Business aspects

Project #28
3D Eddy Current Solver in Matlab

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Summary

Eddylyti Consulting Partners Ltd. focuses on providing agile eddy current analysis solutions for its customers. Customers are electrical engineering industry and academic institutes which want to buy complete solutions from us to their eddy current problems.

Eddy currents are induced every time when a conducting material is in a time varying magnetic field. Eddy currents cause unnecessary heating of materials which often leads to shorter product lifespan.

Our company’s core product is MATLAB software that can model a solid object in three dimensions and then analyze how eddy currents will induce in the object. Results are then visualized. Two dimensional eddy current solvers for MATLAB already exist.

Main competitors for our consulting business are other existing software capable of analyzing 3D eddy currents and engineering offices which may include our services quite easily into their service portfolio. Software itself is not “a competitor” but our potential customers may substitute our services by gaining knowhow and using these other products but this is quite unlikely since this often requires addition in human resources.

Eddylyti Partners Consulting Ltd.’s competitive advantage is the personnel behind the product development. Because the company is developing the software and also using it the best understanding of the product is among the small amount employees. Therefore it is crucial for the company to keep its key workers in the company at least as long as the market has been entered successfully.

1) Business idea

The business consists of providing the customers with complete eddy current analysis solutions. Our imaginary company is called Eddylyti Consulting Partners Ltd.

1.1) Eddy Current Consulting

The customer does not always even know what the underlying phenomenon causing issues in their electromagnetic application is. In case of eddy currents, we are there to help to customers from the problem identification to the complete resolution.

It is our advantage that we are able to model arbitrary three-dimensional solids and simulate the eddy currents in them. Therefore we can quickly study the customer’s problem in simulation domain with reasonable accuracy.

1.2) Customers

The electrical engineering industry that works with high currents or high frequencies is affected by eddy currents. Therefore the equipment design and manufacturing companies, such as ABB and Danfoss, or electronic board design and manufacturing companies are potential customers. Eddy currents are found in transformers, frequency converters, power electronics, electrical substations and even power lines.

Additionally, universities and other institutions performing scientific study may find externally subcontracted eddy currents analysis beneficial, especially when the eddy currents itself are not the core of the study and schedules are tight. However, if the eddy currents are in the core scope of the study, usually the research team completes the analysis themselves.
1.3) Revenue logic

Eddy current consulting is charged per project and case-by-case. Cases and customers are different from each other. With large industrial customers it might be beneficial for both parties to make contracts for longer periods of time and for multiple projects.

1.4) Competitive Advantage

We are a small company that definitely knows its capabilities and acts quickly. We don’t waste customer’s time with elaborate start-of-service-processes, but are there to help within hours of the first contact. Our company offers end-to-end services since we are able to provide 3D modelling, 3D analysis and the improved results from our subcontractors if the customer does not have their own subcontractors yet. This is often probable with startup companies.

2) Product/service

Our company develops eddy current analysis software running on MATLAB. The software can model an arbitrary 3D solid, define the magnetic field and using harmonic analysis (single frequency at a time) and T-omega principles model the eddy currents in the solid. The results are both visualized and available in vector form.

Our company does not sell the software itself. Instead, we provide the customer with complete eddy current analysis solutions. We join the customer in as early phase as possible and are present when figuring the problem. Then, we will use our own simulation software to find the eddy currents and visualize the results. Care is paid to craft the simulation results to answer exactly the customer’s problem. We will also work together with customer’s subcontractors or provide our own subcontractors for their use to make the improvements to the product based on our analysis.

3) Market situation and competitors analysis

3.1) Market situation

Our potential customers are divided into three categories 1) large industrial customers, 2) startups and 3) academic research. These customers have different kind of needs and therefore we need to provide them.

Large industrial customers for our eddy current consulting business are e.g. companies manufacturing power electronics or equipment for power systems. In every product dealing with or being near large time varying electrical currents the induced eddy currents should be taken into account.

Our potential large industrial customers like ABB have multiple research and development processes going on at the same time. Alone in their electrical drives business division located in Helsinki are multiple potential product lines that may need our solutions. Other similar companies are e.g. Danfoss and Siemens. These customers have large R&D divisions that often are not that flexible. Parallel projects may not know much about other projects. Often these projects acquire outside consulting for certain parts of the project. This is the place where majority of our company’s assumed financial potential is.

Other potential customers are startups and academic research. Startup companies are often forced to buy some parts of the research from outside the company. Our company will provide quick and easy modelling and analysis for their products. Academic research is not financially a large customer but working with academic research projects gives us valuable challenges to test and improve our software.

We are assuming that the market size is couple tens of thousands per year in the region. Calculation
is based on the assumption that we could attract at least 5 to 10 companies from the Helsinki region to be our customer. Pricing would start from 1 000 euros upwards per customer projects. Pricing would be adjusted along the way when better understanding of the market is gained.

3.2) Competitor analysis
In this section there are presented two similar software options to our MATLAB software. These softwares themseelve are not competitors to our consulting business but they can be used by our potential customers. Also the possibility of some engineering offices entering the market is shortly analysed.

CSC - ELMER
IT Center for Science (CSC) Elmer software is open source multiphysical simulation software. It is free to install. Elmer itself is not a competitor since it is just a programme but competitors may use this software to penetrate the same market where our software consulting business is. Elmer software has roughly the same capabilities that our software has. Elmer’s problem is that it requires workforce that have understanding how to use the software effectively.

Faraday - integrated engineering software
The following marketing text introduces Integrated Softwares Faraday software: “Reducing design costs and development times is an ever-increasing challenge. FARADAY, a 3D time-harmonic eddy current field solver from INTEGRATED Engineering Software gives you the advantage you need to meet this challenge head on. Using our innovative Boundary Element Method (BEM) and Finite Element Method (FEM) technologies, FARADAY is the only clear choice for applications requiring large open region analysis, exact modeling of boundaries and problems where dealing with small skin depths is critical.”
Faraday provides same capabilities as our software does. The same problem with Elmer also applies to Faraday: the software needs to be learned first and someone has to be able to adapt it to different kind of situations. Faraday’s software is not free.

Gmsh
“Gmsh is a free 3D finite element grid generator with a build-in CAD engine and post-processor. Its design goal is to provide a fast, light and user-friendly meshing tool with parametric input and advanced visualization capabilities. Gmsh is built around four modules: geometry, mesh, solver and post-processing. The specification of any input to these modules is done either interactively using the graphical user interface or in ASCII text files using Gmsh’s own scripting language.”
Gmsh description is very similar to our product like the functionalities are. It is very similar to Elmer and the same comparison with Elmer and our software applies to the comparison between Gmsh and and our software.

Engineering offices e.g. Etteplan, Ramboll, Kuava or FS Dynamics
Some of the big engineering offices working in Finland like Etteplan or Ramboll might have incentives to include eddy current consulting into their service portfolio. These offices have resources to enter the market if they see it profitable.
Also there are some engineering offices that can widen their service portfolio to eddy current analysis quite easily. For example FS Dynamics is already provides Finite Element Method based analysis of different kind of structures and Kuava is selling software development for MATLAB. Sources: FS Dynamics’ website, [http://fsdynamics.se/fem/](http://fsdynamics.se/fem/), checked 9.3.2017 and Kuava website, [http://www.kuava.fi/services/tailored-software-engineering/](http://www.kuava.fi/services/tailored-software-engineering/), checked 9.3.2017

### 3.3) Market analysis: Porter’s five forces

Porter’s five forces analysis is a tool to analyze the level of competition in the industry. Five forces are threat of new entry, threat of substitutes, bargaining power of customers, bargaining power of suppliers and competitive rivalry among industry.

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**Threat of New Entry**

There is already couple of software packages available to do the approximately same thing as our software is capable of doing. Therefore the threat for a new entry is quite low. Some of the existing software is free and the capital requirement to enter the market is not big. Anyway gaining the knowledge and human resources to use these products are not as simple.

**Competitive Rivalry**

In our research we did not find competing companies. Those firms that are doing eddy current research are also the ones to manufacture their own products. Rivalry is therefore between the easiness to purchase a competing product and then using it and the easiness to buy the end-to-end solution from us.

**Supplier Power**

Supplier power in the market is quite low since there are similar software existing in the market and customers might have the ability to start using these softwares on their own.

**Threat of Substitution**

Substitute for our services could be some new materials that would decrease the bad effects of eddy
currents in different applications. E.g. if a new metal-like material which does not heat up from eddy currents would become popular in the industry, our market potential would be affected.

**Buyer Power**

Large industrial customers like ABB certainly have the financial resources to establish their own eddy current research groups. Small startup companies generally do not have resources to do all of the research by themselves. Buyer power is quite large in case of larger customers but not with smaller companies like startups.

**3.4) Competitive factors**

Our company’s most important competitive factors are our strong specialization in eddy currents and agility being a small but capable partner which is using own software to solve problems. We are able to provide the complete solution to our customer which is one of our biggest assets.

**4) Intellectual property**

According to the lecture given by a senior specialist from the Finnish Patent and Registration Office, software itself is not patentable. Especially since we do not introduce a new algorithm or invention, we must rely on protecting the software as a trade secret. On the other hand, it is easily protected, since only company staff has access to the software.

The freedom to operate is guaranteed by the fact that as long as we have a MATLAB license, we are free to create and run our own software on that particular platform. In long term development we have to take into account that MATLAB software might turnout to be too expensive for our company after the student licence is not available anymore. MATLAB’s licence fee for companies is significant. The scientific basis the software is based on fundamental books published for academic study and research. Using them for commercial applications is permitted. Therefore, T-omega method of Finite Elements Method is not patented and is freely usable principles for our software.

**5) Product development and technology**

At the time of this business aspects document the product development project has just passed the halfway point. Therefore there are many aspects still quite uncertain and the many assumptions about the final outcome had to be made to finish this document for example.

One big asset of ours is the fact that we are developing our own software. We always have the best knowledge what the software is capable of doing and what it is not.

To be ready to enter the market our company will need to finish the software. Most important parts are finishing the geometry-matrix-mapper, equation solver, result visualization and the validation of the final product. Also our company has to decide the organization structure before actually establishing the company and sending all of the required information to the Finnish Patent and Registration Office. The final pricing model needs to be completed before we can take our first customer.

**6) Conformance**

We need to proof ourselves that the results are precise. This can be done by comparing the solution of a particular problem with the solution provided by other software, such as Elmer. Otherwise setting up a consulting scheme is not regulated on technical field.

Our software itself does not have to meet any certain requirements from outside authorities but the products that are involved have their own individual requirements. These regulations and directives
are of course really important to understand in every product development process. Close working with the customer is essential to understand the product specific regulation in each project. Acquiring the necessary regulation is consuming time and resources if not done effectively. Therefore the business area specific knowhow of our client needs to be utilized.

7) SWOT-analysis

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<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<tbody>
<tr>
<td>Agile company structure</td>
<td>Market uncertain</td>
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<tr>
<td>Ability to do the 3D modelling of the customer product</td>
<td>Little understanding of the business</td>
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<tr>
<td>Talented experts of the software since we are in charge of development and usage of the software</td>
<td>Getting visibility among large companies with larger marketing budgets may be hard</td>
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<table>
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<tr>
<th>Opportunities</th>
<th>Threats</th>
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<td>Business is easily scalable to outside of Finland</td>
<td>We may not have enough knowledge how to work in the market</td>
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<tr>
<td>Public concern on electromagnetic fields may increase the demand for our services</td>
<td>Threat of new entry or substitutes is large</td>
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<tr>
<td>Electrical devices are using higher frequencies for higher power density which leads to higher eddy currents -&gt; potential market is growing</td>
<td>Company depends largely by its current personnel and if some leave, it might cause extensive problems</td>
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Critical success factors
Critical success factors for our company to enter the market are 1) finishing the unfinished software, 2) finding the right pricing model and 3) attracting first customers.

Risk factors
Biggest risk with unsustainable consequences is if the product is not finished within reasonable time. Delayed finishing of the software may lead to a point where our key personnel are no longer available to work for the company which may lead to a halt in the product development. If at some point MATLAB software turns out to be too expensive for our company, we need to be flexible to move to other available software, e.g. Octavia which is free but has approximately the same capabilities as MATLAB.

Avoiding risk in the product development
To avoid previously stated risks we are putting focus on the development of the software by assigning the whole team to work on it from here on.

8) Marketing plan
[Comment: Product/service marketing was not mentioned in the business aspects template]
One of the company employees is going to take responsibility of the marketing. In the beginning marketing is going to focus on getting the first customer. This first customer then can be used as a reference project in the future marketing. Marketing director’s main task is to plan and contact potential customers through their R&D directors. For the use of the marketing director a contact list of industry’s R&D directors and Customer Relationship Management software will be bought.

**Supplement: Distribution of work and learning outcomes**

Project manager Mikko Laakkonen and group member Juha Korpio had the main responsibility to develop the business aspects. Especially difficult was to find the market space for our business and to develop the artificial business model around our software. Partly because of this the market analysis and finding competitors were also challenging.