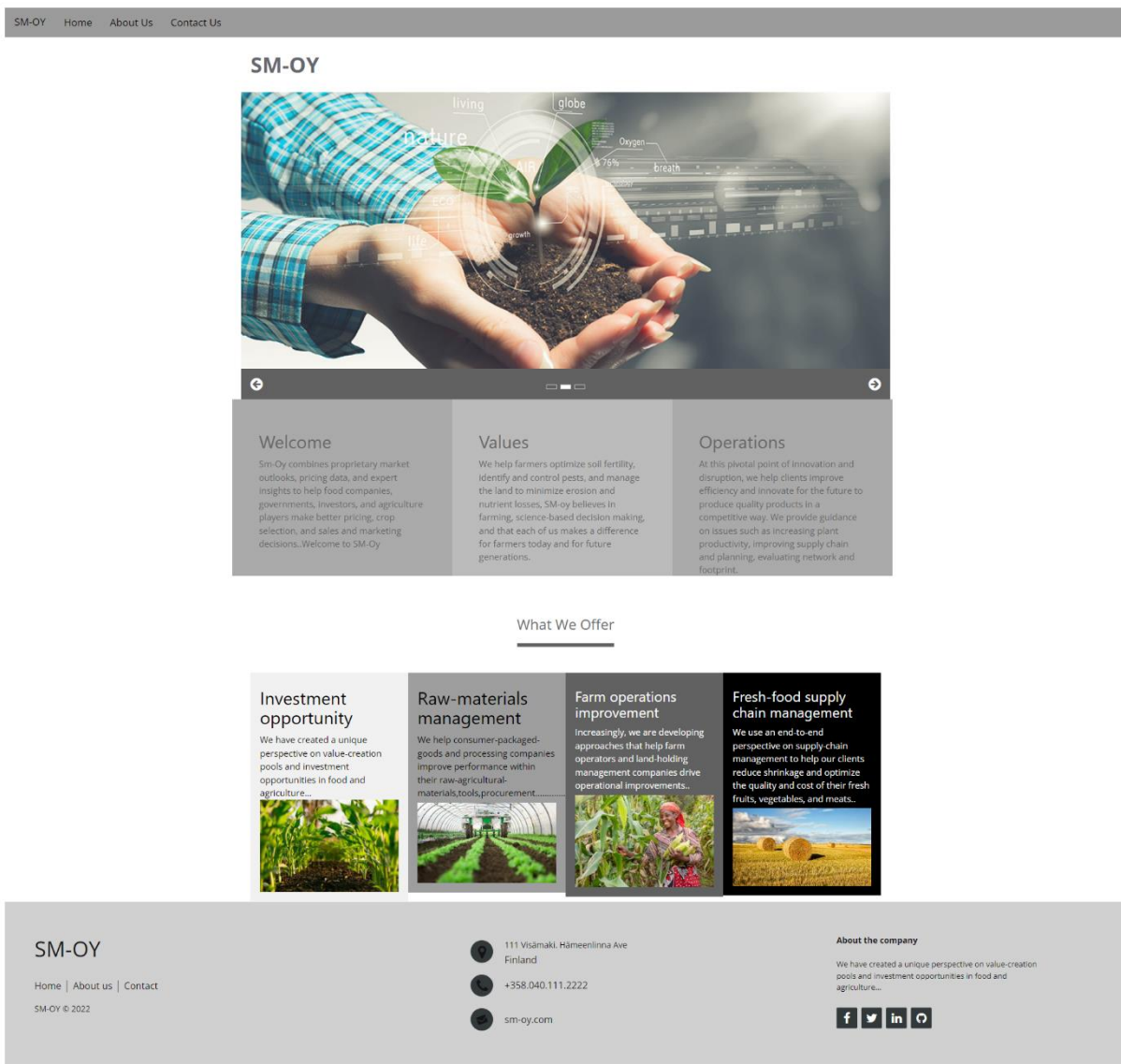
The source code is available at this GitHub repository: <https://github.com/EnnyMautin/sm-oy.git>

Figure 10. SM-Oy Home page with first slide.



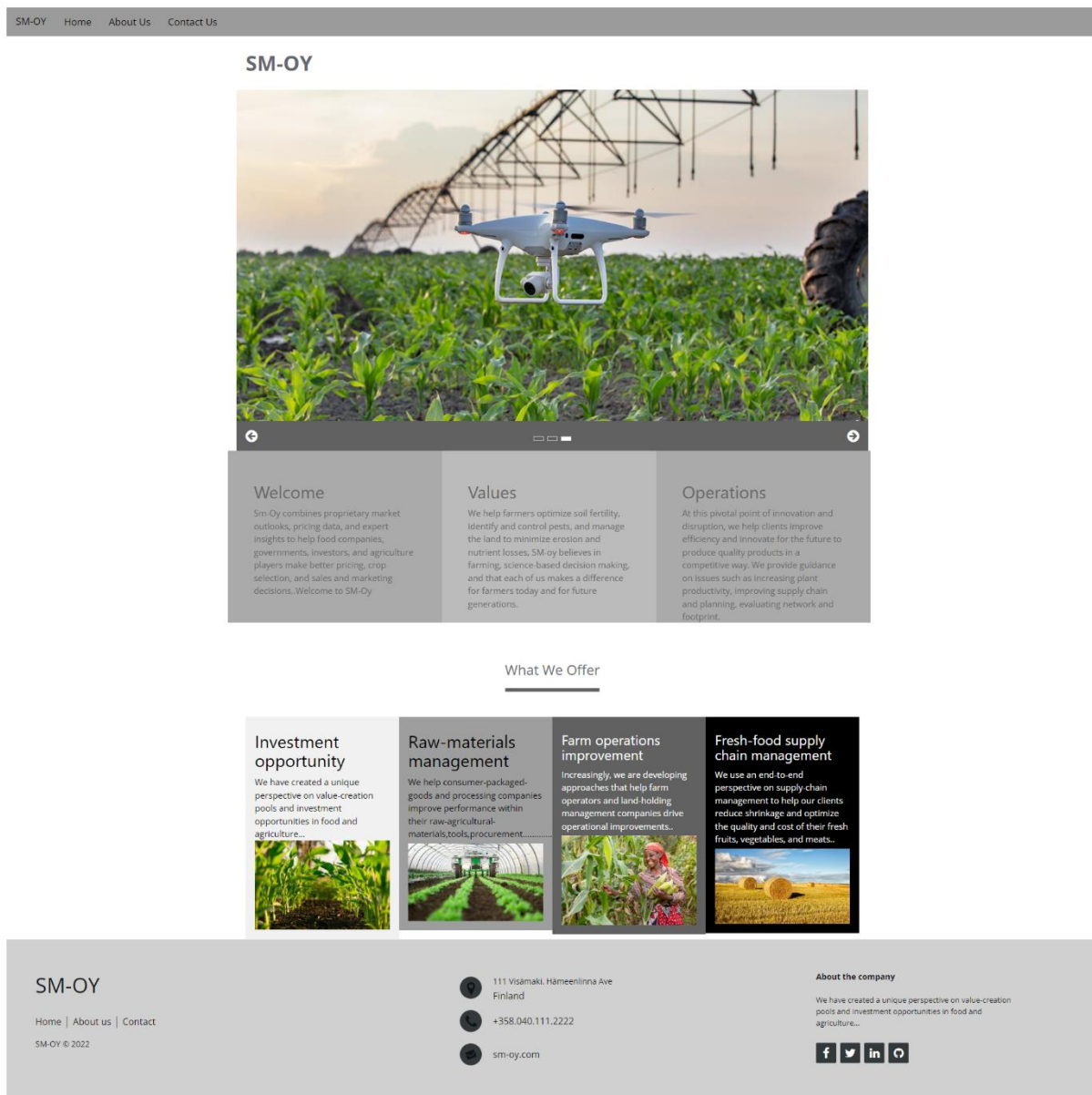
Home page as shown in figure 10 above, welcome clients with the welcoming speech, its core values, and operations. SM-Oy offers Investment opportunities, raw-materials and technologies managements, and clients can take advantage of how to improve farm operations and fresh food supply chain management.

Figure 11. SM-Oy Home page with second slide



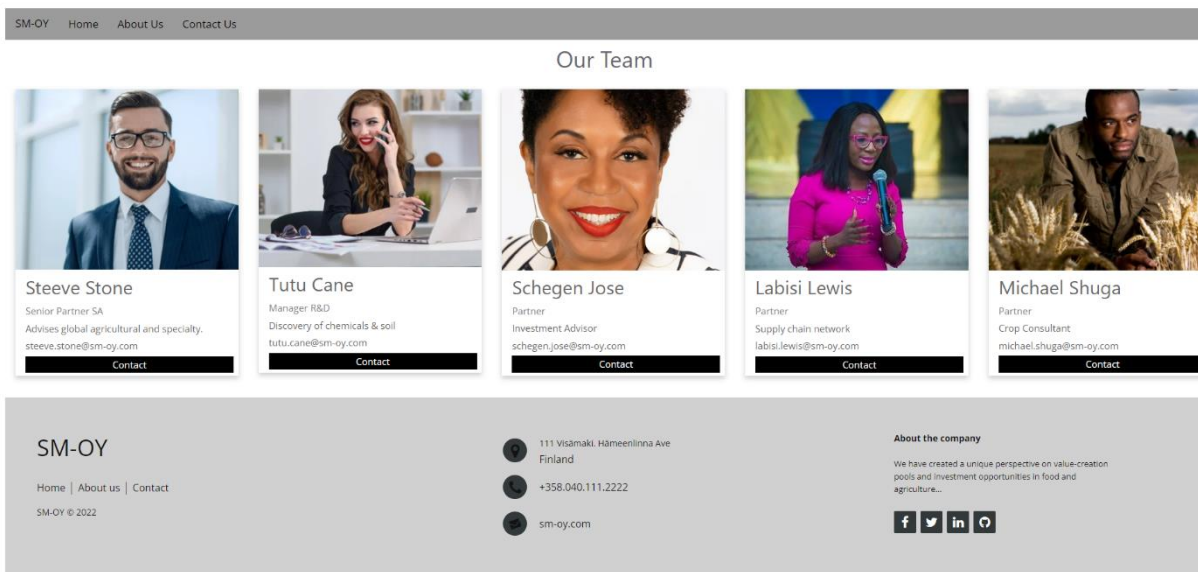
This shows continuation of home page with different slide of soil testing and planting. Figure 11 above shows soil testing and one out of all SM-Oy services.

Figure 12. SM-Oy Home page with third slide



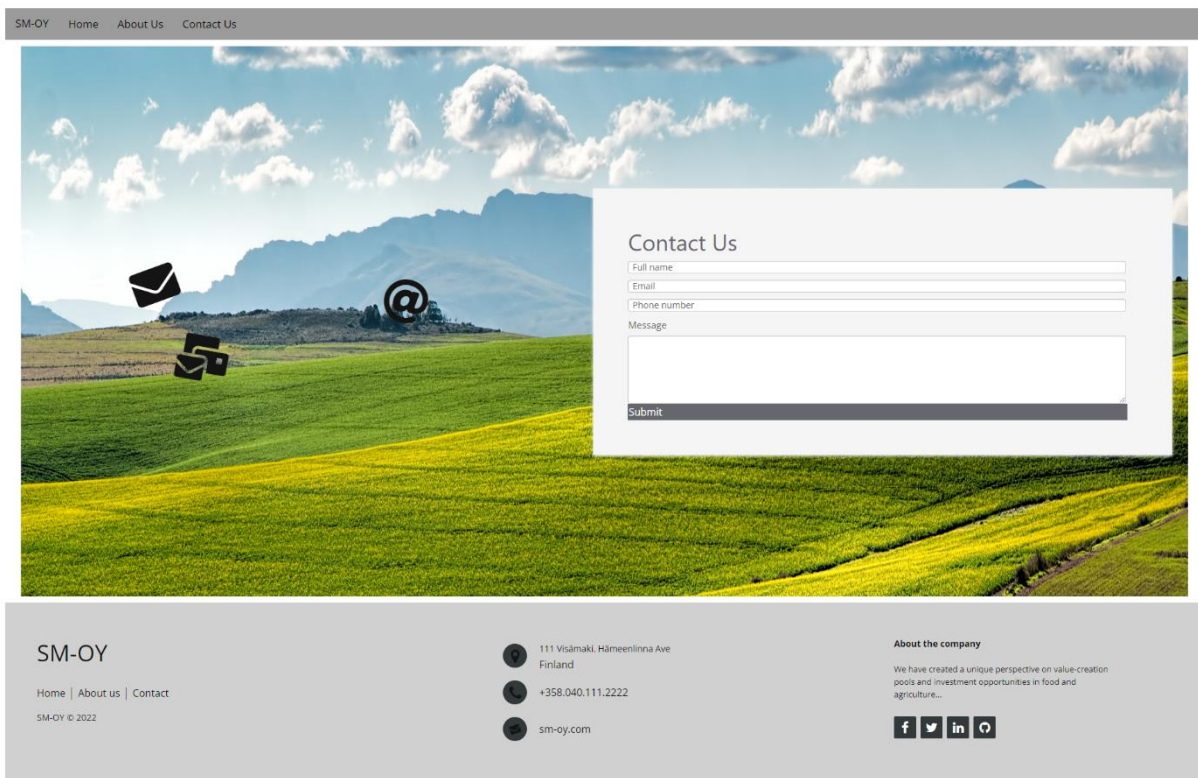
The third slide of home page shows different technologies available for farming (Drones for Agriculture). Figure 12 above, displays flying drone applying insecticide and wetting the crops etc.

Figure 13. SM-Oy About page showing the team



SM-OY about page entails details about the team, figure 13 above, ranging from its Senior Partner who is the adviser and specialist on global agriculture, R&D Manager on Discovery of chemical and soil, and other partners with other roles and duties.

Figure 14. SM-Oy Contact page



The contact page is the channel enabling client to get in contact with SM-Oy for further enquiries or feedback. Figure 14 above entails clients full name, email address, phone number and message column and a submit button.

6 Summary

The goal of this paper was to create a general-purpose website for SMEs utilizing Meteor Js. Implementing a general-purpose website for SMEs required guidance from different sources such as Meteor Js official site, textbooks, HAMK library and internet. Previous knowledge from past modules such as Introduction to Software Development, Web Development, and experience from internship with a Finnish software development company gave great assistance both in the theory and practical part of this paper.

As a practical application of this thesis, SM-Oy an agricultural consult web application was created. SM-Oy web application contains different pages which allow easy navigation and potentials for great user experience.

Nonetheless, the following limitations were encountered and could be referenced for future development of the website. The Web accessibility was not studied or considered during this thesis work. All groups of users (adult, young, visually impaired etc.) should be considered when developing a website. Colors, text sizes, text fonts, images should be adapted to fit all groups of people.

The web application focused on general website. Mobile compatibility was not taken into consideration. Considering most mobiles can access internet. This is a huge opportunity when building web applications. Mobile friendliness should be considered in future.

Due to the nature of this project and time constraints, getting feedback from users was out of scope. Inputs from users would have helped to understand preferences and expectations on the client-server side that would have greater impact on the usability of the website. Thus, the usability study could be considered in the future.

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