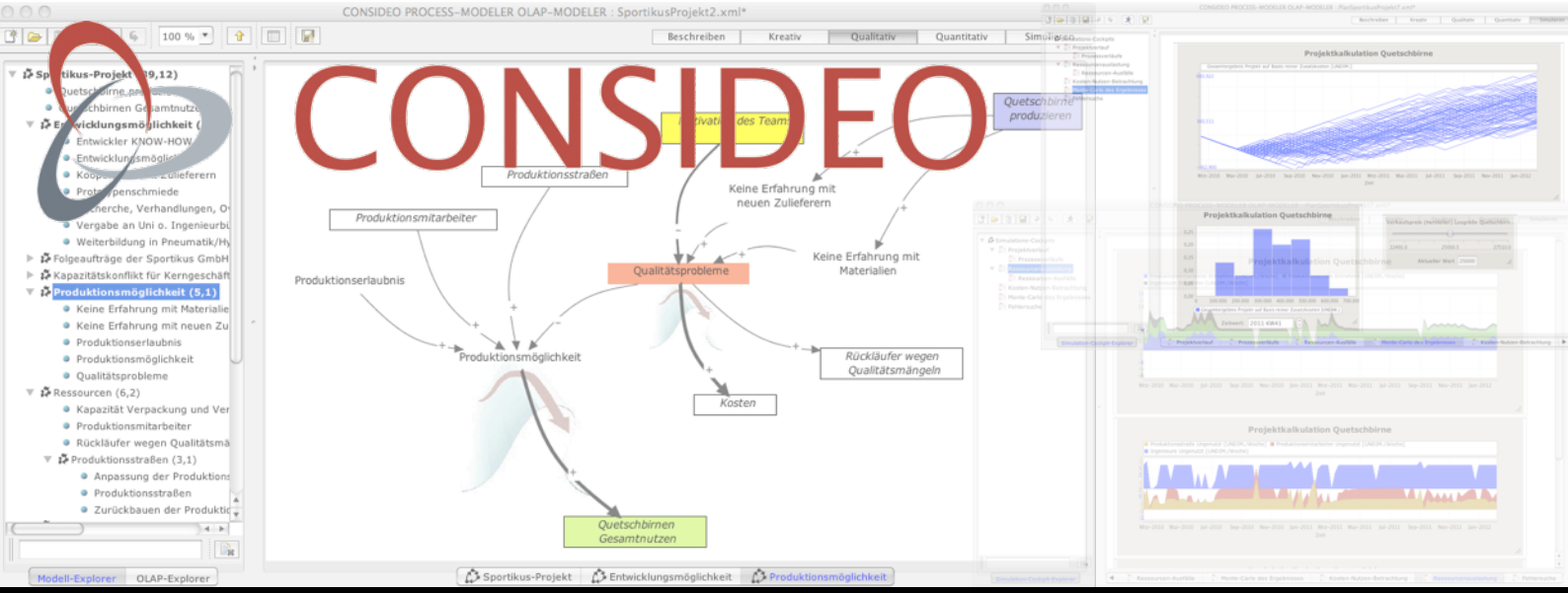

How to Master Complex Projects

Systemic Project Management with KNOW-WHY and the MODELER / PROCESS MODELER

Kai Neumann

… please think for the environment before printing this e-book …

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How to master complex projects

Projects fail because the crucial interrelationships where not taken into consideration
Most projects fail because the crucial interrelationships that exist in a given project are either not taken into consideration or their possible effects are grossly underestimated.

But even if we have the necessary insights regarding these connections, successful project management still depends on our being able to clearly communicate our insights to others and also on our acting according to them.

When we use cause and effect models we can foresee most of the possible effects that these interrelationships will have. If we do not model, we will come up against our mental limits, and we will negligently rely on our limited gut feelings.

By applying KNOW WHY Thinking, we can identify the crucial factors that exist in a complex situation. This also means that we can systemically predict the success of a given project.

With the help of the CONSIDEO PROCESS MODELER, we can run scenarios to determine the effects that complex interrelationships in a project might have.

KNOW WHY Thinking, modeling and the project team's awareness of all dynamics at hand result in systemic project management.

What causes projects to fail?

According to studies[1] between 50 and 87 percent of all projects do not come in on time, on budget, and on quality. This is the reason that project management has been such a booming topic during the last few years, and also why there are so many new tools, methods and training courses on offer. However, recent studies show no signs of improvement—despite all of these measures.

The reason that so many projects still fail is due to the fact that these tools and methods do not

help to identify the various events and dynamics that may arise during the course of a project on account of the complex interrelationships at hand.

You will certainly agree that in almost all cases the reason that projects fail is due to the fact that effects have been underestimated or because crucial factors have been overlooked.

A systemic approach to management, however, holds the promise of helping executives to manage in complex environments. Nevertheless, even after more than 50 years of systems theory and systems thinking, only a handful of managers know about—and speak of—systems thinking. And only a few actually apply it. This is most likely due to its rather

[1] http://spatialnews.geocomm.com/features/mesa1/

complicated theories and the need for sophisticated computer software to foresee complex developments.

Together with Consideo, I have simplified systems thinking and developed a software tool that can be used on a daily basis. My concept of KNOW WHY Thinking, the software CONSIDEO MODELER, as well as the CONSIDEO PROCESS MODELER are so easy to use that hundreds of schools and universities around the world use it today to teach systems thinking to our future decision makers.

KNOW WHY Thinking asks that you determine which crucial factors exist within a complex challenge, e.g. in a project. Such factors include all kinds of different incidents, which can trigger dynamics that may at some point become decisive. If we visualize the interrelationships that exist between the factors in a computer model using the CONSIDEO MODELER, we can analyze their effects. We can either model them very quickly—"qualitatively"—using rough assumptions, or "quantitatively" using both mathematical descriptions of the intercorrelations and concrete data to run scenarios on a given project's possible developments.

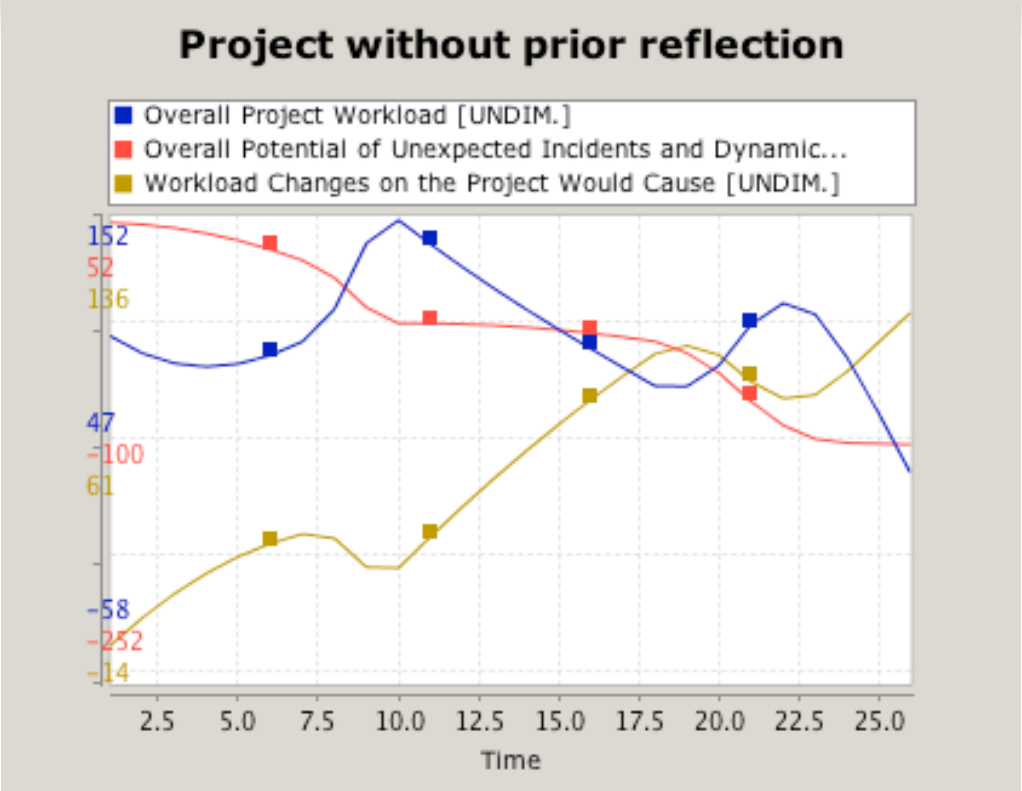
The following illustrations[2] demonstrate the principle behind systemic project management:

Think first - then act!

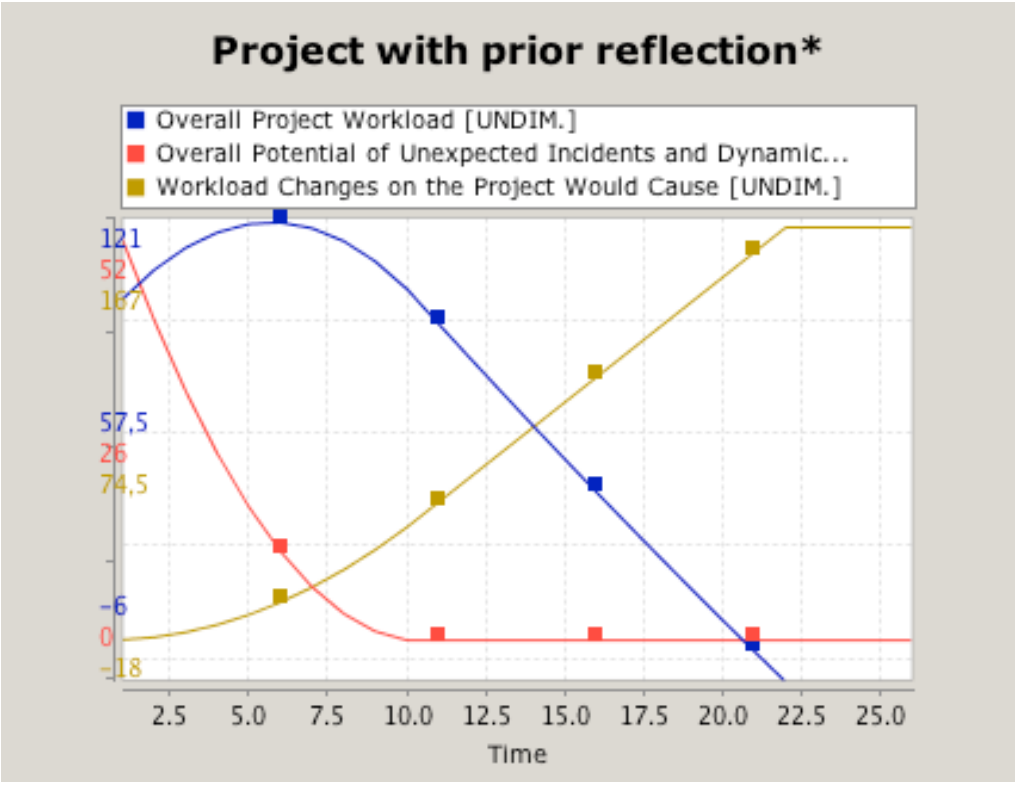
The extra effort you invest in visualizing and analyzing the various interrelationships that exist in your project before you actually begin with it will minimize the likelihood of encountering problems and delays as your project progresses.[3]

[2] These illustrations stem from my experiences while coaching the state governments of Hamburg and Schleswig Holstein in Germany as they planned a multimillion euro project that would introduce a new IT solution. Before the project began, we built a model of the requirements, the dynamics that the use of the new software would create and of both the hard and soft factors of its implementation, as well as the organizational changes that would ensue.

[3] Thinking about all of the various factors that exist in a creative and systemic way—by using KNOW WHY Thinking—can be described as taking a "holonic" or "holarchic" approach, which is a combination of holistic thinking and reductionist modeling of cause and effect structures. I provide an in-depth explanation of this approach in my book entitled "KNOW WHY: gain insight - get success" (2010).



Pic 1: The longer a project takes to complete, the more unwanted incidents may occur, which will result in higher costs.



Pic. 2: Although the start of a project will initially be delayed due to applying KNOW

WHY Thinking and cause and effect modeling, it will be completed earlier and risks will be minimized.

The project that I use as an example in this e-book could just as well have been undertaken by a company in the service, software or machine tool industry. In this case, the company in question is an automotive supplier of illumination components. The company is considering getting involved in an additional project to utilize the resources that were set free by the crisis in the automotive sector. It was offered the opportunity to produce a new gadget for a supplier of fitness devices called a Squeeze Pear. This item is the size of a pear and customers squeeze it to alleviate their frustration or anger. The force of their squeeze is indicated on a nanometer display or by a different number of lights turning on.[4]

Here are some examples of complex challenges that may arise from various interrelationships that exist in a given project:

- The aim of the project and its benefits have been misinterpreted. It turns out that even doing the project makes little sense. During the course of the project—often without the continued support of management—employee motivation will decrease significantly, and not just for this one individual project. (Example: a renowned oil company invests roughly one million dollars a day over an 18-month period to implement a major ERP software solution before everyone realizes that they have chosen the wrong tool).

- Making specification changes—regardless of whether these changes could have been prevented or not—may lead to expensive stockpiles of unusable unfinished products. The change will, of course, cause employee frustration, and in many cases employees may even have to undergo time-intensive retraining.

- Wrong and/or late deliveries from suppliers teach us important lessons on how to prevent this from happening in the future. However, it is important to note that it is seldom simply the delay of a delivery that creates a problem, but rather the resulting chain reaction. E.g. follow-up processes must be postponed to a time when the resources are actually needed for other processes, which means that the overall delay will exceed that of the original delay caused by the late delivery. (Example: when Terminal 5 at the London Heathrow Airport opened, personnel training had started too late, and this had disastrous consequences on baggage handling).

- Possible resource outages require that we calculate buffer times. The challenge is to identify both the reasons for the resource outage and have countermeasures ready for such a situation. Otherwise, for example, we risk buffers that are too short to lead to a lucrative project or too long to remain competitive in a bidding process.

[4] the idea for this and similar products I have first published in my German book "Modelst du schon - oder tappst du noch im Dunkeln?"

- Loss of competence if employees leave the team. The challenge here, too, is to identify the reasons that have made employees decide to leave and have countermeasures ready for such a situation.

- The trap of multitasking: parallel to the current project at hand, resources are also needed for other projects and tasks as well. The challenge is to minimize multitasking—or to at least make sure to consider its effects during the planning of a new project.

- Another classic challenge: bottlenecks—or constraints, as E. M. Goldratt refers to them in his theory of constraints (ToC). In any project or process there are resources that are constantly in use, so called constraints, that limit the overall throughput. We can quicken a process or project only by identifying the constraints and by removing them if possible. Another challenge that results from bottlenecks is minimizing stockpiles resulting from resources that have not been fully utilized: the non-constraints.

- Insufficient quality checks that result in rising follow-up costs. It is, of course, necessary to differentiate between errors that do not cause any additional costs and errors that result in the need for repeating process steps—which is both time and cost-intensive as it will probably also block running processes.

- Decreased employee motivation that lowers performance. The challenge is not only to know what motivates your team but also how to detect any diminishing motivation. This is important because less motivated employees have a negative influence on other members and actually serve to lower motivation within the entire team.

- Underestimating the complexity of a project's environment. (e.g. the escalating development costs at Boing and Airbus)

Please take a minute to think about some publicly known or smaller projects that did not come in on time, on budget, and on quality. What were the reasons for this? I am pretty certain that the causes somehow can be explained with underestimating the complexity of the project, with one or more unforeseen developments and with the fact that certain factors had been left unconsidered. You will probably agree with me when I suggest that it—at least in theory—would have been possible to devote some attention to all of these "causes" before embarking on the project—at least before they began playing a role in it.

The standard methods and tools used within project management only implicitly address these "causes".

Established project management methods

The following measures and methods—at least in theory—are widespread within management:

- Improving project preparation

- Improving communication
- Improving the planning of project step sequence (critical path or critical chain)
- Improving the allocation of resources
- Making quality controls mandatory
- Applying knowledge management to secure and share competencies
- Applying methods, such as the water fall, the V-model, the agile, the scrum and the XP method, etc.
- Applying the theory of constraints (ToC)
- Etc.

I imagine that neither being faced with complex challenges nor applying the aforementioned measures are new to you. However, neither one of these lists is exhaustive. It is also important to note that not every point will be applicable to every project. Furthermore, the measures that are adopted strongly depend on the mentality of the project team at hand.[5]

The challenge, therefore, is to identify all of the challenges that exist in a given project case-by-case, as well as any further project risks at hand, and also to develop concrete measures that the project team is able to execute. Recognizing the unique interrelationships that exist in each and every complex project will result in systemic project management. But yet another challenge still remains: finding a way to not just think and speak about systemic project management, but to actually establish it as a new culture of thinking, working and communicating in your project team.

In order to help you to identify both potential risks and successful countermeasures, I will now explain the method of KNOW WHY Thinking. I will then present you with cause and effect modeling that uses the CONSIDEO MODELER and the CONSIDEO PROCESS MODELER. These tools can be used to foresee both the impact of project risks and the effectiveness of various measures. Finally, I will give you some advice on how to motivate your team to adopt systemic project management.

KNOW-WHY-thinking: what are the crucial factors ?

Allow me to now give you a brief overview of KNOW WHY Thinking and the KNOW WHY Method.

To begin with, I developed both because I concluded that in most cases the existing systems theories do not explain why something—be that an enterprise, a product, a project, a communication strategy, or a policy, etc.—is successful or unsuccessful. In my mind, these theories only provide descriptions of a given system's behavior, but do not

[5] P. Hamilton describes in "Dynaxity" how the application of scrum and other agile project management methods depend on a team's mentality.

give explanations as to WHY. Apart from this, for most managers they remain much too complicated to establish in actual planning and decision-making processes. And although many claim to be systems thinkers, frankly only a handful actually do more than simply announce that it is necessary to see interconnections and that hierarchies within organizations need to be flattened so that they function like self-organizing, living organisms, as defined by cybernetics.

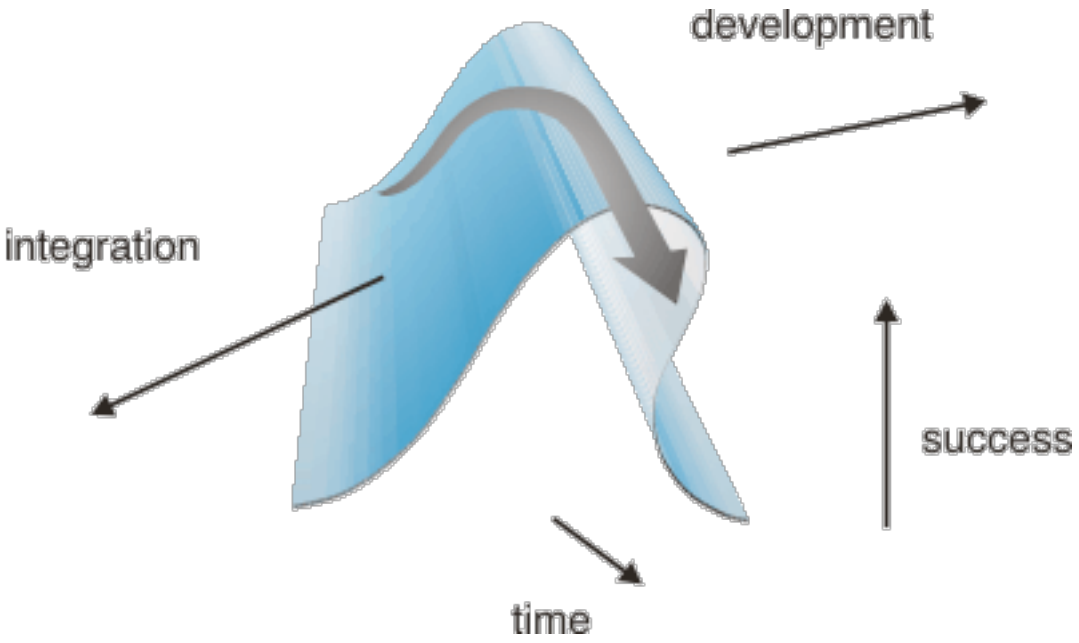
KNOW WHY Thinking also follows cybernetics, but it does not seek to determine fixed structures, but rather to find a general pattern of success:

According to KNOW WHY, success depends on two things: integration and development. This is to say that any given thing must be able to both become integrated into the environment that it is in and also to develop as the environment that it is in changes or in order to remain competitive.

Integration and development - both are needed to avoid failure

This meta-systemic principle and pattern of evolution can be applied to explain the success of everything from enterprises to politics, strategies, products, human relationships and even texts (such as this one), etc… Although this may sound a bit trivial to you, believe me when I say that this simple fact can be extremely powerful when reflected upon on a daily basis.

We can easily think about our challenges and the environment that we are in with the help of the so-called KNOW WHY Wave:



Pic 3: The KNOW WHY Wave is an iconographical depiction of the surrounding environment of a given thing—where it lives or has been placed into. The higher something is positioned on the wave, the more successful it is. Of course, the wave is constantly in motion. Any given thing is therefore required to continue developing in order

to ascend on the wave—ensuring that it gains more success or that it just keeps up with the wave's movement. However, if a given thing develops without at the same time also integrating into its environment it may suddenly slide off the wave. The end result: no success at all.

Human behavior, too, can be directly linked to this pattern. We are motivated by our feelings, and every feeling we have causes us to either integrate or to develop. Allow me to give you an example: every gadget we buy gives us a sense of development. Being a fan of something, or being a part of a group or something larger than ourselves gives us a feeling of integration. Interesting is also that there is no emotion in our lives that cannot be explained without referring to either integration or development.

It is amazing how we can improve our planning, our decision-making and even our view of the world if we just become conscious of exactly where something is located on the KNOW WHY Wave. Coming back to the example I used before, the automotive supplier's project in relation to the wave might look something like this:

- First off, it is a given that the project is positioned somewhere on the wave. One important question that needs to be asked right off is what the economic goal of the project is. If the project is able to attain this goal—and remain profitable both today and tomorrow—it will stay on top of the wave. If the project does not hope to earn a profit until the distant future, its position on the wave will be well beyond the top of it—with the very good possibility of sliding away from it. Such a project may end up quickly losing the support of the team involved, because the members will not feel any success in the present. This means that the project lacks integration. However, if the long-term goal of the project is integrated into the overall company strategy—and this strategy is made known to the project team—both the project and the strategy will be positioned together (integrated) at the top of the wave.

- Another question that needs to be asked is what the economic, technological and organizational conditions are? Is the project integrated by the capacities or the company?

- On the other hand crucial questions to ask are the following: does this project mean that we will develop? Will it help us to grow? Or might it possibly be an area we do not really want to be involved in anymore?

- Are the resources integrated? Might the project cause too much development for the resources overextending them? The employees, of course, need to feel integrated into the team and believe that the project makes sense.[6]

- How are the milestones integrated into the overall project? And how do they develop? Have the milestones been chosen arbitrarily? Can they change based on how the project develops?

[6] I describe the need to feel integrated—and all that it entails—in detail in my book entitled "KNOW WHY: gain insight - get success."

You might also think that the following aspect is trivial, but truly it is not. Please think of a problem that you have experienced while working on a project in the past. You can even think of a project that failed entirely. I am certain that it is possible for you to describe the problem or the failure of the project using KNOW WHY Thinking, i.e. the project either lacked integration or it lacked development. If you do not think it is possible to think about a certain project in these terms, please send me an email at neumann@consideo.com describing your specific example and I will analyze it for you using KNOW WHY.

Qualitative Modeling using the KNOW-WHY-method

If you tell me that applying KNOW WHY Thinking to projects needs to be done in a more precise and sophisticated way, I agree with you completely. In fact, it is for this very reason that we should always apply KNOW WHY Thinking in combination with the MODELER[7]—aka the KNOW WHY Method.

On the one hand, the KNOW WHY Method helps us to think creatively about the crucial factors involved in a given project and also to systematically build a model. On the other hand, it gives us the chance to interpret a model that shows us both the integration and the development of a given factor.

The KNOW WHY Method is fairly simple. All you have to do is place a factor in your model and then list which factors either cause or hinder the integration of this factor to the left of it, and which factors either cause or hinder the development of that factor to the right of it. In the center, right above the factor, you should place those factors that cause both integration and development. I will illustrate how this is done in the following section.

Once you have done this for one factor, you should place more factors in your model and continue as I described above—in most cases using submodels to ensure that even very large models always offer a clear overview.

For some factors it is also often helpful to place a picture of the KNOW WHY Wave in the background.

The automotive supplier from the previous example has a difficult decision to make regarding the complex project the company is contemplating to take on. Will it be a successful endeavor? How will the project influence core business? Does the company have the technical and engineering expertise to do the job successfully? What are the risks involved?

It is common practice for many companies to make these kinds of decisions by simply asking their engineers if they feel up to the task. This is, of course, after the economic

[7] Every year the Verein Deutscher Ingenieure (Association of German Engineers) publishes a list of "world champions" from Germany. In 2009 and also in 2010, the MODELER was named the leading tool for visualizing and analyzing complex situations.

aspects of a given project are taken into consideration. What will the project cost? At what volume will it become profitable?

As far as the automotive supplier is concerned, the company's capacities had not been fully utilized during the crisis, so the decision is made to go ahead with the project.

We will take a look at where this will lead them.

Please note: there will not be one "correct" way to model a given scenario. This is because there are so many different ways to reflect on a situation. But never forget, every model you create will take you further than if you had not modeled at all.

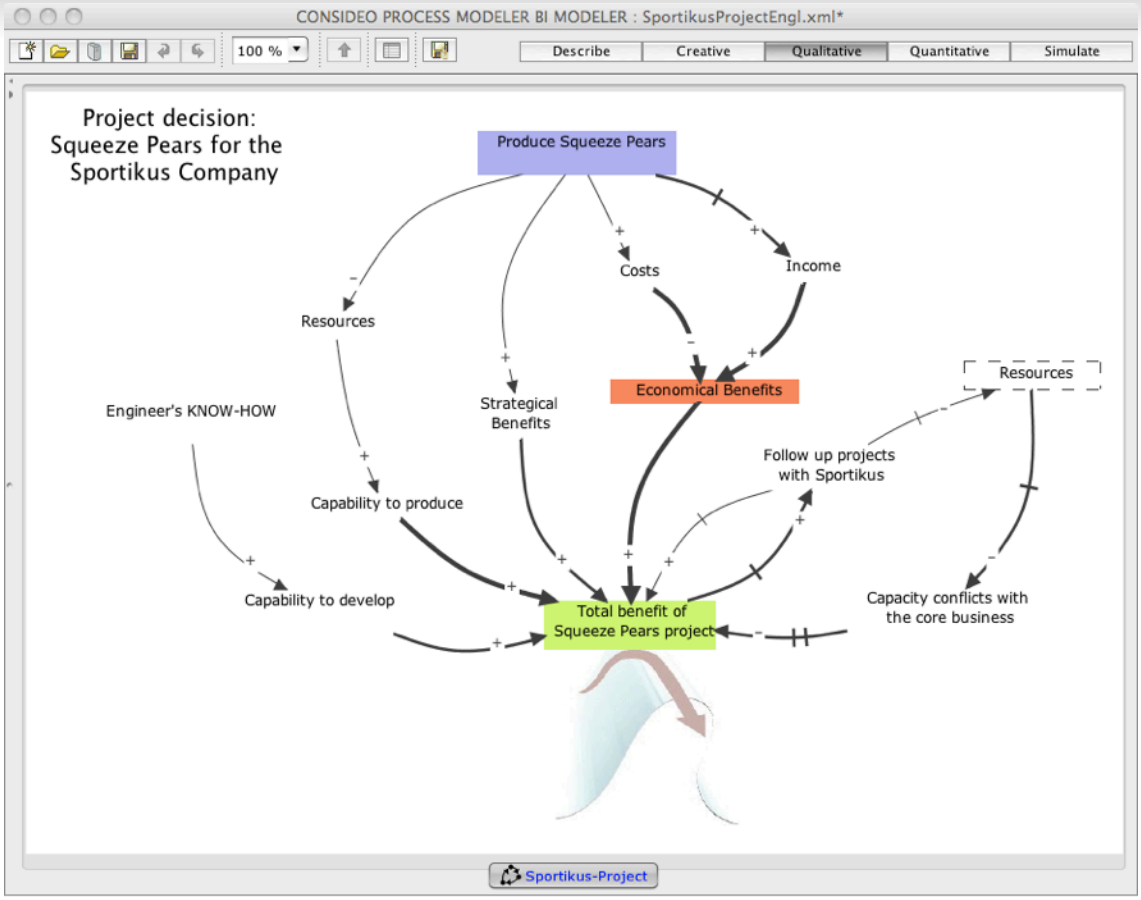
Quick-start: thinking creatively about a project

And now back to the automotive company. It has determined that "the total benefits of the project Squeeze Pears" is a main factor and places this as the first factor in the model. The company team then brainstorms what factors influence both the integration and development of this factor. The first answers that they come up with are, of course, factors that describe whether or not the product can be developed and manufactured by them, and also if it will be profitable.

Especially when you beginning to model, it is important to think of as many factors as possible—not only considering the most common ones, which are hardly ever the underlying reasons that a project will fail. Using KNOW WHY means asking what factors will influence a project in the near future, and what the affects of those factors might be. This method ensures that not only profitability will be considered, but also strategic benefits and the possibility that capacity will be limited when the core business rebounds.

The company members continue to brainstorm—looking for everything that might influence both the integration and development of the factors. What is the manufacture of the Squeeze Pears dependent on? Will this change over time? What things influence both short-term and long-term profitability? And so forth…

To then clearly show what the positive and negative effects on the project are, they place the factor 'Manufacture of Squeeze Pears' at the top of the model, showing the effects it has on the factor 'Total benefits of the Squeeze Pears project'.



Pic. 4: An example of the first level of a qualitative model for the automotive company. It applies the KNOW WHY Method and shows the interrelationships that exist in the project.

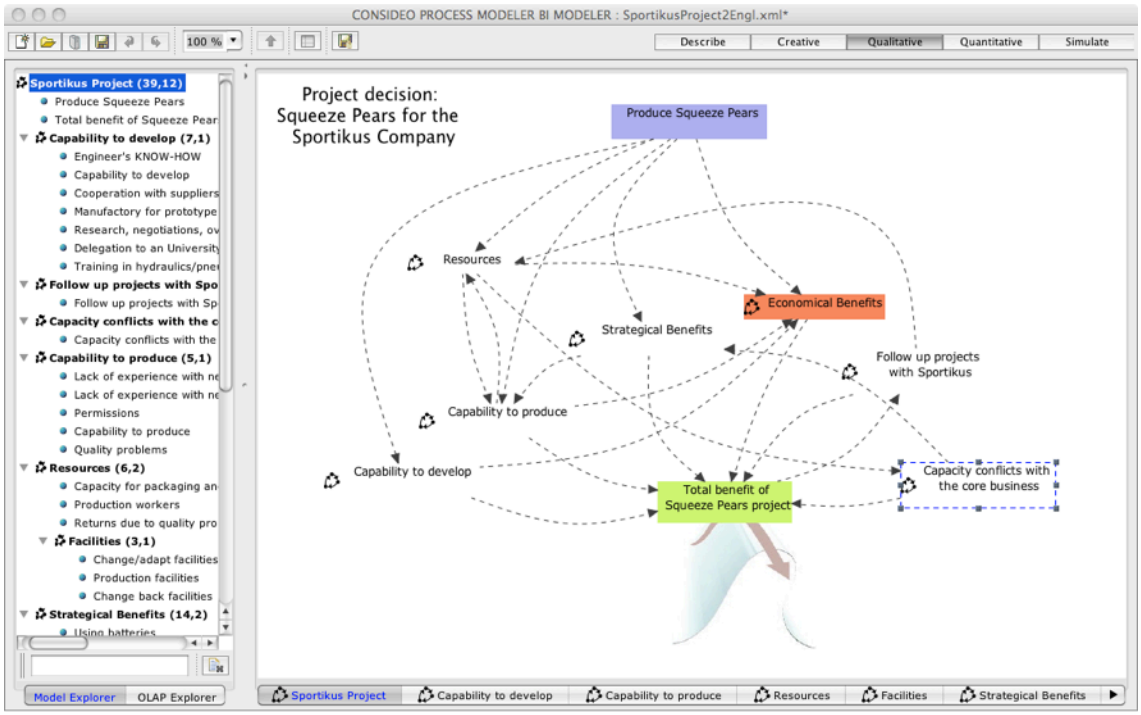
Since some members in your team might find the terms 'integration' and 'development' too abstract, you should consider asking the questions differently as well:

- What causes something to integrate and what hinders it?
- What is something dependent on and what needs to be eliminated?
- What are the conditions like today? What obstacles are there?
- What will conditions be like tomorrow? What risks are there?
- How will something develop? Can it develop? Is it required to develop?
- What will be different tomorrow?

Already at this first level of modeling, the automotive supplier can develop a gut feeling about whether or not the project is integrated, whether it will help the development of the company and if there are any imbalances at hand that may lead to failure:

- As far as development potential is concerned, the company is positioned beyond the crest of the wave. This means that the engineers will probably need additional training. The project asks for too much development.
- Regarding the ability to manufacture the product, the company is positioned right at the top of the wave. Some minor adaptations need to be made, but there is no reason that they could not easily be able to produce it on their assembly lines.
- The profitability of the project is positioned far away from the top of the wave. This is on account of the fact that this job is just too small to be called a major development.
- As far as the company's strategy with regard to this project is concerned, it is positioned beyond the crest of the wave. This is due to the fact that the project is not integrated into their current business strategy—which is to be the leading supplier of illumination technology for the automotive industry.

The company can continue to reflect on the project in this manner—applying a combination of gut feeling and KNOW WHY Thinking. However, it is important to note that for a project of this size it would be grossly negligent to rely on gut feelings. Therefore, it is pertinent that the company continue to model the interrelationships that exist in the project using submodels:

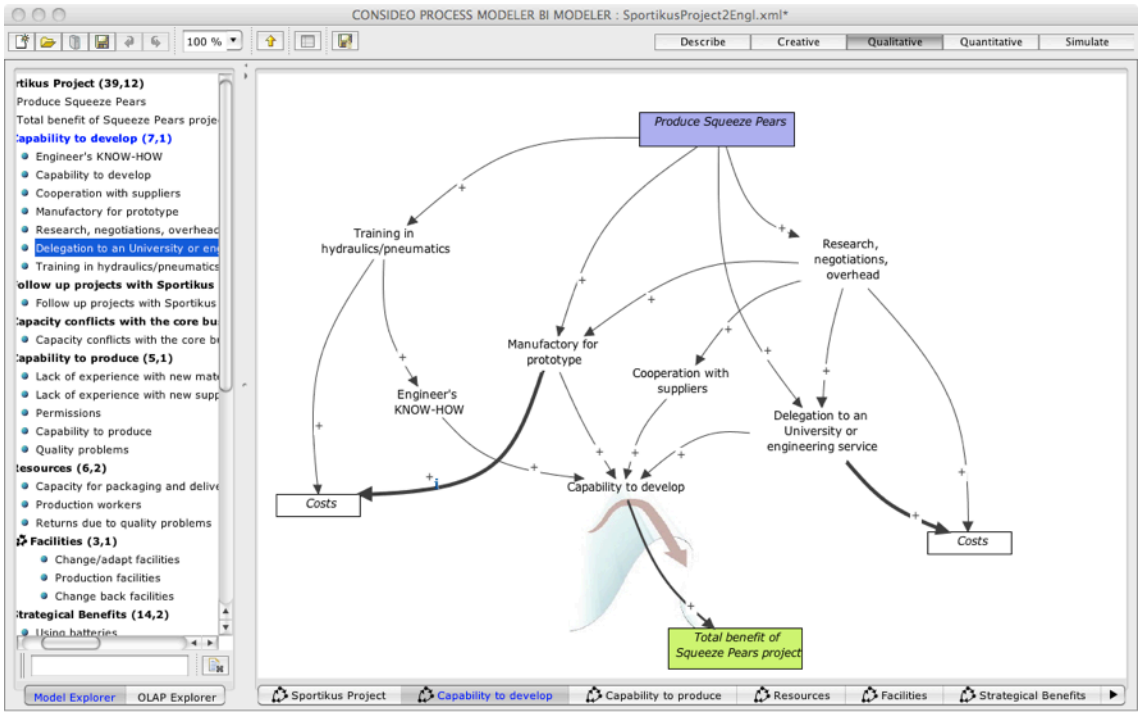


Pic.5: Submodels are used to add even hundreds of factors for a more detailed model. The Model Explorer on the left shows you the structure of the submodels.

The example I show here is a submodel that shows the reflection on the factor 'Ability to develop'. Of course such a model depends on the knowledge of the engineers. It is also

necessary to find a manufacturer for the prototype. Alternatively, the development of the product could be arranged via a supplier or an external engineering service.

The following submodel shows that it is not all too important if you place a factor to the left or to right of the KNOW WHY Wave to indicate the effect it has on development or integration in a given model. The factor 'Contracting a university or engineering service' has in this submodel been placed to the right of the wave, but it could just as well have been placed to the left of it as an alternative to the factor 'Engineers' expertise'. During the reflection process, the company members asked themselves what would happen if they were not able to develop the product, and in order to show the development of their cability to do so, they placed this factor to the right of the wave.



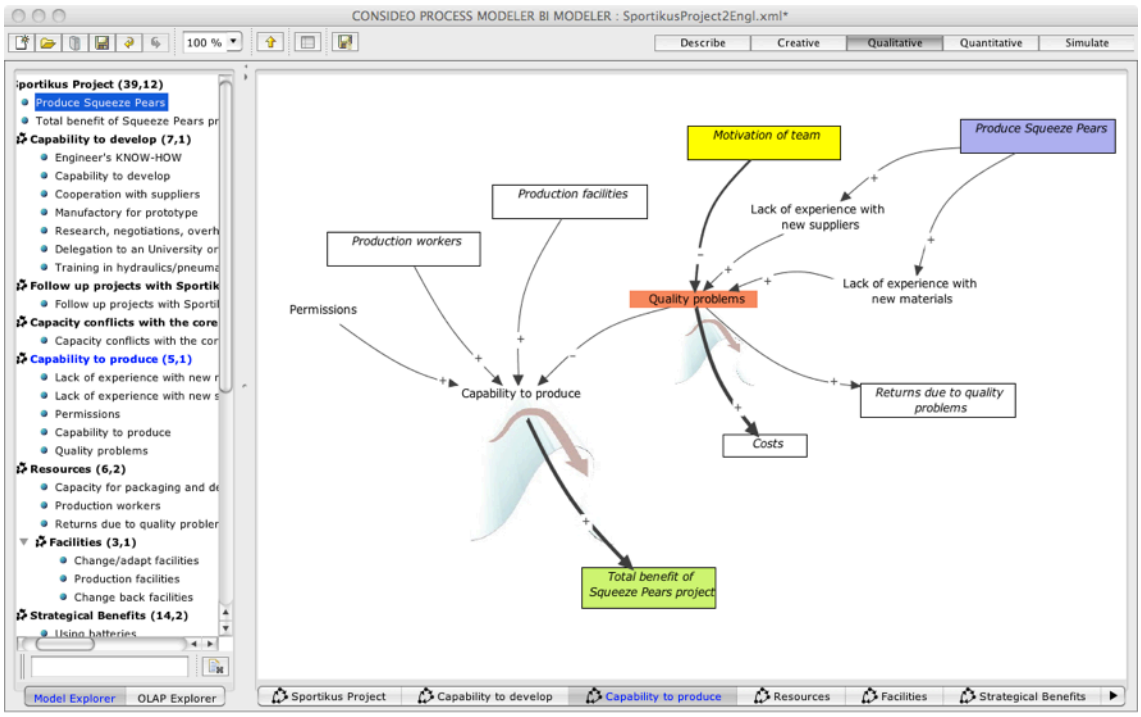
Pic. 6: Submodel for the integration and development of the factor 'Capability to develop'.

One vital factor that must be considered has been disregarded in this submodel: the use of the product. The deficiencies that a product have are often not discovered until after the first generation or the first production batch. The engineers are also usually forced to admit that these deficiencies could have been avoided had they paid more attention to these aspects of the product before it was manufactured. When you apply KNOW WHY, it will help you to think of a whole host of factors, e.g. the different ways that a given product can be used, the parts that are susceptible to damage, possible material abrasion, safety issues, etc.

Although I do not address the subject of Idealized Systems Design in his e-book, I would like to briefly mention that it also uses KNOW WHY Thinking and facilitates reflection on the use of a product. Applying Idealized Systems Design means that we do not simply go ahead and develop products, but rather begin by thinking what some ideal "science

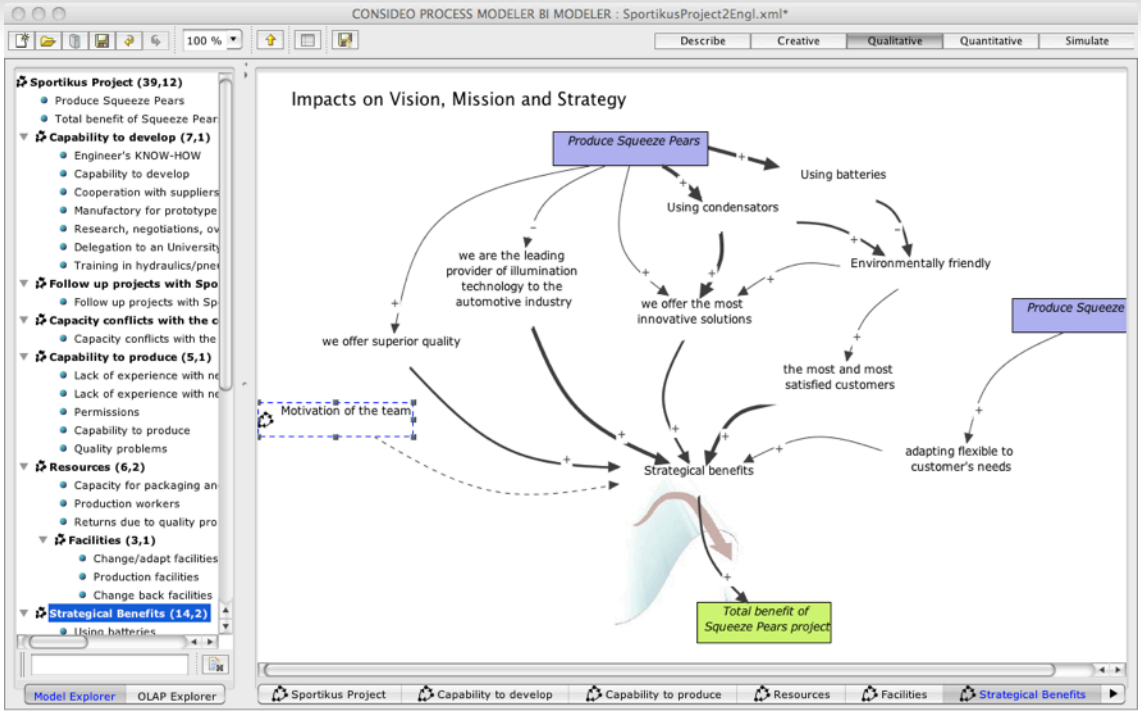
fiction" solutions might be. We take these unrealistic solutions and successively modify them using KNOW WHY until we come up with a feasible solution.[8]

Let us now take a look at some other submodels for the factors 'Ability to manufacture' and 'Strategic benefits':



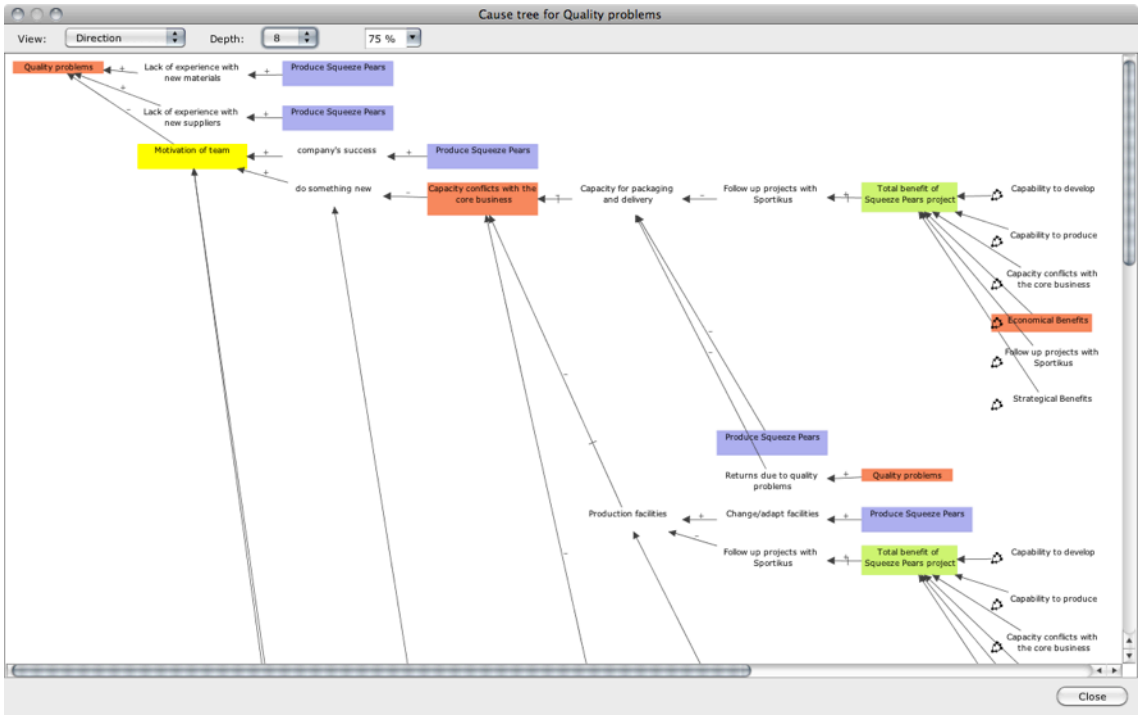
Pic. 7: The submodel of 'Capability to produce'

[8] See "KNOW WHY: gain insight, get success".



Pic. 8: The submodel of the effects that the project will have on the business strategy.

I will not present any further submodels here. You can show cause and use trees for any factor to see the interrelationships that exist across submodels:



Pic. 9: The cause tree of the factor 'quality problems'

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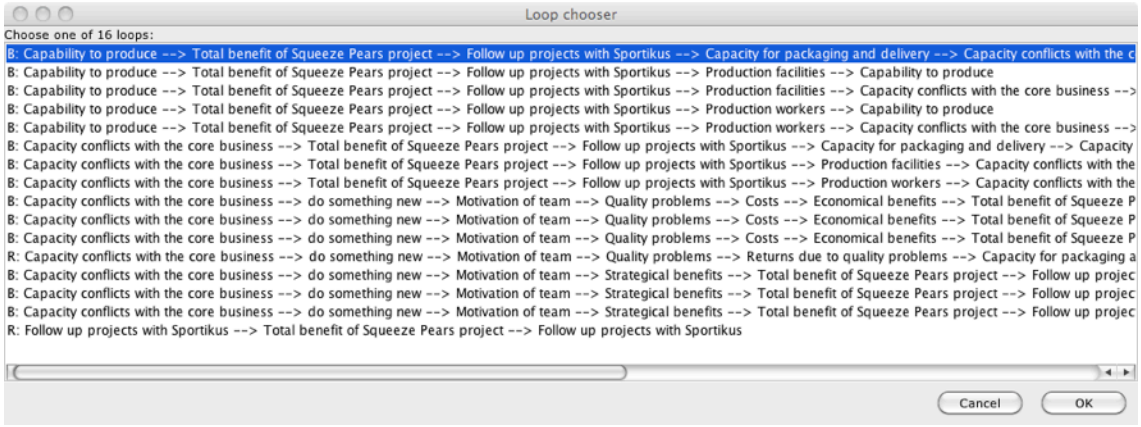
The cause and effect model contains a number of feedback-loops: reinforcing feedback-loops (R-loops) have an increasing impact and balancing feedback-loops have a decreasing impact.

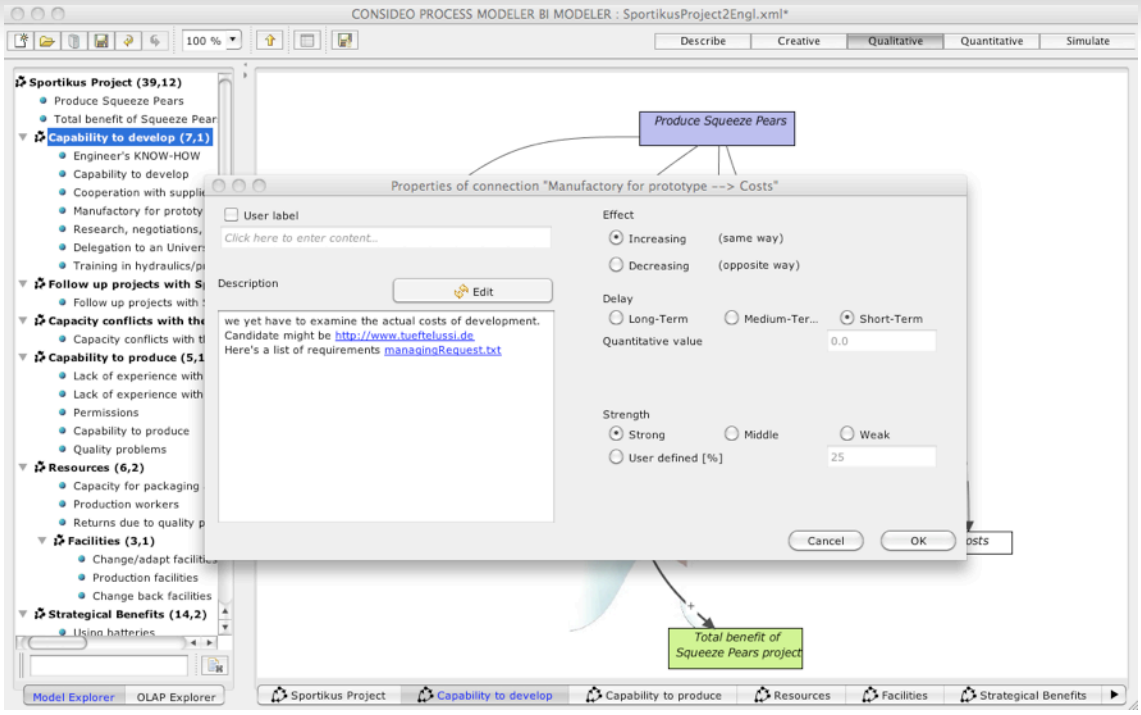


Pic. 10: Feedback-loops cause the dynamic of the interrelationships

Reflecting on a project in the way that I describe here already serves to improve many projects. This is because one is made aware of more aspects involved in the project and these can then be communicated. The MODELER not only allows you to visualize the interrelationships, but also to analyze their implications as well.

Insight Matrix: insights through rough assumptions

To identify short- and long-term measures or potential risks we can roughly weight the To identify both short-term and long-term business measures or potential risks, we can roughly weight the effects that the factors will have on each other. Already these rough assumptions will lead to concrete insights that most likely go way beyond any gut feelings.



Pic. 11: The weighting of the effects

When we roughly weight interrelationships using the attributes "strong," "middle" and "weak," or any percentage value, we refer to this as qualitative modeling. This is opposed to quantitative modeling, where we are required to describe all effects using data and formulas.

The project I have described here is but one example of a possible business scenario. Nevertheless, please take a minute and use your gut feeling to think of what the crucial factors involved in the success of this project might be.

After you have done this, we can qualitatively analyze any factor in the model using the so-called Insight Matrix. On the x-axis we see the short-term impact that the other factors will have on the factor we have selected to analyze. On the y-axis we see the possible change in impact that the factors may have over the long-term due to feedback loops. If these factors are on the upper right, their impact might be increasingly positive, and if they are on the lower right, they might be decreasingly positive. If they are on the upper left, they might be decreasingly negative and if they are on the lower left, they might be increasingly negative.

The ability to do qualitative modeling and to use the Insight Matrix are unique selling points of the MODELER. Doing both is extremely powerful not only because they give you very quick results, but also because it is simply fascinating how the rather fuzzy qualitative weighting of effects leads to a robust analysis of a complex situation. This method is also very useful because even opposing parties can easily agree on rough weightings, while the analysis of concrete figures and data might end up causing long and tedious discussions. If participants of a group modeling agree on a common model is also called mental modeling.

Pic. 12: The Insight Matrix for the factor 'Total benefit of Squeeze Pears project' (without and with zoom)

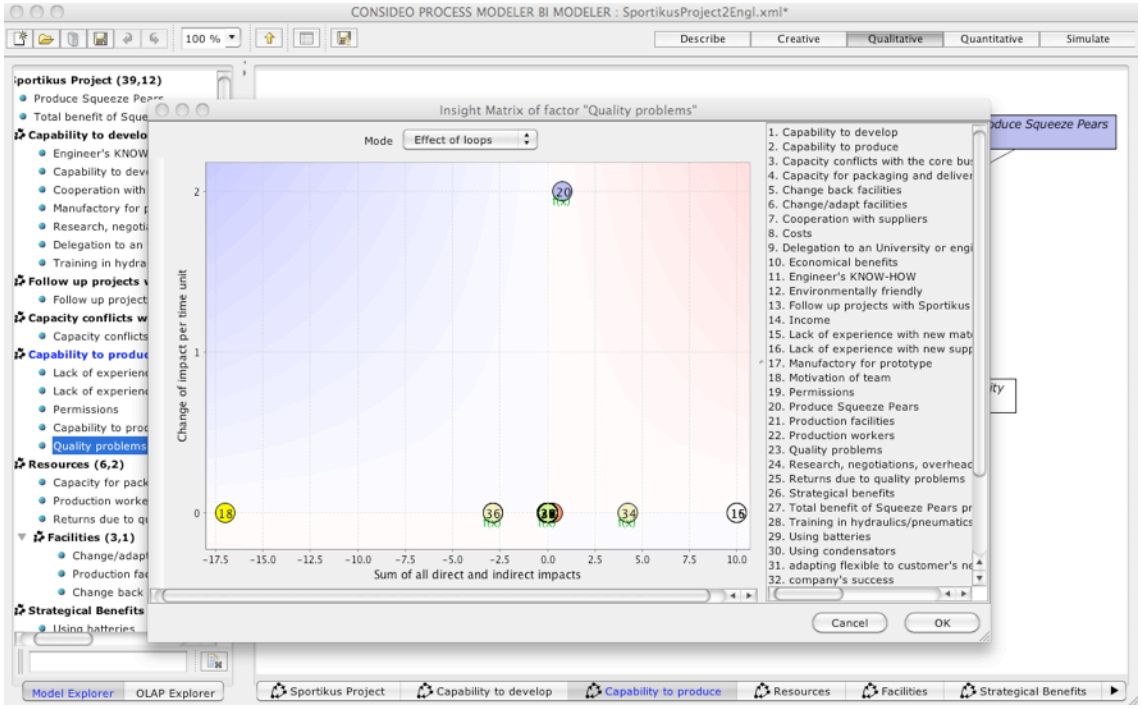
The Insight Matrix shows that the blue factor number 20 is slightly positive on the x-axis and considerably positive on the y-axis, which means that manufacturing the Squeeze Pears will only have slight short-term benefits for the company, but that the potential does exist that the benefits will increase in the long run. The positions of the other factors in the Insight Matrix indicate whether they contribute to the success of the project or appear to put it at risk.

The matrix also makes clear, for example, that team motivation plays a decisive role. To many members of your team and/or the management this may sound trivial, but now you can prove to them just how important it is by showing them the use tree of the factor 'motivation' or the cause trees of other factors.

It is also apparent that factor number 23—'Quality problems'—has a negative impact on the overall success of the project. If you then switch to the Insight Matrix of 'Quality problems,' you will see that 'Team motivation' has a negative impact on 'Quality problems' and therefore a positive impact on the overall project. Please refer to Pic. 13.

The example that I provide here may sound trivial to you, but using the Insight Matrix will help you to both determine and communicate the role that many crucial factors play in your projects. It also helps you to decide which measures you need to take to either make your project a success (positive impact), or which scenarios you must avoid (negative impact).

In many projects, especially the soft factors, such as motivation, communication and learning curves, etc. are left ignored, despite the fact that they are often decisive to the overall success of the projects.



Pic. 13: Insight-Matrix of the factor 'Quality problems'

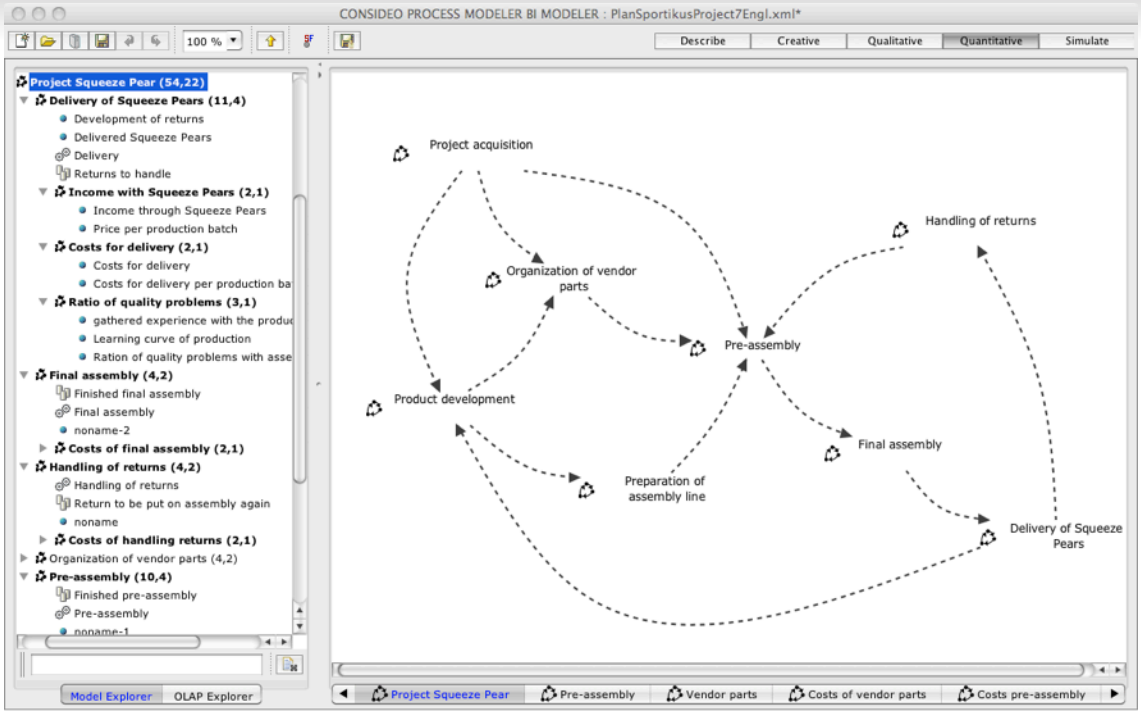
Quantitative Modeling: possible developments of the project in scenarios

Qualitative modeling showed the company what the decisive factors of the project were and also made clear that the project would have some short-term success, but that the long-term benefits looked more promising. The company therefore decides to model the project quantitatively as well. They opt to model the actual costs of the project and the price they need to ask from the supplier of fitness devices for the project to be profitable.

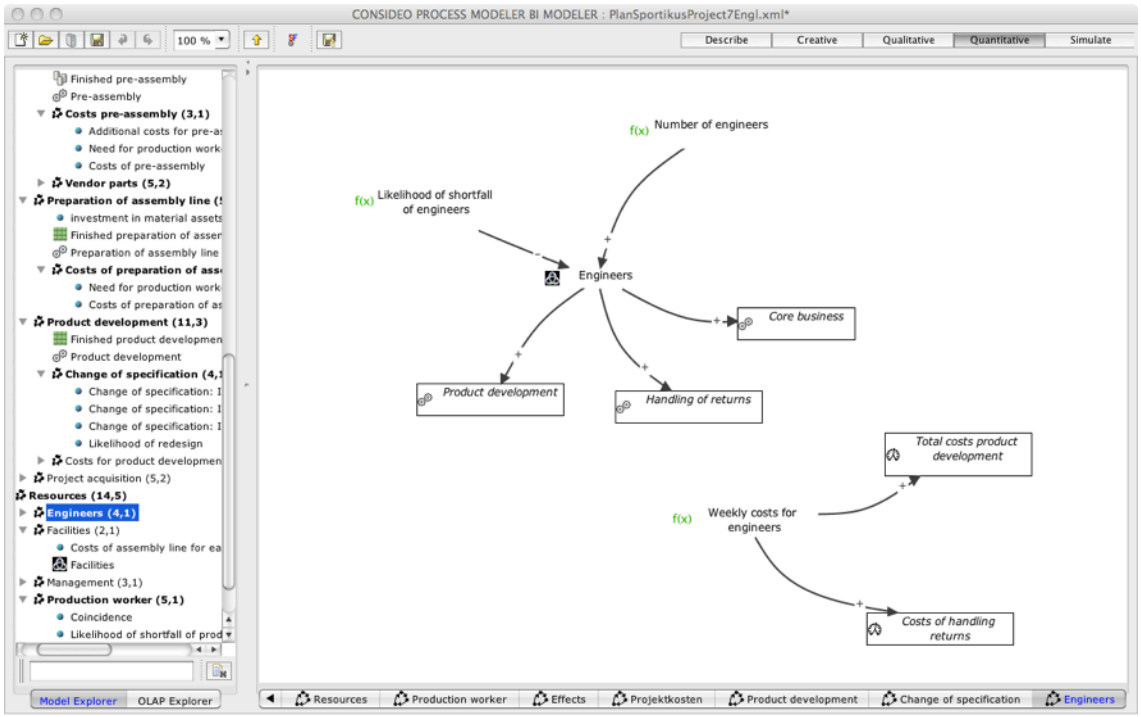
They start by modeling the processes using just the information they would use within the application of MS-Excel or an MS-Project. The PROCESS MODELER, by the way, also allows you to import MS-Project files.

It is advisable to use submodels for all models that have more than 20 factors. For processes and projects, it has also been proven valuable to use a submodel for each project (or process) step, as well as for each resource. Factors used in other submodels will in these cases become so-called 'external factor copies'. They are indicated by a frame. When you use submodels, you can even create models that have thousands of factors.

And the resources can be used to model several steps involved in a project or in the different processes of a project. If you look at the submodel of the resource itself, you can see where it has been used by its connections to external copies of process steps. You can compare this view to that of swim lane diagrams.

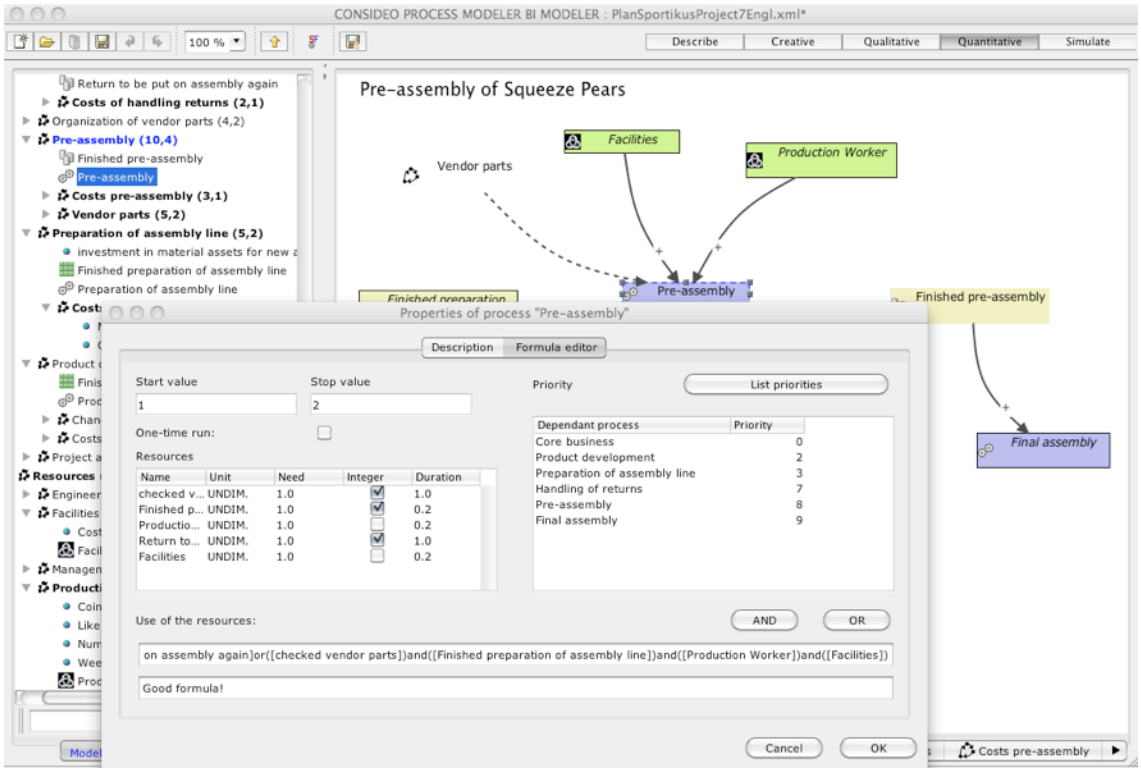


Pic. 14: Submodels for the process/project steps



Pic. 16: Example of a submodel of a resource

Compared to the MODELER, the PROCESS MODELER also features some additional types of factors. You can connect processes, resources and milestones and spare yourself the use of sophisticated formulas. The process factors have their own dialogue window to set the parameters for the need and duration that each of the connected resources needs in order to process one unit of the process step.



Pic. 15: Resource- and process-factors and the parameters of a process step

The PROCESS MODELER takes this information and calculates the shortest possible duration of a project depending on the availability of the resources that are needed. This is the so-called critical chain,[9] implying that the buffer-times for the individual steps are removed from them and added to the end of the project instead. This also means that each project step starts as early as possible, even if it is not a critical one.

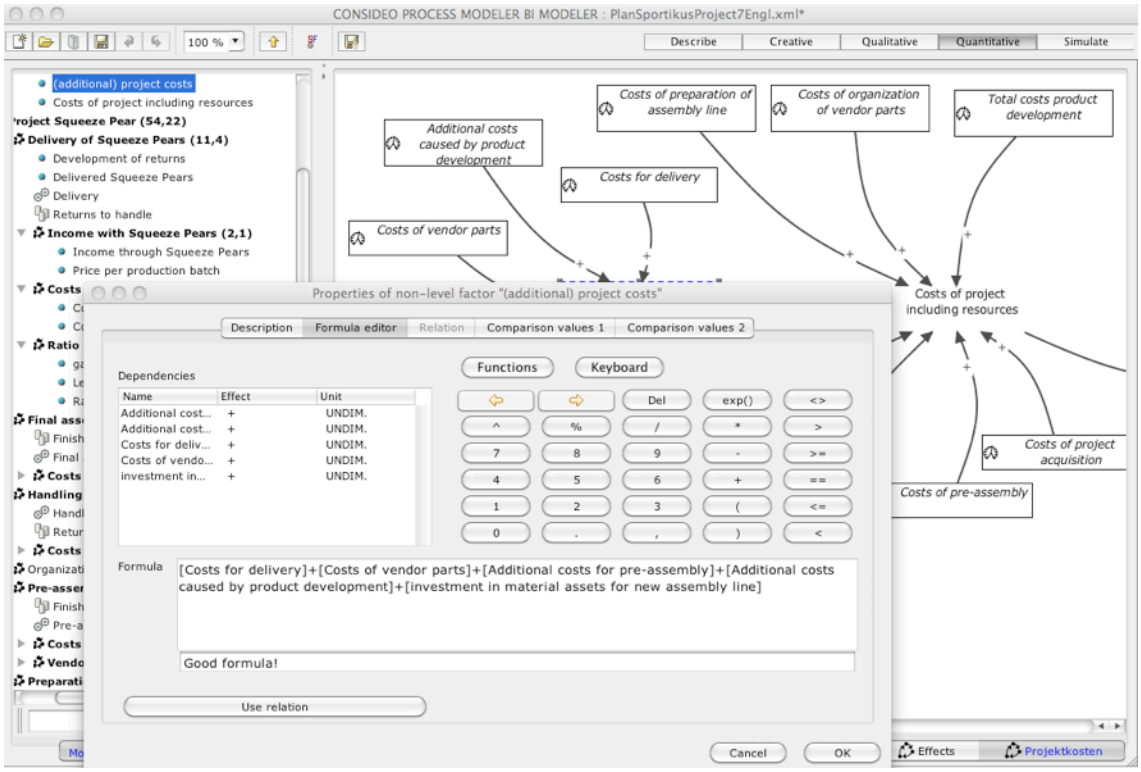
Even more settings can be selected:

- The sequence of process steps follows the list of priorities, but if a process step cannot start because a resource is not available, the next step in the list will try to start.
- It is also possible to define whether it is a project with a one-time run or a process that starts and stops at certain numbers of accumulated items.
- Finally, we can combine resources by using AND and OR. If we use OR, the program will try to use the resource on the left first.

Since the PROCESS MODELER features the same functionality as the MODELER, we can combine process and resource factors with ordinary factors. This makes it possible to describe the dynamics at hand, e.g. of learning curves or project costs.

[9] E. M. Goldratt, "Critical Chain".

The following illustration shows the formula editor for ordinary factors. Using the formulas is just as easy (or difficult) as with Excel. You can use if-then-else formulas, as well as calculate the mean, the max, the min and random, etc.:



Pic. 18: An example of a formula

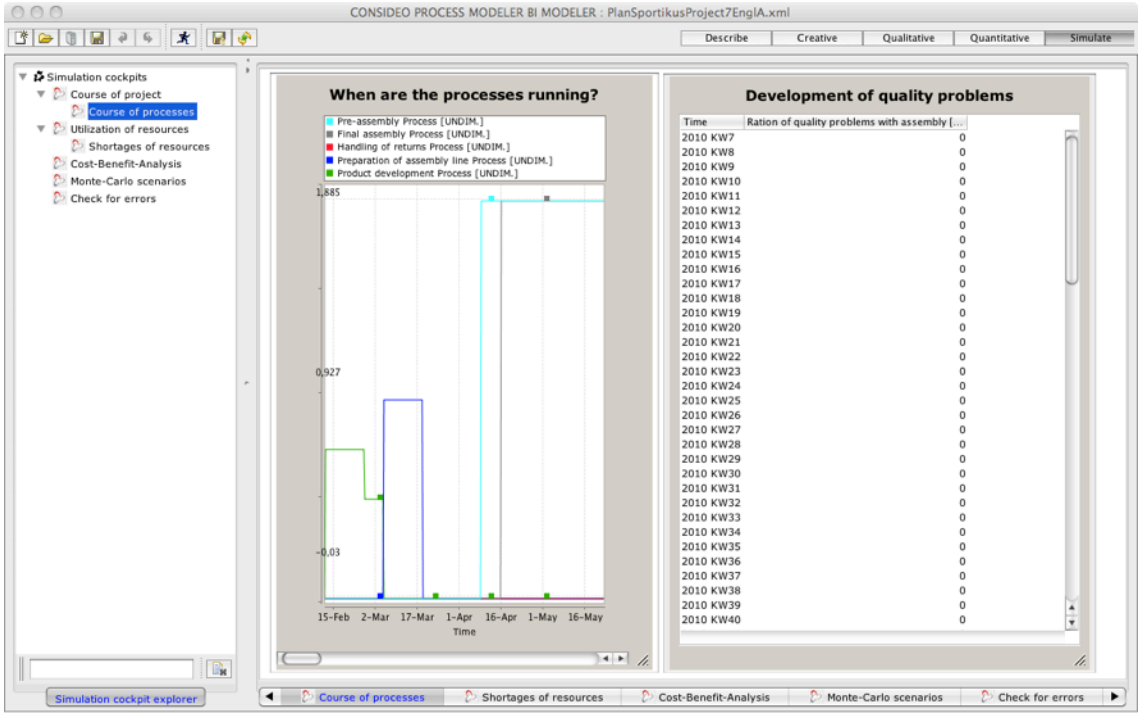
To run simulations, you can set up any number of cockpits using tables, diagrams and manipulators. This enables you, for example, to see the utilization of resources, the levels of finished or semi-finished products, or the dynamics of costs, quality, etc.

Following the principles of the Theory of Constraints (ToC),10 you want to reduce the strain placed on the fully utilized resources—only by improving this will there be an overall improvement—and minimize stockpile levels along the process chains. These levels—with the exception of those found at the end of a project, of course—always indicate suboptimal processes—as they imply storage costs, tied up capital, and the risk of losing capital in the event that they have to be discarded due to one or more specification changes.

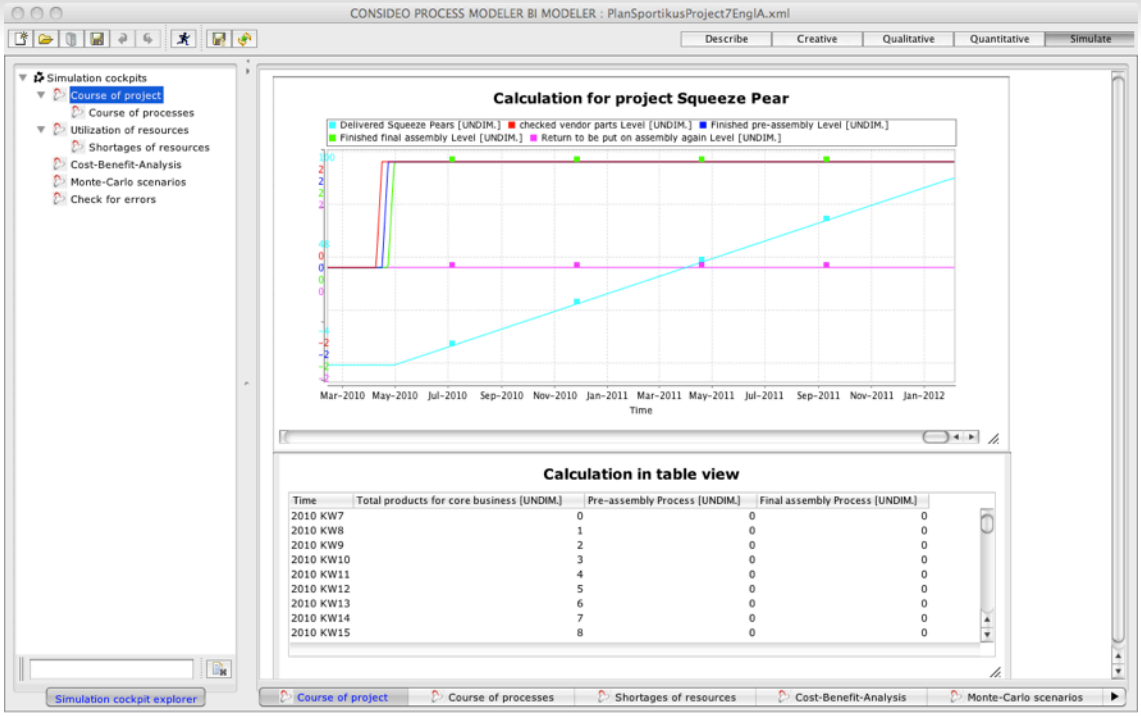
As the following illustrations of cockpits show, the automotive supplier should easily be able to manufacture Squeeze Pears on an ongoing basis. The core business would remain a priority, but the project would serve to optimize the utilization of the company's resources.

[10] E. M. Goldratt, "The Goal".

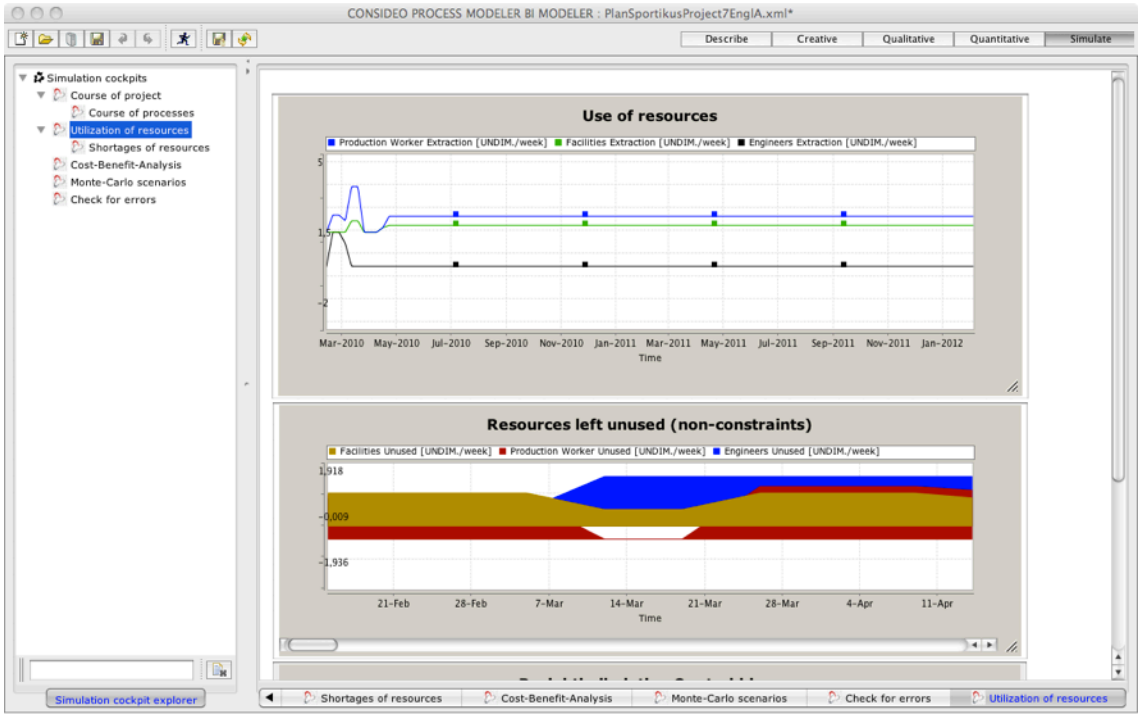
Illustration 22 shows the profitability and the early break-even the project can achieve if the actual costs of the project are taken into consideration—compared to the break-even the project will reach at a later time if the market prices for the use of the resources is taken into consideration. To clarify the break-even or the reach of the targeted profit, a comparison value can be added to the diagram (the red and the green base line in Pic. 22).



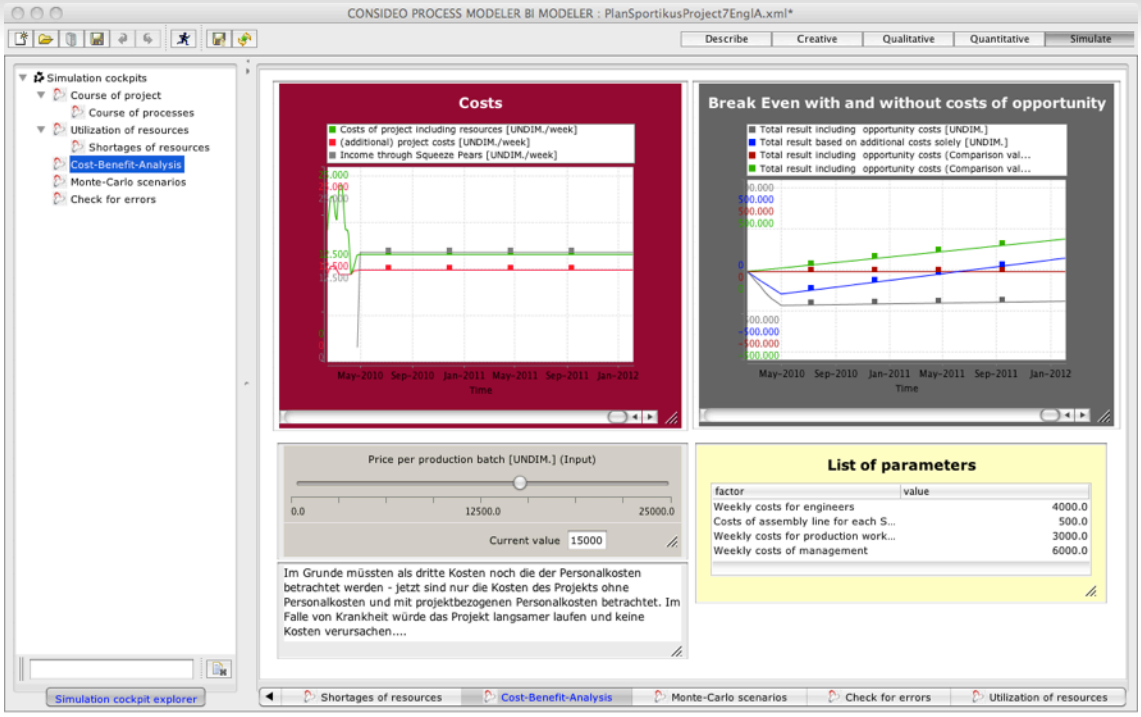
Pic. 19: The project processes



Pic. 20: The amounts of semi-finished and finished products



Pic. 21: The utilization of resources



Pic. 22: The profitability of the project under ideal circumstances

It is clear to see that the project becomes lucrative at a price of 15,000 EUR for each production batch. This price can be changed using the slide manipulator (see Pic. 22) to compare different scenarios.

Complex challenges - example 1: resource outages

It is fairly simple to calculate the resource outage caused by employee vacations. But it can be quite a challenge to take possible sick days or other reasons for outages into consideration without using a simulation model.

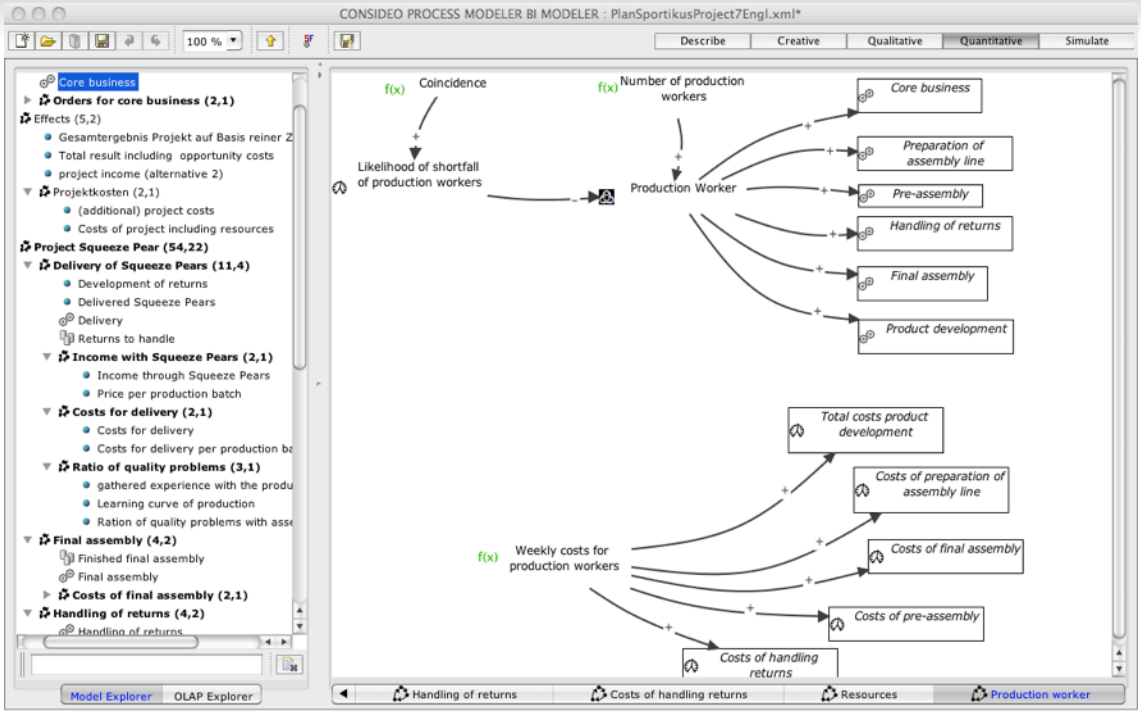


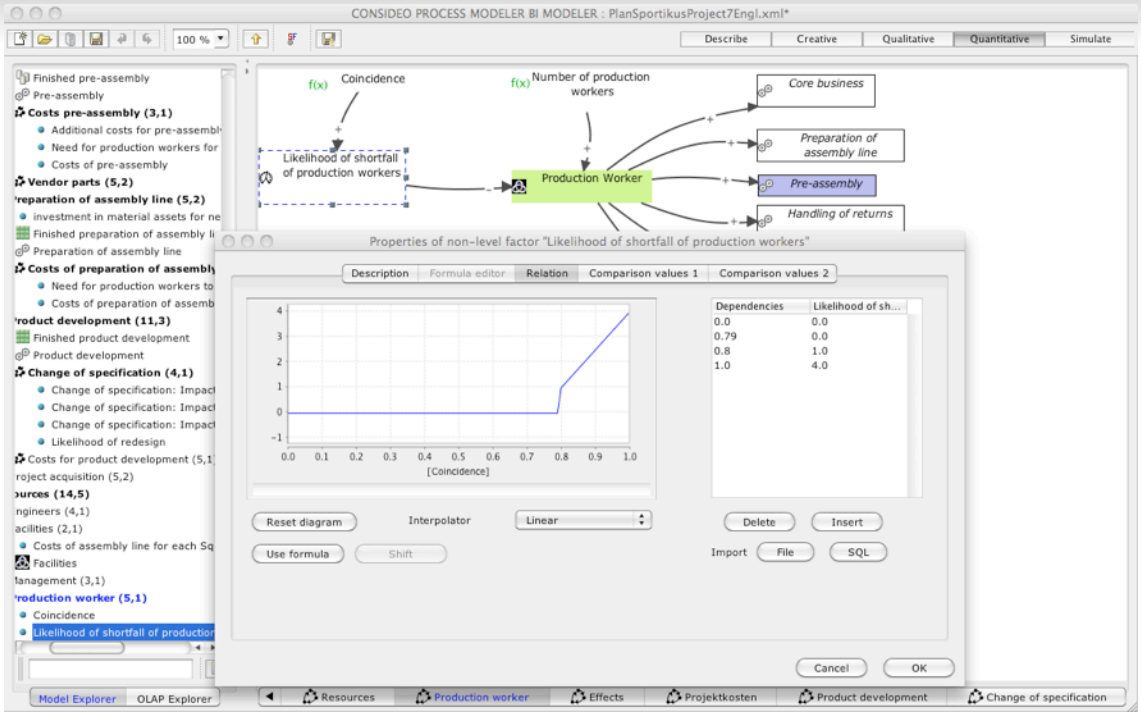
Abb. 23: Submodel for production workers

With the MODELER, you can easily run Monte Carlo simulations on the likelihood of e.g. sick days. If the likelihood that one employee will stay home from work due to illness is 5 percent, then the likelihood that one out of 4 employees will stay home on any given day goes up to 20 percent. And the likelihood that 2, 3 or even 4 employees will stay home on the same day steadily decreases. Illustration 24 shows you one way how to model this.

The MODELER not only gives you the possibility of calculating likelihoods—which you could also do with Excel—but also the chain reactions caused by outages in a complex project. If you face outages of your constraints then the whole process will be delayed. But also non-constraints can turn into constraints if they remain unavailable long enough. In many cases the sequence of project steps will be disrupted and the resources needed at a certain time may be tied up elsewhere. In such a case, the entire project will be delayed for much longer than just the outage time(s) caused by one resource.

And this does not even take into account that employee outages have an effect on both the workload and the motivation of the other employees, which causes reinforcing feedback loops.[11]

[11] Consideo was hired by the Munich airport for a fairly large project. We modeled the soft factors, such as motivation, communication, etc. and then their reinforcing feedback loops. As a result of this, we then developed a kind of dynamic balanced scorecard and identified the successful countermeasures to lower the number of sick days. A report of this project (in German) can be found at: http://www.consideo-modeler.de/papers.html.



Pic. 24: The likelihood of sick days: there is a likelihood of 80 percent that there will be no outage(s), but there is a 20 percent likelihood that one to four employees will take sick leave.

Complex challenges - example 2: the learning curve and quality issues

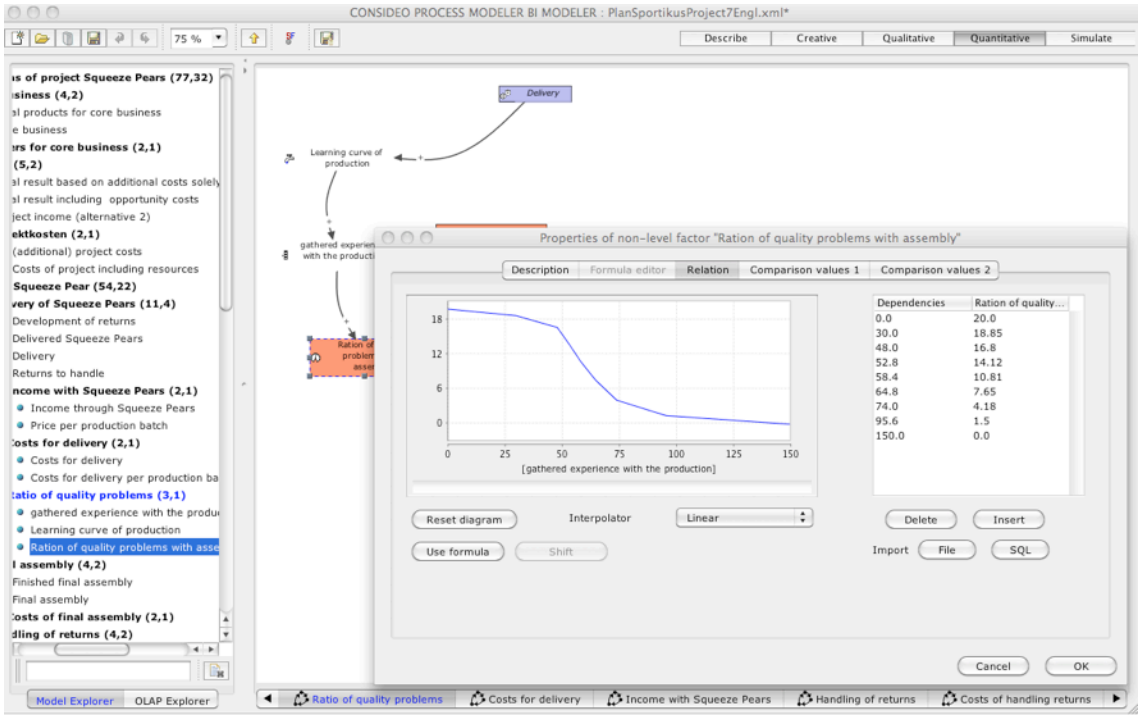
Looking at the famous recalls in the automotive industry or the quality issues we experience when we purchase cheap products, it seems only logical that the company I have been using as an example must calculate a buffer for possible quality issues and product returns. This, of course, also applies to companies that offer services and/or manufacture high-quality products as well.

It is wrong to simply accept inferior quality or ignore quality issues. However, there are many things to consider since the cost calculation of your offer could end up being too high to win a contract, or the actual project costs might cause the project to fail overall. Also the loss of reputation caused by an inferior product or service might serve to hurt your company more. Therefore, you should use KNOW WHY to come up with measures that will keep quality issues to a minimum.

It is always cheaper to think before going into production than fixing what went wrong afterward!

Aside from quality controls and integrating one's suppliers into manufacturing processes, motivation, as well as learning curves and/or the fatigue curve, too, play a crucial role in the quality of a product or service. The following illustrations will show you the basic way of modeling this.

Picture 14 already demonstrated that product returns add to the pre-assembly of the production process. The pre-assembly of incoming orders is delayed and the final assembly and delivery costs arise a second time.



Pic. 25: A freehand sketch of a learning-curve that decreases from 20 to 0 percent.

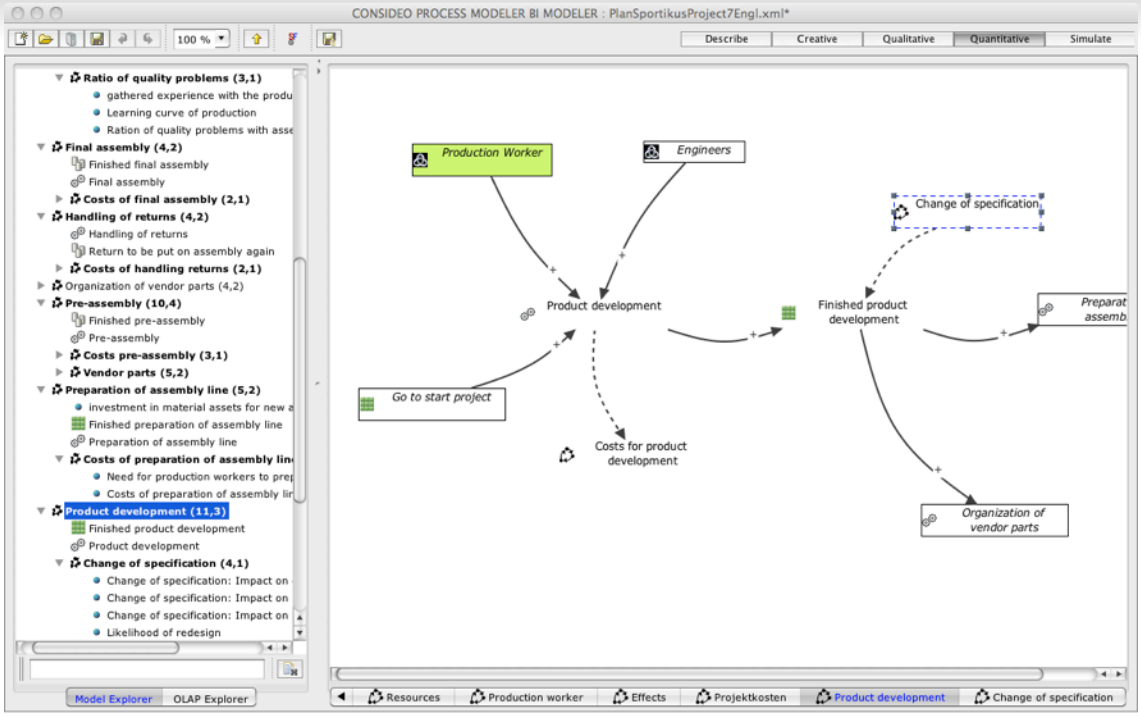
The simulation will show that there's a big difference whether I assume just an average error rate or a decreasing one. The higher returns at the beginning have a major impact on the running processes!

In this case the error rate is given. We can also model the likelihood of errors and their normal distribution using Monte Carlo simulation, which allows you to see the best, the worst and the most likely case scenarios.

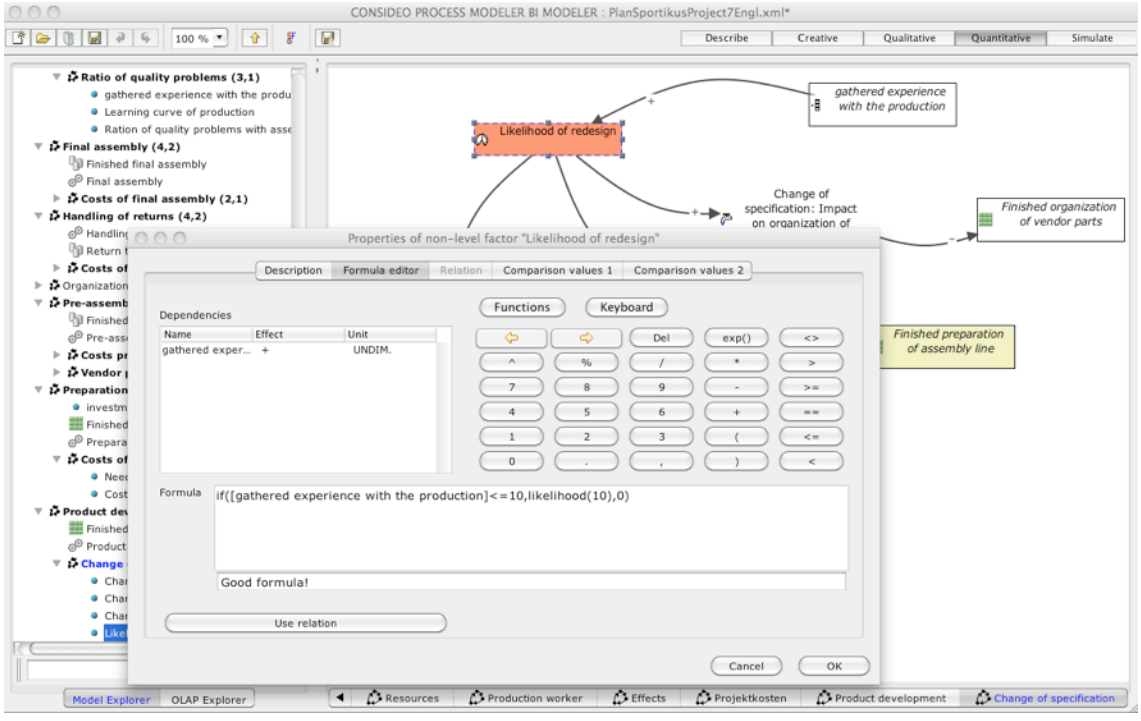
Complex challenges - example 3: the impact of specification changes

Although systemic reflection on the possible use(s) of a product or the possible problems that might occur during production, etc. should minimize the likelihood of needing any specification changes (see Ill. 2), we should know what the implications will be if it does happen anyway.

Let us assume that a specification change means that an assembly line has to be reorganized and that we have to exchange vendor parts, too. In real life, this situation would have to be scrutinized more closely. In this illustration, the specification change causes the milestones 'Completed product development,' 'Complete assembly line' and 'Complete organization of parts from suppliers' to go to 50, 60 and 70 percent, which means that all production will stop until the milestones reach 100 percent again. A specification change in and of itself is defined by an if-then-else function that is dependent on the number of finished production batches.



Pic. 26: A specification change as a submodel of product development.



Pic. 27: A decreasing likelihood of the need for a specification change for the first 10 production batches.

Worst, best and most likely scenarios due to complex challenges

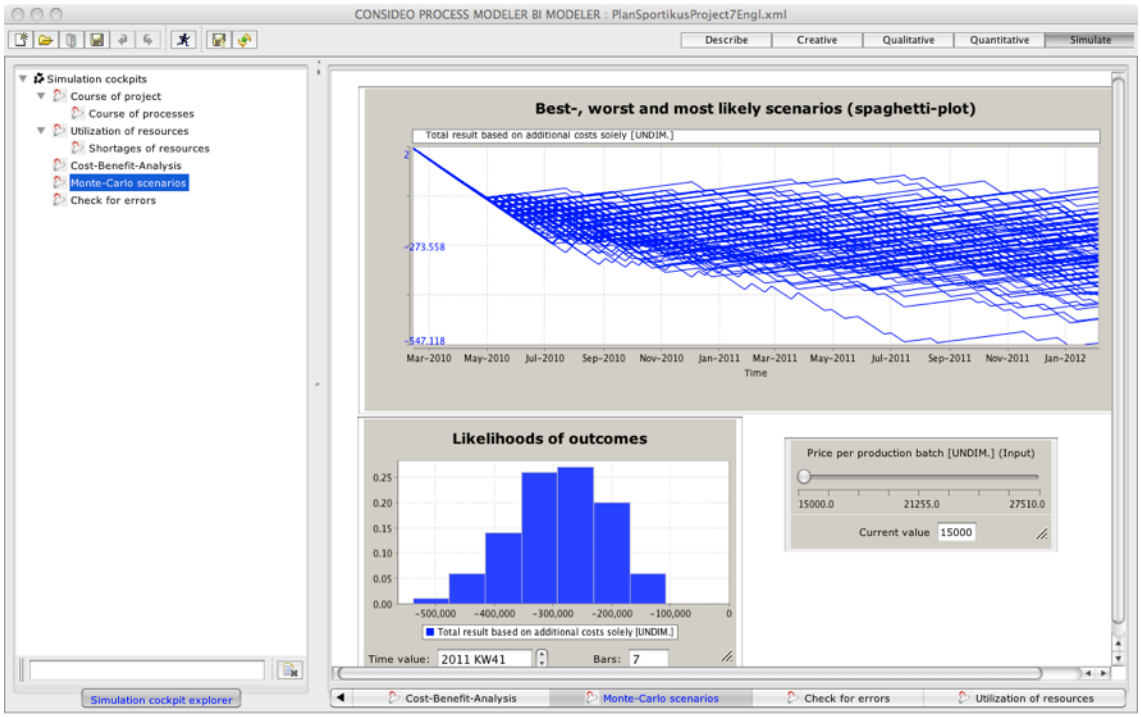
I have not modeled all possible complex challenges of this project, but rather shown you different ways of how it can easily be done.[12]

Now, after we have included the complex challenges in our model, it should not come as a surprise that the 15,000 EUR per production batch we calculated earlier will not result in a profit for the company. Before we look at what amount would, I'd like for you to contemplate which amount would lead to a profit—follow your gut feeling or base your answer on your best practice experiences.

Unfortunately, both globalization and growing competition keep us from being able to add a fixed surcharge to our calculations. If we were to add one, our competitors might either have made an offer that is much lower, meaning that we will not win the contract, or that our surcharges to buffer the risks are low enough to win the contract, but our competitors anticipated the risks and we still not make a profit.

It is no wonder that it has become crucial for project-orientated enterprises to have tools and methods that can calculate the risks of their projects in an appropriate way. However, most of the tools on the market that I know of that can do this do not take the complexity and the dynamics of individual projects into consideration.

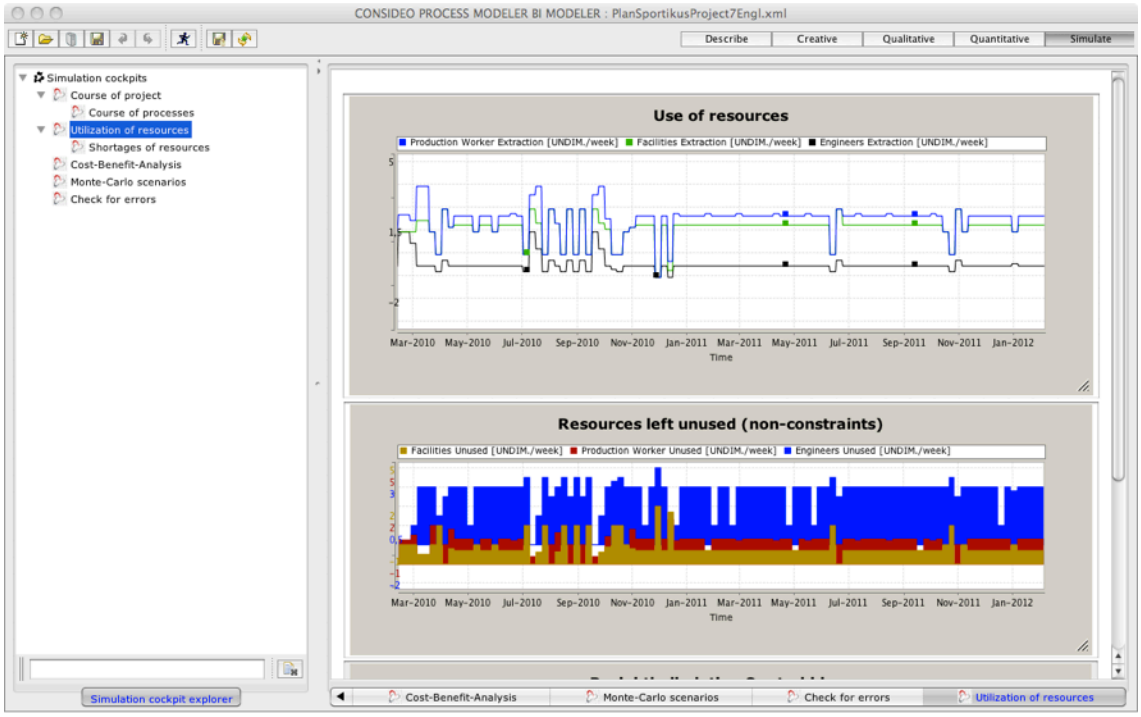
So what scenarios do our automotive supplier face?



Pic. 28: A Monte Carlo simulation of the profitability of the project. The spaghetti plot shows that with 15,000 EUR per production batch no curve reaches a positive value. The histogram shows a most likely loss of 250,000 EUR by the end of the next year.

[12] If you have some concrete examples in mind that you do not know how to model, please post your questions in our MODELER forum.

The Monte Carlo simulations in this example ran 100 times to combine the different likelihoods of any quality issues, specification changes or employee outages. To see what problems led to each of the individual spaghetti curves all you have to do is select the simulation that you wish to inspect from their context menu. It becomes easy to see that the reason for the losses is not just the utilization of resources or the fact that we have constraints due to outages:



Pic. 29: This cockpit shows bad case scenarios of the utilization of resources and is taken from the Monte Carlo simulation. The employees are a constraint some of the time.

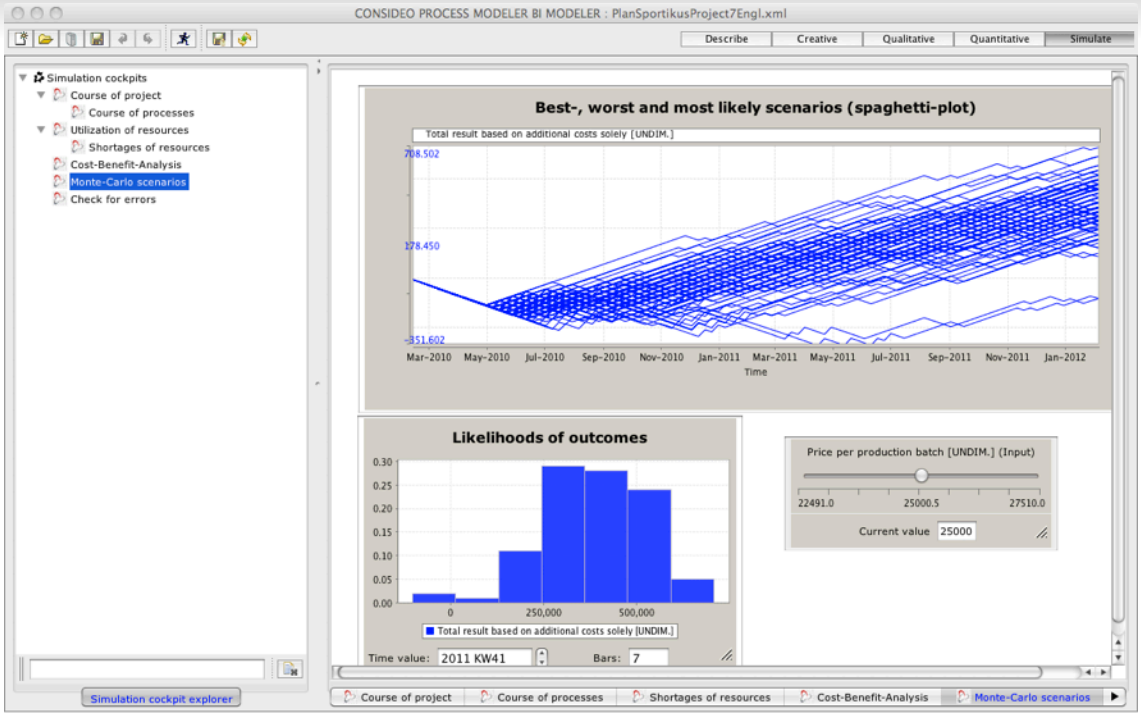
It is rather the combination of quality issues, resource outages and specification changes that has led to the negative scenarios for the project.

15,000 EUR per batch will guarantee financial loss for the company, but if the price is increased incrementally, the risks of loss can be decreased—and even eliminated.

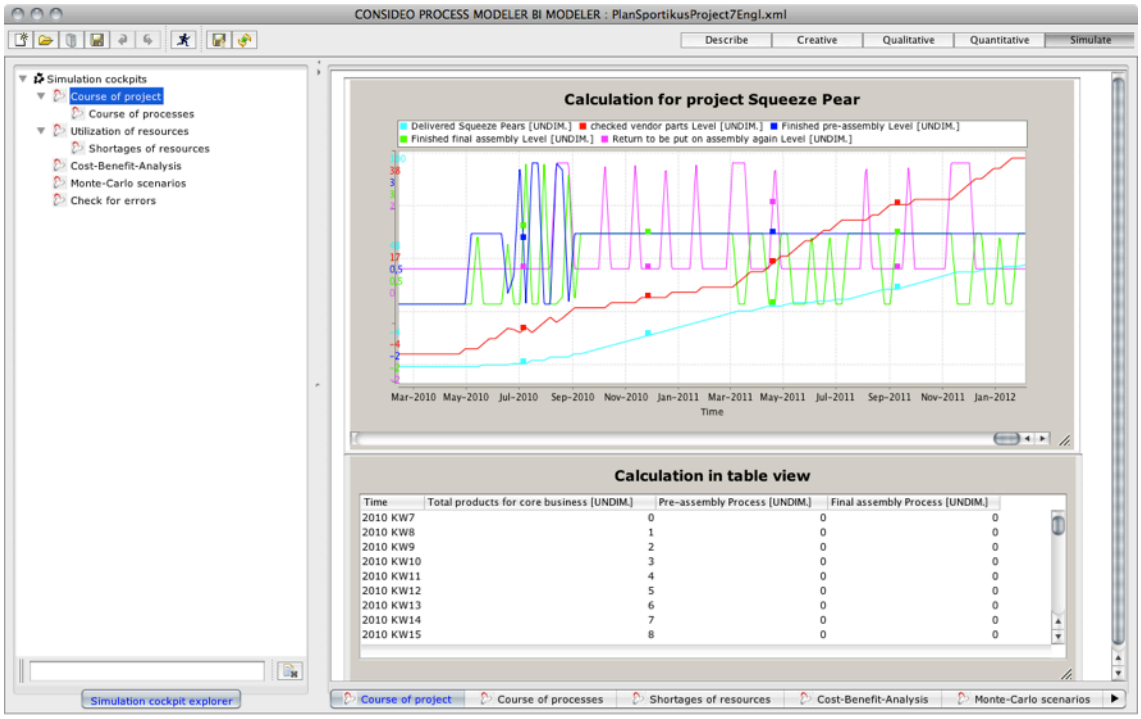
Another option for the company is to increase the number of resources, but not even this can guarantee a break even.

A more promising option is to minimize the likelihood of quality issues and specification changes from cropping up.

The next illustrations show that an increase to 25,000 EUR per batch promises a profit. However, the company will still not be able to deliver the number of Squeeze Pears agreed upon.



Pic. 30: Scenarios for a selling price of 25,000 EUR



Pic. 31: Example of a simulation run chosen for a very positive Monte Carlo curve. More than a third of the delivered parts from suppliers remain unused as the number of delivered Squeeze Pears rises only slightly.

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There are many more scenarios imaginable. For our automotive supplier, gaining insight into the complexity of the project and seeing the possible outcomes is extremely beneficial. The regular use of KNOW WHY Thinking and the MODELER facilitates organizational learning[13] and even improves the accuracy of gut feelings.[14]

So it just takes the MODELER and KNOW-WHY ?

So far I have shown you that it is possible to identify the crucial factors of a given project using KNOW WHY Thinking, and also that it is quite easy to overcome the complexities at hand with qualitative modeling. It is also even fairly easy to run scenarios on the likelihoods of the possible developments of a project.

The insights that are gained are your key to success. But it takes more than just a single project manager to gain these insights. Project teams need to adopt an entirely new culture of working, thinking and communicating. The collective intelligence of a team contributes with crucial factors while applying KNOW WHY Thinking—which, by the way, makes the team members feel integrated and causes project integration as well. Without good communication within a team—especially regarding insights that go beyond gut feelings—no one would be able to implement the decisions made by the project manager. The project would have development without integration!

It is not advisable that you try to model a quantitative model in a large group. It is better if one or two people take on the task of gathering data and parameters, and then later the other team members join in to run the scenarios on the model. A qualitative model, in turn, can be easily modeled with a large group. However, the first time the group models together, it might be challenging to handle notorious objection raisers—people who have a dislike for applying methods, especially new ones. I suggest that you ignore any discussions of the tool itself and/or the method, and simply focus on the factors that should be considered, as well as discuss what would serve to both benefit and hinder the positive outcome of a project. In doing so, you should only use KNOW WHY Thinking implicitly. As a moderator, you should ask your team to contribute their ideas and you will see just how enthusiastic they will become once they see these ideas in a cause and effect model.

Nonetheless, you may come up against team members who still dislike the extra effort that has to be made when consciously reflecting on a project's complexity. You should tell them about Ashby's law of variety[15] which states that the number of possible conditions a project can have has to be met by an appropriate number of possible states a project team can have, if the project is to be a success. This includes mental states, too. Therefore,

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[13] P. Senge, "The fifth discipline: the art & practice of the learning organization".

[14] G. Gigerenzer, "Bauchentscheidungen", M.Gladwell, "Blink" and K. Neumann, "KNOW WHY: gain insight - get success." Most of our gut feelings come from the experiences we have had with cause and effect phenomena. Therefore, modeling cause and effect structures increases our intuitive intelligence.

[15] I also explain this law in "KNOW WHY: gain insight - get success."

scenarios on possible developments are crucial to complex project management. This also explains why it is so important that an organization have flat (or at least multidimensional) hierarchies. It facilitates good communication and ensures that even minor factors are addressed during the planning and decision-making process.

However, flat hierarchies and a high degree of freedom have been known to be successful measures for decades. Nevertheless, in many organizations these measures—as well as agile project management methods— seem impracticable. It is also the case that many strictly managed organizations with rigidly structured project plans can work effectively, too.

If I have successfully explained KNOW WHY Thinking, you will now fully understand that two things are needed: a certain degree of structure to ensure integration and a high degree of freedom to ensure development! Complex projects and enterprises will fail if either integration or development is lacking for a longer period of time.

This rather abstract principle must be implemented by the management in real life situations:

- Team members that tend to merely integrate—meaning that they are positioned very low on the KNOW WHY Wave and simply wait for directions to be given to them—must be motivated in such a way that they begin contributing to development. If you get your entire teams to sit down in front of a model you can ask them what factors they feel need to be included. If some members still insist on staying quiet in the background, you should ask them directly if they agree or disagree with a specific cause and effect structure in order to make them feel that they too are responsible for the model. You should also praise everyone who contributes, regardless of how short-sighted you might think that their idea is. It gives you the opportunity to make the complexity of a project clearer and also to teach your team members how to think ahead.

- There are also team members who like to develop without becoming integrated—which means that they repeatedly go beyond the crest of the KNOW WHY Wave and make changes that no one can really follow. These individuals must be forced to justify their actions using the cause and effect model.

- In conclusion, those team members who have ideas that they can explain using a model—even if they do not know if these ideas could work and therefore they are asking the team to comment on them—are right on top of the wave, and will not move beyond it because they are integrated in the team.

According to KNOW WHY Thinking, a project (as well as a project team and every member of that team) is most successful when the team is integrated and developing.

If our automotive supplier did not integrate the engineers and the production workers into the project team, the employees would probably become fearful that the company was following some nonsensical or even nonexistent strategy and that it was in some sort

of crisis. The project would extend beyond the crest of the KNOW WHY Wave. But even if a the decision and most of the planning has been made by management, it is still possible to ask employees for their opinions and advice, which makes them feel integrated.

Last but not least, you should use the features that the MODELER offers to document your project, e.g. by including links to documents, description texts and even annotations to track discussions. The model can tell you what changes have taken place in the project environment.

Of course, it is not necessary to model extremely small projects, but it is easier to reflect on a project using a qualitative model than it is to use conventional project management software. It is definitely beneficial to think about where on the KNOW WHY Wave different aspects of a project would be positioned.

However, if your qualitative model shows you that a project is only slightly beneficial to the company—as was the case in the example I used with the Squeeze Pears—you should definitely take the time to model it quantitatively!

I hope I have shown you just how easy it is to reflect on the complexity of a project.

Nonetheless, it takes some effort and even quite a few soft skills to work and communicate effectively within a team. This is the reason that many companies—and most project managers—find it easier to rely on fixed schemes that can be followed as if according to a book. Lists are made and principles taken from the past are followed, without taking responsibility for the very specific complexity of the project at hand—nor finding it necessary to communicate this to the team. Unfortunately, as long as KNOW WHY Thinking and modeling are not commonly known, it will remain widely acceptable to simply say that a project was too complex to be planned in advance.

To model and to reflect using KNOW WHY Thinking can be referred to as systemic project management. Many systemic approaches to management regrettably remain nice theories, but with systemic project management, you can start reflecting on any given project as mentioned in this e-book immediately. Within only a few hours, you will be a practitioner of systemic project management.

Further informationen

In the MODELER forum, you will find further examples and/or you can ask for help on how to model some concrete challenges that you are faced with.

Well documented models are also available as templates in the MODELER-SHOP.

Books on Systemic Project Management:

- Edward Yourdon: "Death March"
- Kai Neumann: "KNOW-WHY: gain insight - get success"

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- Patrick Hamilton: "Dynaxity"

Books on systems theory and thinking:

- M. C. Jackson: "Systems Approaches To Management"
- D. Dörner: "Die Logik des Mißlingens"
- F. Vester: "Die Kunst vernetzt zu denken"

Books on modeling:

- Kai Neumann "CONSIDEO MODELER: Beyond Mind Mapping - systems thinking and simulation for everyone"
- J. D. Sterman: "Business Dynamics"

For more information, please visit www.consideo.com.

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