Business Strategy Deltares' Delft3D

How to adjust business strategy of the company according to the changes in the organizational policies

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Abstract

A research institute in the field of coastal life and infrastructure has changed its strategy from licensing to the open-source code for the Delft3D modelling software – the company decided to use "dare to share" concept. In order to increase the number of users of the product, the company was looking for a methodology that could help to understand how to do that well. System Dynamics had been chosen as a tool, which is helpful to analyze the current strategy (to see how the system is working now) and create the policy in order to reach the goal and adjust the strategy. In order to do that, we will research the effectiveness of previous marketing efforts and test them in the model.

Problem

This work will be devoted to the construction of the model in order to improve Deltares' business strategy and help to the organization to find effective levers for the main goal – spread the modelling software product Delft3D. System dynamics is used by organizations for developing, correcting and adjusting business strategy. It is very useful to have a model that shows possible scenarios of the company's future development. System dynamics is a modelling tool to help the organizational development.

Deltares is an institute for applied research in the field of water, subsurface, and infrastructure. The main focus of the company is on deltas, coastal regions, and river basins. Managing these densely populated and vulnerable areas all over the world is complex, which is why Deltares works closely with governments, businesses, other research institutes and universities in the Netherlands and abroad. (O. W. Deltares)

All contracts and projects, whether financed privately or from government research budgets, contribute to the consolidation of Deltares knowledge base. Furthermore, Deltares believes in openness and transparency, as is evident from the free availability of Deltares' software and models. Open source works – is the firm's conviction.

Since 2011 Deltares started to spread Delft3D software programme as an open source after 13 years of licensing. With open source strategy Deltares shows that they "dare to share" and believes in switching from a "commercial" perspective, in which licensing is the basis for the revenue stream, to a "value delivering" perspective, where creating value for a client results in a sustainable revenue stream.

Deltares wants to strengthen its "strategic positioning as a research institute" (Bruggers, November 13, 2013). Software need to be up-to-date (highest possible standard that will help to contribute the software). The aim is to achieve the bigger market share in the area of water security software. Deltares is at the stage of transition from "commercial view" to "add value" view.

Here it is very important to understand the difference between "open-source code" software and "free" software. With the "free" one user will get working programme, which he/she can open and immediately start working. "Open-source code" means that user will get the code of the programme and user does not have to pay a license. There is also a possibility to ask for the graphical user interface (GUI). But the user still need to compile it together and to do so he/she need to buy the special compiling programme or can buy one of the final version of the programme from the Deltares. It is a scenario for the non-programmers users. If user has a time and programming skills the compiling stage is not difficult.

According to the new policies, the license is absolutely free for any amount of users, but the support and maintenance are costs that depend on the package. In the end, the user will get the working programme, will receive all updates for the programme and agreed amount of time for the support and maintenance if there are any problems during the work with the programme. Because of the same reason (no license payment) it is obvious, that the product cost less. It attracted many new companies as clients (see *Figure 1*). The number of users inside the company is varying from 1 till 20 in average. For example, the university is able to have more than 50 users: students simply have classes with Delft3D.
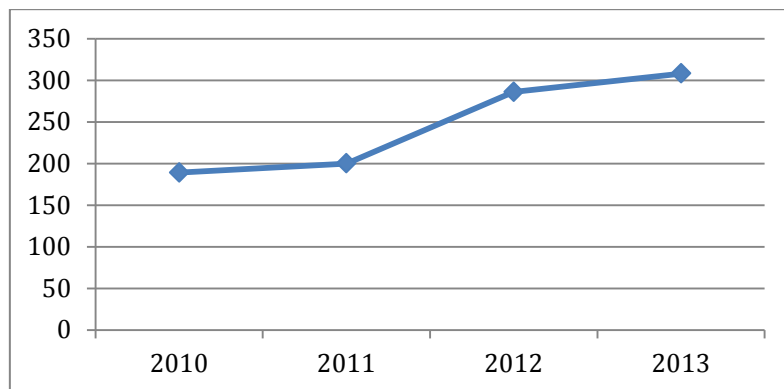
Figure 1. Companies (Delft3D clients)

The main aim for the company: enlarging usage of the product (Delft3D) in order to achieve bigger market share. Deltares wants to see more Research Institutes in the list of clients. Because institutes not just use it, but may help to improve and support the product.

Deltares is a semi-public organization. The 46 % of the revenue are supported by government (see *Figure 2*). The last 54 % comes from public and private sector (Deltares, 2013). The main objective of the company is that software should be widely spread to contribute to the developments. Profitability in terms of money is secondary (soft) goal. The primary goal is continuation acknowledgement of issues relevant to water security which shows up with new clients.
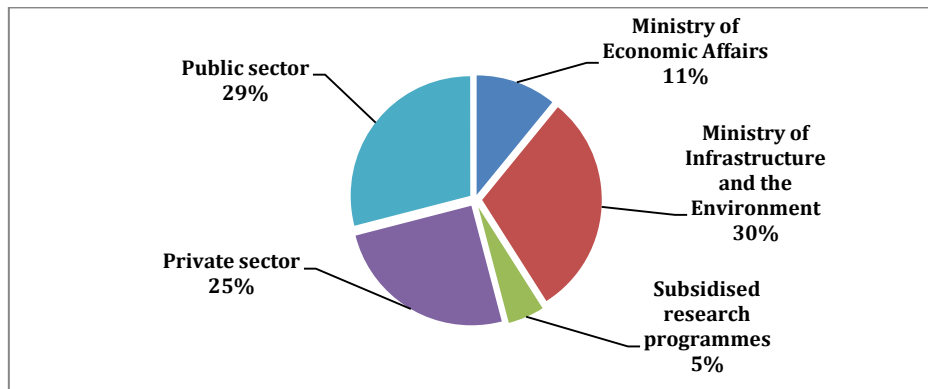
Figure 2. Structure of the Deltares Revenue

As it was mentioned before company politics allows spreading the software among unlimited amount of users inside the company that had bought the support and maintenance package. That is why number of companies/clients in the *Figure 1* does not show the all picture of the users. The number of end users can be approximately assessed through the people that joined Open Source Community of Delft3D. There are more than 6000 participants, among them employees of Deltares. The first idea was to extract number of employees from the total amount of users (around 800 people), but on the other hand employees are one of the effective promoters of the product and extracting them from the model will be a mistake.

After changing to the open-source strategy, company obviously started to lose the revenue based on the previous values. But in the all structure of the revenue it has changed not so dramatically because it took and still takes very small fraction out of the all turnover (number cannot be published because of confidentiality matter). This statistic demonstrates that Deltares did not lose a significant amount of the revenue. Deltares sacrificed it in order to get more clients that will have more research and development projects with the company. "Revenue" will come with those projects.

The main purpose of constructing model for Deltares is to have an overview of the all system surrounding Delft3D business case in order to find out what kind of marketing efforts are the most effective. To have a possibility to play with parameters to create better understanding how the processes are interacted with each other. Therefore, contribution of this project work is very practical and useful for the company.

Lane (1997) described the case when modeling process helped managers understand the dynamic processes. "The visual and interactive aspects of System Dynamics modelling provide information processing advantages to users. The visual representation of variables and relationships using causal loop diagrams, subsystem overviews and computer models with iconic interfaces all allowed the participants to deal with more information than unaided working memory normally allows." Morecroft (2007) stated that "causal loop diagrams offer a special overview of business and society, showing what is connected to what and how changes in one part of the system might propagate to others and return". This research will be also devoted to the point of learning during the modelling process in order to give the understanding how dynamics are going on in the system of Delft3D business case.

Hypothesis

Sterman (2000) states that there are two main initial characterizations in the modelling process: reference modes and time horizon. Reference mode is a graph over time characterized problem dynamically. The main purpose for the modeler is to represent with the model's structure the same pattern of the system's behaviour. Time horizon should define how far back modeler starts represent behaviour through its structure: in our case it begins on 2011. That is why it is important to define reference mode in the beginning: number of users Delft3D software programme.

Because of the simplicity of downloading source-code form the web-site of Deltares it became very difficult to evaluate amount of users of Delft3D software product. One of the options to do that is to look on all groups of participants, interested in Delft3D. One of the main source is "Deltares Open Source Community" (Deltares, 2014). That is why there are only rough data for the reference mode, it does not suggest much about the structure of the system. But research suggests using the Bass Diffusion Model as a starting point for developing the structure. The dynamics of product adoption by word-of-mouth effect – growth from diffusion – are well explained by Sterman (2000) and Morecroft (2007). The archetype of the model suggests that there are going to be at least two stocks which will create diffusion process: adopters and non-adopters. Produced behaviour will be S-shaped. Warren (2008) says that Bass Diffusion model is a "useful framework" to show results of word-of-mouth communication between potential and current users.

According to the internal data-base of users subscribed for exactly Delft3D in the open-source community by 31st of December 2013 we got *Figure 3*. These numbers do not show the all picture. A lot of users are missed. But in general trend are considered to be right which means that this graph over time is suitable to be a reference mode for our case.

According to the *Figure 3*, growth of the clients in the period between 2010 and 2011 can be represented by structure of reinforcing loop. The period from 2011 and 2013 is a result of behaviour by both reinforcing and balancing loops.
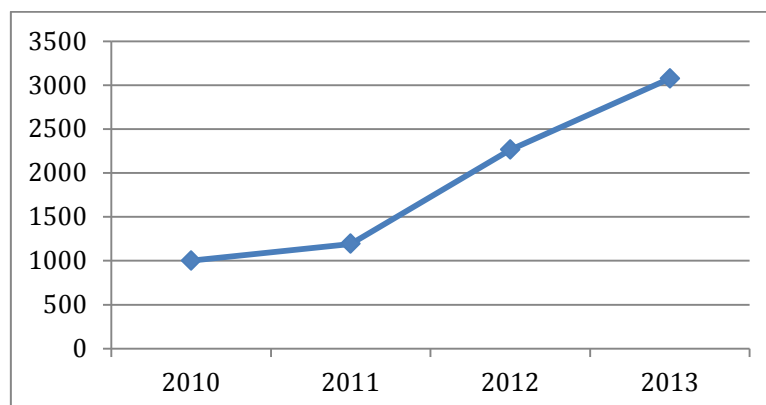
Figure 3. Approximate amount of users of Delft3D since 2010 till 2013

## Model conceptualization and formulation

Warren (2008) suggested three questions which are helpful to analyze the issue how organisations are perform over time. According to this approach there were formulated

research questions to answer in order to reach described objectives and understand how the business situation around Delft3D is functioning now:

- Why is this dynamic behaviour happening?

- What is the most likely forecast of new clients of Delft3D?

- What is possible to do to increase number of users even more?

Answers on these questions will help to identify main parts of the system and links for the modelling purposes. Presentation of all interconnections and interdependencies inside the system will provide better understanding of how is system working and what kind of performance it will create.

As it was said before the beginning of the model starts with the Bass Diffusion model structure. However, it will not be bounded with only two stocks of non-adopters and adopters. The structure starts with the stock of Potential clients – all amount of people who potentially could be interested in the product. Going through the flow some of these people are becoming aware of the Delft3D software product. And from here there are two ways: to be adopted or person also can decide that this product does not suit his requirements and go to the stock of Unsuccessful clients. Most of the people have the probability to change their mind and come back to the stock of People aware of Delft3D. Adoption rate is the next flow in the link to the stock of Delft3D users. Here is we have two stocks of users: regulate users (stock of Delft3D users itself) and stock of Latent users, who stopped to use the software for some time, but most of them will become the regulate users again. Described structure is on the *Figure 4*.
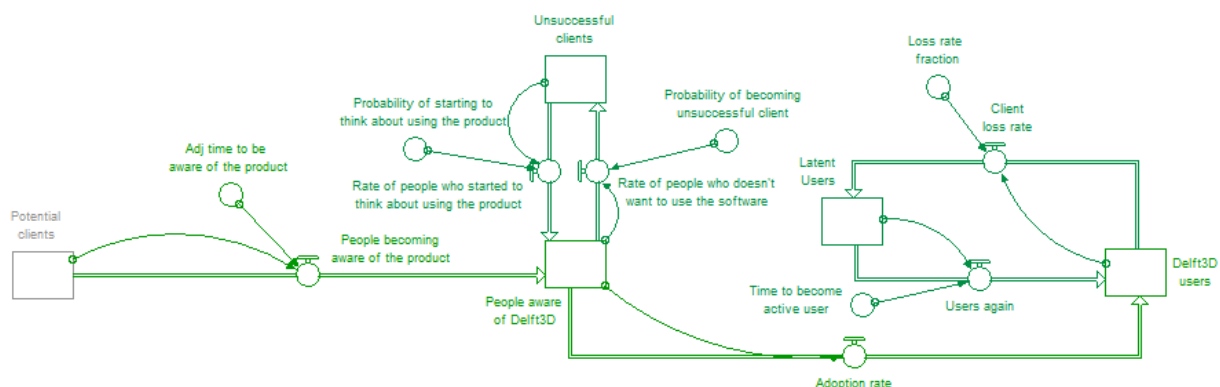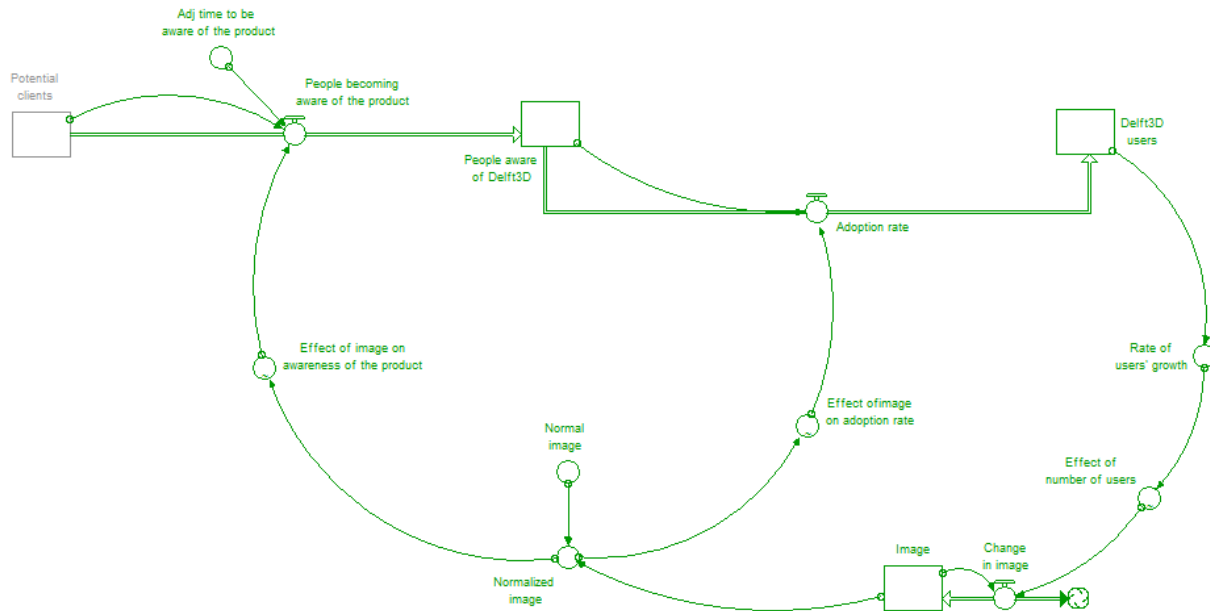

Figure 4. Model Development. Part 1

Flows of people becoming aware of the product and adoption rate are regulated with extra parameters which will be described later. Loss rate fraction was defined by the expert's view of programme manager in Deltares as 10 % out of all users. Similarly, time to become active user was defined as 2.5 years and adjustment time to be aware of the product – 2 years.

Connection between stock of People aware of Delft3D and Delft3D users through the adoption rate explicitly shows diffusion concept when users are flowing from one stock to another. Stock of Delft3D users are influencing back to the adoption rate through the effects you will find below.

Next big part include in it stock of Image, which is defining was the experience with the product good or not. And to do so there was calculated relationship between number of users in the previous year and current amount of users (trend) – to define the rate of users' growth. If the fraction is less than 1 it means that more people went to the stock of latent users than we got through the adoption rate this year (see *Figure 5*). The logic behind constructing Image stock is that when there are more users than is was one year before product become more popular, people got a good experience and shared it with others (word-of-mouth effect). And when there are lees people than it was in the previous year, people were unsatisfied with something and also shared their opinion with others.

Figure 5. Model Development. Part 2

To get the effects of experience on the flows of people becoming aware of the product and adoption rate there was conducted normalizing procedure. For the normal image there was chosen number 0.5 – it is an estimated assumption. The logic is the following: if there would be number 1 it means that image is perfect which suggests that all users should belong to Deltares. But we know that it is not a truth. We also know that number of users is not a small amount. And we also understand that number which is going to be used later on in the system is normalized, so it does not affect the end result directly. The first effect of number of users that changes the image looks as following (see *Figure 6*):
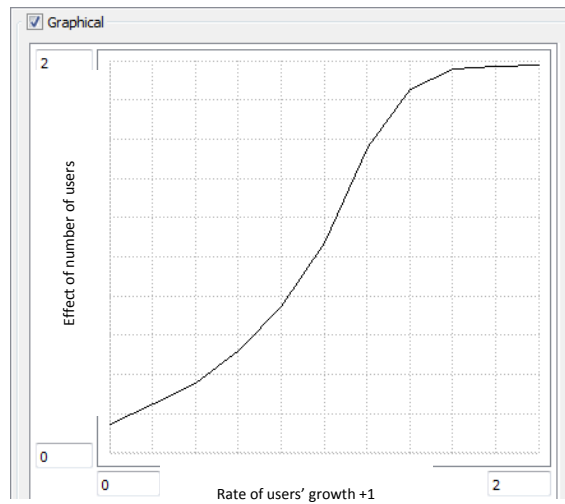
Figure 6. Effect of number of users

Effect of image on awareness of the product was defined by expert's view is on the *Figure 7*:
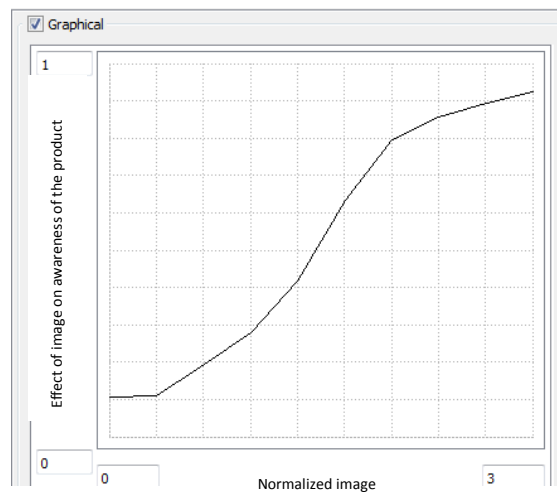

Figure 7. Effect of image on awareness of the product

S-shaped growth means that better become image, bigger effect there will be on potential clients. But at some point effectiveness of the effect is getting lower and stabilizing.

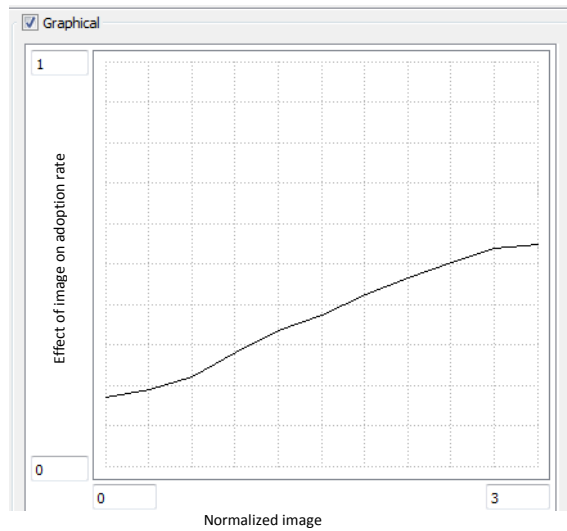Effect of image on adoption rate was defined as on the *Figure 8*.

Figure 8. Effect of image on adoption rate

The shape is close to the effect of image on awareness, but the effect itself much less. Because it is not only about recognition and knowing about the product, but about real users, who started to use Delft3D.

These two effects are the main in order to describe word of word-of-mouth effect: the more people use the product leads to more people know about the product, and again more people started to use Delft3D brings more users through the image effect – loops are closed. Therefore, described parts create two big reinforcing loops (see *Figure 9* and *Figure 10*).
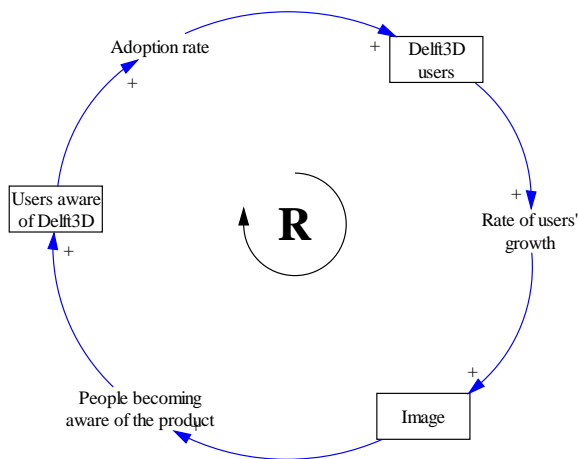
Figure 9. Loop 1: Influence of image on the awareness of the product

Users create certain Image (experience received using the product) which changes number of users aware of the product and next step is increasing of users.
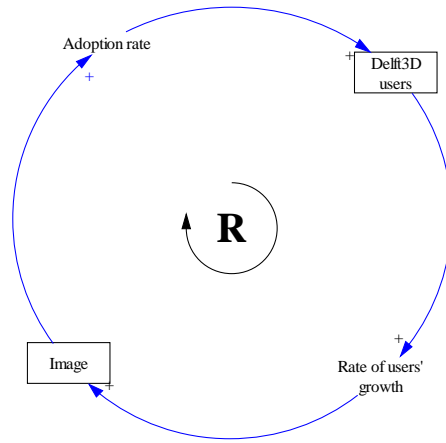
Figure 10. Loop 2: Influence of image on the adoption rate

The next part of model development is about marketing budget and its influence on the people becoming aware of the product. This part mostly constructed in order to create policy structure in the future and make test simulations to check the possible influence of the changing in the marketing budget on the awareness of the product (see *Figure 12*). The spending out of the bank account affects the flow of people becoming aware of the product through the effect of direct marketing cold contacts. The story behind this connection is that specialists from the marketing department are making new contacts though the e-mails and phone-calls. Every day they contact with the new people as well with old contacts, which are still not users of the product, but were thinking about it. The interesting thing is that budget for the marketing purposes does not change a lot during last years since going open-source (our case). And the real influence cannot be proved and evaluated even by expert view. That is why the following guess is just guess for the simulation and testing purposes (see *Figure 11*).
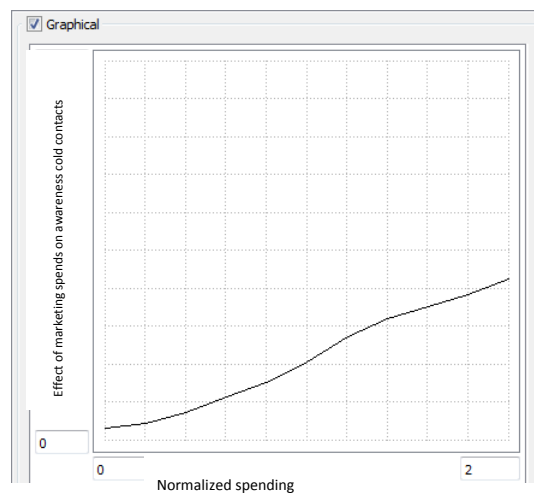

Figure 11. Effect of marketing spends on awareness cold contacts

Marketing budget as we can see is depending on either discrete change in budget or growth fraction for the marketing budget, or both. Usually changes in the company can be made through these two options: it depends on the internal rules of the company. In case of Deltares discrete changes can arise when it is going to be new activities in order to promote company's products.
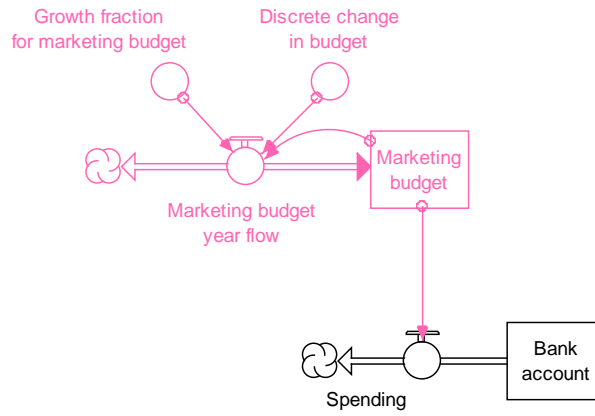
Figure 12. Model Development. Part 3

The next part of the model is connected to the financial section (see *Figure 13*). The number of users creates demand for the research and development projects with Deltares. According to the expert's view of programme manager there around 60 % of all research and development projects (i.e. turnover of the company) are connected with the Delft3D software programme. Therefore increase of users supports income increase, which allows spending money for the marketing budget.

The flow of spending gets signal of amount of money to spend from the marketing budget stock as you can see it at the *Figure 13*.
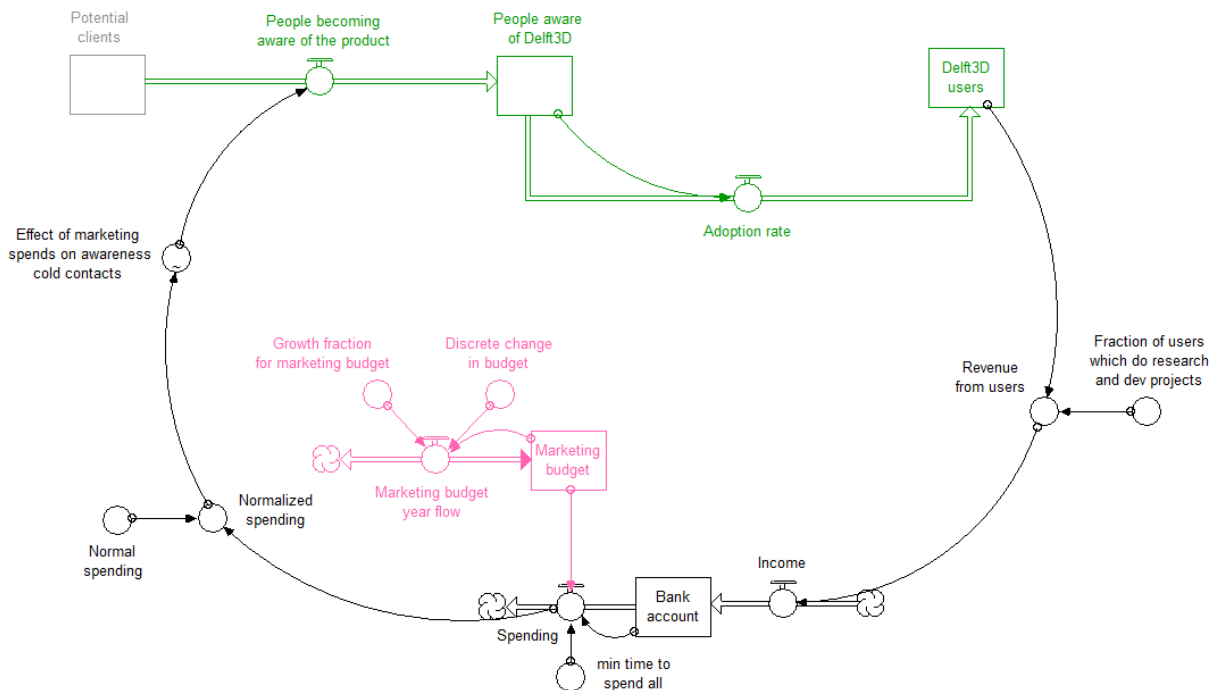

Figure 13. Model Development. Part 4, connection to the part 3

The next part shows how number of the conferences influence on the Image, which in its turn has an impact on average revenue for research and development projects (see *Figure 17*). The mentioned affect are looking as following (see *Figure 14*):
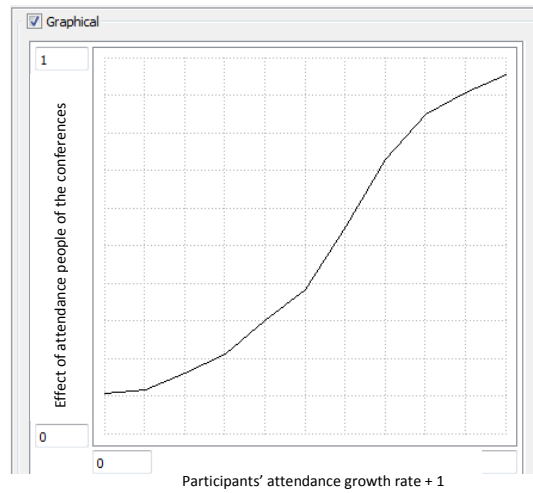
Figure 14. Effect of attendance people of the conferences

The loop for described part will look as following (see *Figure 15*):
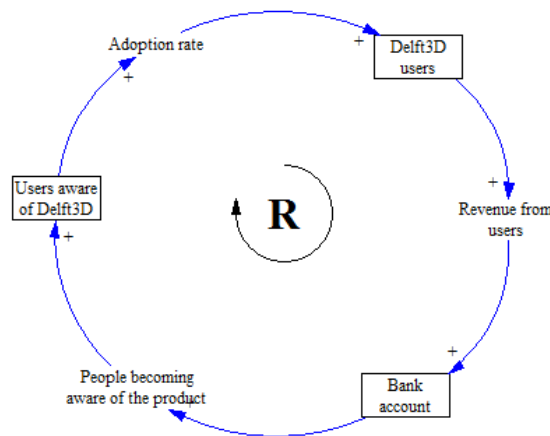

Figure 15. Loop 3: Influence of the marketing spends on awareness cold contacts

More Delft3D users we have more revenue for research and development projects we get. It increases our money resources which company can spend on the marketing activities that will enlarge amount of people becoming aware of the product. And out of this stock Delft3D users stock will also increase.

The number of the conferences attended by the Deltares' employees has influence on the image. The image in its turn has an impact on the average revenue for research and development project per user (see *Figure 16*): higher image – more revenue per user.
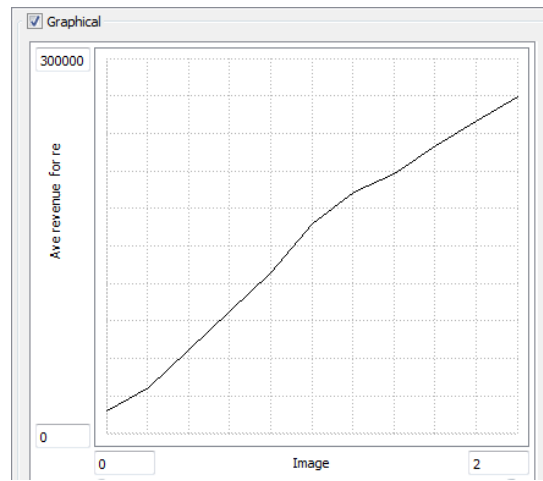
Figure 16. Average revenue for research and development project per user

The curve and approximate data for average revenue for research and development project per user was defined by the expert view: higher image – greater revenue per user.
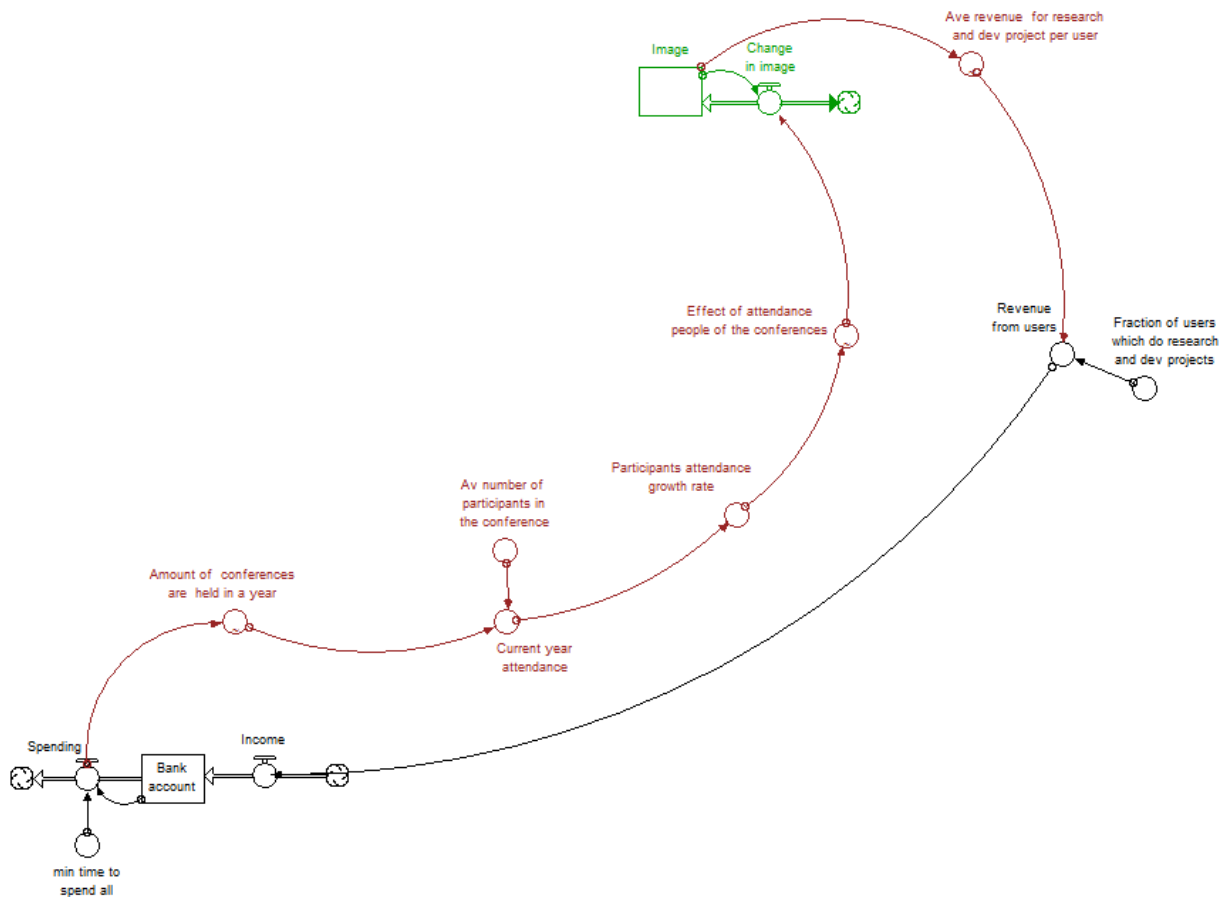

Figure 17. Model Development. Part 5

This stock and flow diagram can be presented as following causal-loop diagram (see *Figure 18*):
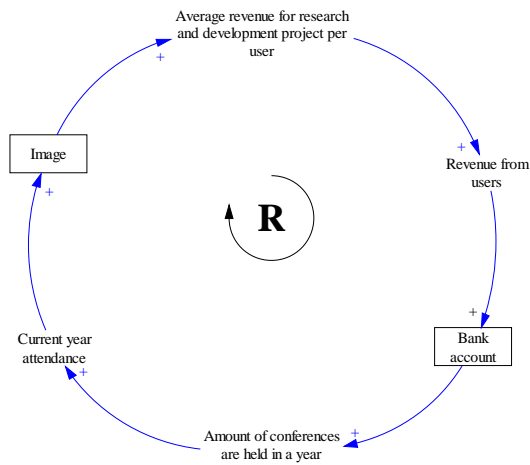
Figure 18. Loop 4: Influence of conference attendance on the revenue through the image

The last, but not least part of the model consists of stock of Universities and Institutes as a development partners. These partners help in promoting and spreading product among the researchers. And its impact is very significant in general. By now, changing of partners' number is exogenous factor (see *Figure 19*).
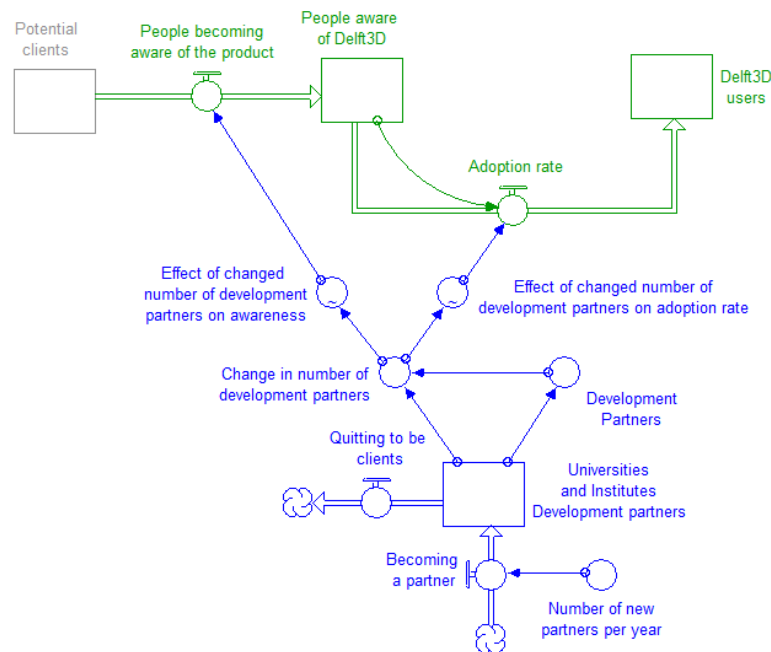

Figure 19. Model Development. Part 6

Therefore after combining all parts of the model we got *Figure 20*. We can see 4 main loops defined before:

- Loop 1: Influence of image on the awareness of the product;
- Loop 2: Influence of image on the adoption rate;
- Loop 3: Influence of the marketing spends on awareness cold contacts;
- Loop 4: Influence of conference attendance on the revenue through the image.
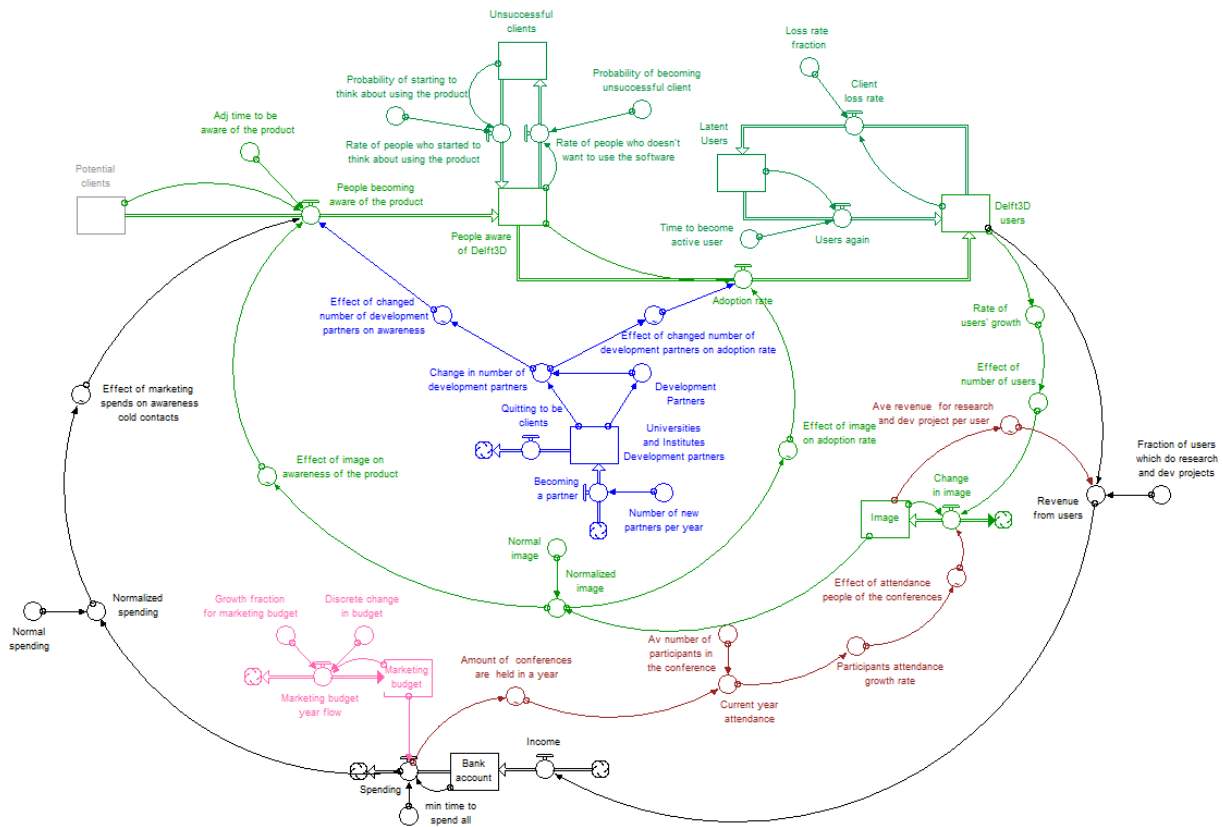
Figure 20. Full model in iThink

Model Validation

In order to verify model there were conducted several validation procedures (but only two of them will be shown with the graphical interpretation). Barlas (1996) stated several formal procedures for the checking model's validity in system dynamics. But he also noticed that procedures cannot be entirely formal and there is room for subjective components. As it was noticed in the paper by Barlas and Carpenter (1990) "A valid model is assumed to be only one of many possible ways of describing a real situation. No particular representation is superior to all others in any absolute sense, although one could prove to be more effective. No model can claim absolute objectivity, for every model carries in it the modeler's world view. Models are not true or false but lie on a continuum of usefulness".

Unit consistency test

Unit consistency test is very helpful in order to understand if the system is constructed in a right way: parameters are connected correctly, so equations will lead to the same units in the end. Unfortunately there are some limitations in the iThink programme software: if the equation is too complicated (i.e. long, includes structure "if then else") it will not be able to check whether right or nor it was constructed. After making this test in iThink, there were several parameters that had to be checked manually. Test was completed and results say that units are right and consistent.

Reference mode comparison test

This test relates to the behaviour pattern test and it should show how close the reproduced behaviour is to the real one. The reference mode is fitted quite well. Of course, the exact numbers are not the same, but the overall behaviour is right (see *Figure 21*).
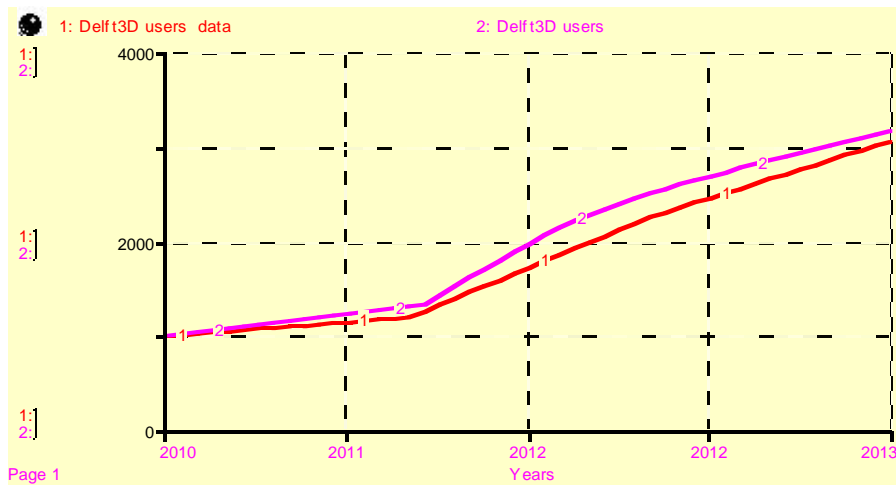
Figure 21. Delft3D users' data vs. Delft3D

Parameter sensitivity analysis

The next important test is a sensitivity test. According to the structure on *Figure 20* we can notice that loops are consist itself effects, which are very important for the structure. And we also know "The behavior of a system arises from its structure" (Sterman, 2000, p. 107). As it was mentioned above, effects were estimated by the expert view and that is why important to see how much system is sensitive to the parameters, will be behaviour changed dramatically or reasonably?

The process of testing was the following: there was a standard (which is used in the model) curve that was changed. Each of these curves was put in the model and the results of running are combined in one graph for each of the effects. According to all results of the testing, there was found that the model is stable for the changes of effect parameters.

Structure behaviour test

Each of the loops with effects was tested and there are results of how system would behaviour if it would not be exist in the *Table 1*:

Table 1. Impacts by the effects

№	Name of the switched off effect	Impact
1	Effect of the image on the awareness of the product	280 users less
2	Effect of the image on adoption rate	2033 users less
3	Effect of marketing spends on awareness cold contacts	335 users less
4	Effect of attendance people of the conferences	1771 users less
5	Effect of changed number of development partners on awareness	308 users less
6	Effect of changed number of development partners on adoption rate	1688 users less

The results are also presented on the *Figure 22*:
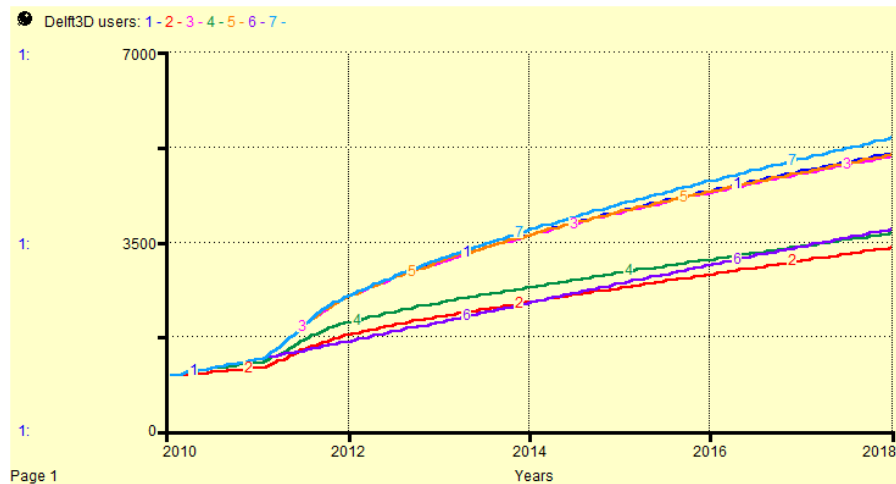
Figure 22. Forecasts without each effect

As we can see out of this table one of the highest influences create image on adoption rate. That means that word of mouth effect has a huge impact on the users' decision-making. In order to increase number of users it is better to focus on the people who know about the product and increase adoption rate. Model gave an insights that it make sense to spread more information about the company at the conferences, where are gathering people who are really interested in the product. And also work deeply with the development partners (universities and institutes). Because people, who has already started to work with some product since the beginning in the most cases would not change preferences in the future.

Scenario tests

Two scenarios were checked:

– increasing stock of Potential clients;

– changes in the marketing budget.

Scenario 1. Stock of potential clients

The main idea of this scenario is that right now in the model there is a stock of Potential clients which is not changing over time, but has given as an exogenous parameter with initial value. The point is that current amount of people who could be interested in the Delft3D software can be increased by making new features in the application. That is how we can increase the stock which in its turn will increase the further flows.

In order to test this suggestion and to see the dynamics of the system there was made a slider in the interface of the model where Deltares can test how exact amount of extra potential clients can change the stock of Delft3D users: from 10 000 till 100 000. There are results of this scenario test from 0 to 100 000 with the step of 10 000 extra potential clients on the *Figure 23*:
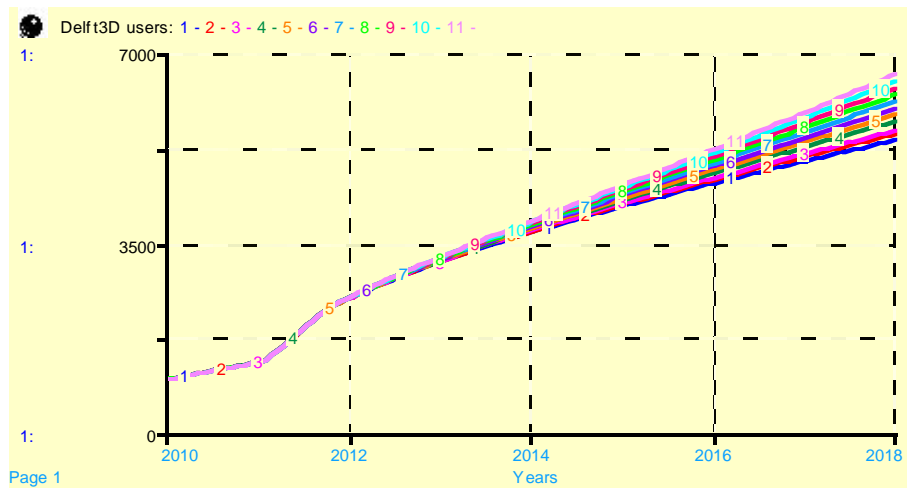
Figure 23. Results for testing "Scenario 1. Stock of potential clients"

Scenario 2. Stock of marketing budget

In order to check the scenario connected to the changes in marketing budget there will be made simulations with parameters of growth fraction of marketing budget and discrete change in budget (see *Figure 20*). The parameter of growth fraction of marketing budget was changed from 0 to 1 with the step of 0.1 and the results are shown on the *Figure 24.*
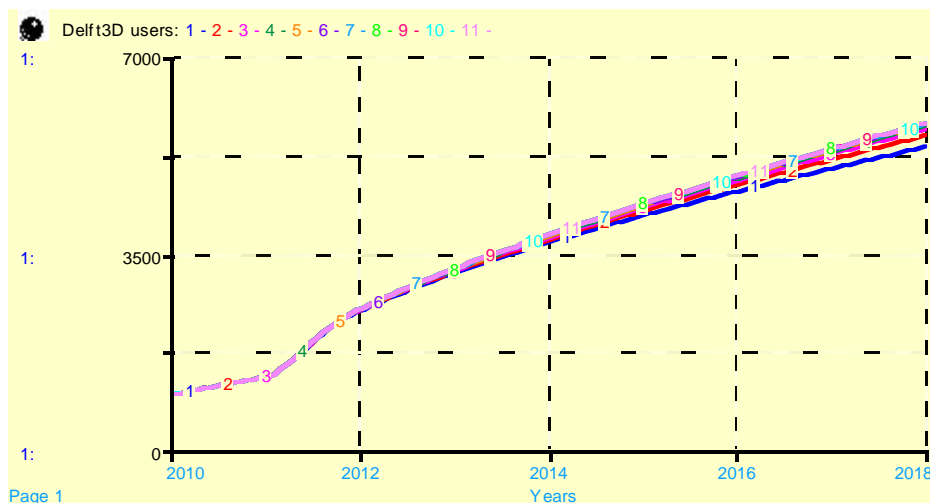

Figure 24. Results for testing "Scenario 2. Stock of marketing budget: parameter of growth fraction of marketing budget"

The parameter of discrete change in budget was changed from 0 to 50 000 with the step of 10 000 euro per month. There are results of testing this scenario option on the *Figure 25*.
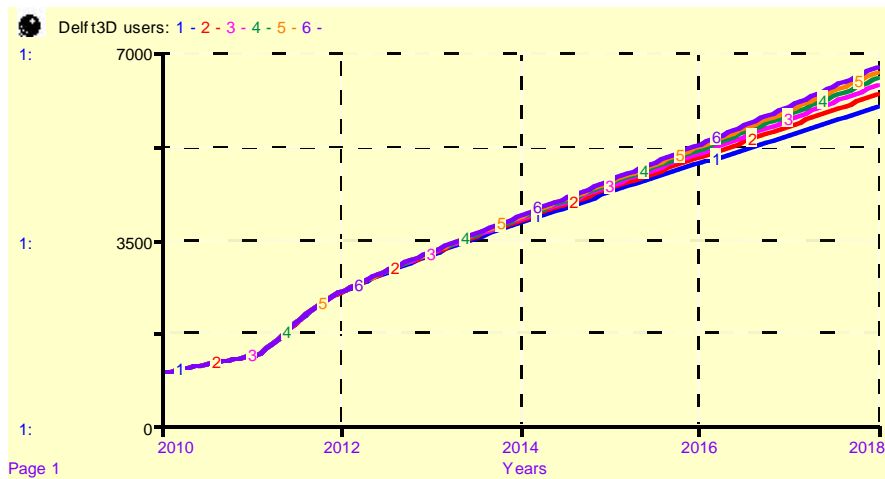
Figure 25. Results for testing "Scenario 2. Stock of marketing budget: parameter of discrete change in budget"

According to the results of testing scenario options make sense to improve the software programme with the new features in order to increase stock of Potential clients.

Conclusion

There were constructed explanatory model of Delft3D software product business case. Plus, there were tested two scenarios in order to improve company's performance. Therefore, research questions were answered. The construction part of model helped to understand why the behaviour of the system is happening how it is. Through the different simulations and checking behavioral test we know and can see on the graphs what kind of behaviour of the system is going to be in the nearest future. And the same graphs can help company to understand where it is better to put more efforts in order to increase number of Users of Delft3D.

The validations tests showed that model is valid for its purpose which is to have an overview of the all system surrounding Delft3D business case. Specialists from marketing department requested to make a model which can show what kind of marketing efforts bring more clients: and it was shown in the part of testing behavioral structure when we switch off the loops and effects. To minimize difficulties in understanding, there was created interface, so specialists can easily "play" with parameters and switching off the loops.

Further research options

In order to develop the scenario about intending new features inside the software, it would make sense to include the budget inside the model. To develop several scenarios of what kind of features it could be, how much it will approximately cost for Deltares and how many potential clients it can bring. This research will help to conduct cost-benefit analysis.

There are limitations of the model: several variables are introduced exogenously and the model cannot be used as it is forever; it needs to be adjusted over time. That is why, it is possible to develop model further and try to make left exogenous parameter as endogenous.

References

Barlas, Y. (1996). Formal aspects of model validity and validation in system dynamics. *System Dynamics Review, 12*(3), 183-210.

Barlas, Y., & Carpenter, S. (1990). Philosophical roots of model validation: two paradigms. *System Dynamics Review, 6*(2), 148-166.

Bruggers, M. (November 13, 2013). [Personal communication].

Deltares. (2013). The World of Deltares 2013-2016.

Deltares. (2014). Delft3D Open Source Community.   Retrieved 14.04.2014, from http://oss.deltares.nl/web/delft3d

Deltares, O. W. About Deltares.   Retrieved 13.03, 2014, from http://www.deltares.nl/en/about-deltares

Lane, D. C. (1997). *Systems modelling for energy policy* (D. W. Bunn & E. R. Larsen Eds.).

Morecroft, J. (2007). *Strategic modelling and business dynamcs: a feedback systems approach*: John Wiley & Sons Ltd.

Sterman, J. D. (2000). *Business dynamics: systems thinking and modeling for a complex world*: Jeffrey J. Shelstad.

Warren, K. (2008). *Strategic Management Dynamics*: John Wiley & Sons, Ltd.