The expected benefits of utilizing simulation in manufacturing companies: Insights from a Delphi study

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THE EXPECTED BENEFITS OF UTILIZING SIMULATION IN MANUFACTURING COMPANIES: INSIGHTS FROM A DELPHI STUDY

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Abstract

In this paper, we evaluate the near-future potential of simulation modeling to transform manufacturing. Potential benefits and the added value of simulation systems are analyzed using the Delphi method. The primary data were collected at the end of 2018. The 20 experts of the Delphi panel came from ten Finnish industrial companies. The focus of the study was on new product development and marketing opportunities. The paper also offers views on the push-pull factors of simulation application implementation affecting firm operations, and how simulation modeling could bring added value to the firms and their stakeholders. The added information helps to explain why stakeholders (*e.g.*, customers) should take part in the simulation process and to clarify the role real-time simulation models play in involving customers. This includes the evaluation of the usability and user experience of real-time simulations. Finally, ways to measure the willingness of customers to participate in the implementation of simulation modeling and how to measure its success are reported.

Keywords: *simulation modeling; real-time simulation; business potential; Delphi survey*

1. Introduction

In recent decades, simulation has evolved away from being a tool just for experts and mathematicians and towards being an all-around technique used in a variety of different areas. The resulting increase in the number of users has contributed to the improvement of simulation technology. Today, it is the fundamental tool driving decisions made on design, validation, and testing for both components and complete products (Boschert & Rosen, 2016). Just some of the fields utilizing simulation include healthcare, marketing, supply chain, military, and manufacturing. Especially within the manufacturing industry, simulation plays a crucial role in improving the design and performance of entire systems and products (Negahban & Smith, 2014). Despite being a critical manufacturing tool, its use has been limited by the complexity of manufacturing systems and the expertise required to efficiently make use of simulation (Benedettini & Tjahjono, 2008).

This paper deals with simulation modeling in the work-machine manufacturing industry. The Delphi research method was used to discover the views of industry professionals regarding the benefits and business effects of simulation modeling for mechanical product manufacturing in Finnish companies. A key result of the analysis is an in-depth view of attitudes and expectations towards simulation models based on the opinions of industry experts. The results also provide insight into how the Delphi method is used to identify new business opportunities that simulation models could bring to manufacturing companies. The Delphi method is commonly used in technological foresight studies, but to our best knowledge, analyzing the business potential of simulation activities related to work-machines has remained relatively unstudied.

The following section reviews prior literature on simulation modeling motives in manufacturing. The third section describes the research methodology. Next, the results of a qualitative Delphi study are revealed. Finally, the paper ends with conclusions.

2. Simulation modeling motives in manufacturing

Law (2007) divided the term simulation into two different concepts: dynamic simulation and static simulation. The difference between these two concepts is the way they interact with time. Static simulation focuses at a certain point in time, while dynamic simulation is a process that progresses through time. For the purposes of this study, dynamic simulation will be the focus. Stewart (2014) further defined the meaning of dynamic simulation as “Experimentation with a simplified imitation of an operations system as it progresses through time, for the purpose of better understanding and/or improving that system”.

Providing maintenance services is a key part of manufacturing. Once a product has been made and delivered, maintenance ensures that it keeps operating at an agreed upon level in terms of reliability and safety (Mourtzis *et al.*, 2014). Jahangirian *et al.* (2010) recognize the potential of using simulation as a tool to support maintenance operations, because simulation can simultaneously provide multiple different functions such as maintenance, production, and inventory control (Negahban & Smith, 2014). This kind of preemptive maintenance and process control through simulation can be further improved upon when done in conjunction with a virtual representation of a physical product – a digital twin. By feeding actual product data to the digital twin, unforeseen situations can be analyzed, and product operation can become more predictable. (Kher, 2017)

Achieving profit is a high priority for most companies, which makes it crucial to be as efficient as possible in all your business processes. In the manufacturing sector, this means improving production and productivity as much as possible, which is done by utilizing your machines and production systems at fullest capacity while cutting down the periods of inactivity (Bako & Božek, 2016). Technologies such as simulation are excellent tools to use when you are aiming to speed up product design and decrease the overall time spent in development. The exploitation of simulation-related technologies provides manufacturers the option of testing and validating multiple different product and process configurations within the manufacturing system, which leads to increased overall efficiency. (Mourtzis *et al.*, 2014)

Gallois (1993) recognized the importance of efficiency within the manufacturing industry, but he also noted that the customer plays a major role. Wortmann *et al.* (1997) advised companies to embrace rather than avoid customer-driven manufacturing. They pointed out that cooperating with the customer as well as tailoring a product after customer needs is important. The central role of prototyping and improving production system customization capabilities was also highlighted. Therefore, not only is it important to be efficient and produce quality products, but it is also important to be flexible and respond to customer needs. Klingstam and Gullander (1999) viewed computer-based aids, such as simulation, as a potential response to increasing market demands. This need for a dynamic model to balance available resources with customer needs was also noted by Heilala *et al.* (2010). They recognized that previous planning methods did not meet present needs and that a simulation model utilizing real-world data was required to meet the needs of the market. By utilizing a dynamic simulation model, they noted that a more efficient balance between customer needs and available resources was achievable.

Fei *et al.* (2017) agreed with Gallois (1993) that customers should be at the core of product design and that customer involvement is incredibly valuable. He points out that to benefit the most from customer involvement, the interaction should begin as early in the design process as possible. By utilizing simulation alongside the digital twin, the communication between customers and other stakeholders can be sped up through the real-time acquisition and transfer of data. Moreover, issues the customer has had when trying to utilize the previous generation product can be pinpointed, thus generating more customer value. The potential for generating customer value through co-development was also noted by Mikkola *et al.* (2014). This type of exploitation of the digital twin is becoming more prevalent within the manufacturing industry, because it has the potential to open new areas of business through services (Donoghue *et al.*, 2018).

3. Research method and data gathering process

A qualitative Delphi study was carried out to provide the primary data. The Delphi-method is a well-known research method traditionally used in forecasting. It is based on expert panel surveys. The surveys promote discussion, because the individuals in the chosen expert group can present their opinions over the course of several survey rounds. A commonly used definition is found in the seminal work of Linstone and Turoff (1975): "Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem."

The Delphi method first applied by the Rand Corporation in the 1950s. The characteristics of the traditional Delphi approach are anonymity, iteration, feedback, and consensus. In Delphi-research, one of the original main goals was consistency, but today this is seldom seen as necessary or even desirable (Okoli & Pawlovski, 2004; Kuusi, 1999). There has also been some criticism towards the Delphi. For example, Sackman (1975) and Baker (2006) argue that the "experts" may not be sufficiently knowledgeable and that their opinions might not reflect reality. The critique has resulted in attempts to re-evaluate the validity and reliability of the method (*e.g.*, Rowe & Wright, 2011).

In this research, the Delphi method was expected to be effective in forming a common view of professionals related to the benefits and business effects of simulation modeling of mechanical products in Finnish companies. Delphi is a well-structured method for collecting in-depth views of experts, and documenting the research process is straightforward. The Delphi study is critically dependent on the quality of the knowledge captured. This study benefited from a wide range of opinions presenting specialist knowledge of simulation modeling in Finnish industrial companies that use simulation modeling to some extent in some of their operations. The 20 experts chosen were product development engineers, software specialists, business managers, and executives (see Table 1).

Table 1. The Delphi panelists

Company / business	**Position / expertise**
Elevator and escalator industry	R&D team leader Category manager, machines
Tractor manufacturer	Team leader, research and simulation
Forestry and material handling technology manufacturer	Head of R&D Product designer, software developer
Material handling machinery	R&D director Developer, drive systems
Digital twin and simulation solutions provider	Managing director Project engineer
Electrical drive technology solutions	Managing director
Hydraulic cylinder manufacturer	R&D engineer System engineer
Machinery and equipment for production process in the wood industry	R&D manager Simulation engineer
Equipment and tools, service and technical solutions for the mining and construction industries	Engineer manager Product Development Manager Dynamic simulation engineer
Forklift solutions	Manager, testing & prototypes Simulation engineer

The analysis focuses especially on the effects and possibilities of simulation modeling. It examines discrepancies and views, and at the same time tries to find the relevant arguments behind the views. The Delphi process (Table 2) took about three months.

Table 2. The developed Delphi process

Stage of the process	**Content and tasks**
Deciding on the goals and scope	Planning the research with academic and firm representatives Deciding on the schedule and implementation
Planning the content of the Delphi rounds	4 rounds and joint meeting Identifying the key issue areas of the research Forming the questions
Selection of the expert panel	List of potential participants Willingness of the participants to engage in the research
1st round	What are the companies hoping to gain from simulation/digitalization? What benefits have emerged or are expected because of the simulation models? What kind of resisting forces are there in the organization against the simulation functions/efforts?
Evaluating the results	Summary of the responses Forming the 2nd round questionnaire
2nd round	Possibility to comment on the 1st round summary report Prioritizing benefits and resisting forces (change drivers) based on the 1st round results What kind of business-related effects can be achieved using simulation in the long term? What benefits are there for the stakeholders in the long term and how to measure these business-related impacts? How to identify customers who want to cooperate and commit?
Evaluating the results	Summary of the responses: 'force field' analysis and summary Forming the 3rd round questionnaire
3rd round	Possibility to comment on the 2nd round summary report Prioritizing business-related effects based on the 2nd round results by using two criteria (cost-benefit and attainability)
Evaluating the results	Summary of the responses
4th round	Summary of the 3rd round responses Possibility to comment on the 3rd round summary report
Evaluating the results	Summary report of the whole Delphi process Presenting the results to the panelists Discussion of the results and their utilization Consensus; argumentation of the most controversial issues

The goal of the Delphi study was to establish an expert-opinion-based view of the effects of simulation modeling on manufacturing in Finland. Based on this assessment, the goal was to increase understanding of new business opportunities in this area and of innovations that may affect the current situation. The Delphi expert panelists included 20 carefully selected participants from the business sector. Panelist commitment was confirmed before sending the first questionnaire to ensure the experts would participate actively in the entire research process. The instructions and summaries of the results of previous Delphi-rounds were delivered to the members of the expert group via email attachments. The participants responded to the questionnaires electronically using the MeetingSphere internet portal. MeetingSphere is an electronic meeting software that allows participants to enter their opinions and votes on a common internet page. The response time was set to about three weeks per cycle.

4. Simulation modeling in manufacturing companies: insights from the expert panel

The main findings related to the Delphi research are presented in this section. During the first round, the experts expressed their hopes and goals towards the simulation models, which they are now dealing with in their companies. Table 3 offers a summary of the expressed comments, which were divided into four slightly different categories: things affecting product development alone, things affecting customer-oriented product development and customer interaction (*e.g.*, testing), things affecting other company functions (*e.g.*, marketing), and aspects related to IoT and digital twins.

Table 3. The typical goals the companies are hoping to gain from simulation modeling

Area	**Goal**
For product development	To understand what making a model means in practice and what could be done with the models The better utilization of the opportunities provided by simulation within the context of product development Examining and testing new and more versatile ideas which would be excluded through traditional design process either due to costs or because they are too time consuming Faster comparison of multiple solutions through virtual models Examining what type of simulation model or hardware is required to achieve a reasonable level of results To speed up the product development process while improving quality
For customer-oriented product development and testing	To develop methods for customer-oriented product development To find ways to support user interface development and to gather user feedback from the interface concepts at an early stage To improve product development processes so that through real-time simulation you can test and verify the control system and gather feedback on the control of the machine from the customer before building a physical prototype The premise is that simulation will shorten the required testing time and improve the communication between different departments when the simulation models are used by a larger group Testing the new machine models, configurations and sub-assemblies before production Improving the design of the control system
For other functions	The models should be easily configurable for different purposes; sales and marketing will become easier when it is possible to demonstrate different situations with the models To increase the utilization of real-time simulation and enable a larger group of people from different functions to benefit from it For sales, the goal is to enable the simulation of certain customer cases to provide a better user experience and to verify the functionality of the solution For education, the goal is to make the process of transferring machine models and user interfaces into the simulator faster and easier
Related to Digital Twin and IoT	To be able to enhance application design and preemptive maintenance To apply the embedded real-time models in service business, for example by using Digital Twin models in preemptive maintenance control and malfunction diagnostics To enable the use of real-time simulations alongside IoT-systems

In addition, the panelists were asked what benefits have emerged or are expected as a result of the simulation models, and what kind of resisting forces are there in the organization against the simulation functions/efforts. The answers were summarized and then added to the second-round prioritization task.

In the second Delphi round, the panelists made assessments about the promoting and hindering aspects of simulation modeling in their companies. These forces working for and against the implementation will either favor or hinder the development of simulation as a work tool and the utilization of simulation models. The panelists evaluated the significance of these forces on a scale of 1–5 (1 = minor significance, …, 5 = very strong significance). Table 4 and Table 3 show the forces for change seen as significant (the average rating >3).

Table 4. Benefits emerged or expected because of the simulation models

Forces for change	**Avg.**
Shorter implementation and testing times because the control system has already been tested in the simulator	4.8
Can be spared from a physical prototype manufacturing round if the need for change is already revealed in the simulation	4.7
Benefits for product development by doing virtual testing	4.2
The test situation in the simulator is not too predetermined and it is possible to find out things that could not be asked/noticed in advance	4.1
Products meet customer needs faster / cheaper	4.1
Accelerate failure in planning/testing and thus learning in product development	4.0
Testing different product variations more systematically and comprehensively, especially from the point of view of usability	4.0
A better understanding of the machine's dynamics, especially in the initial dimensioning phase	4.0
Enabling hardware and control solutions that would be too expensive / time consuming to develop without a virtual model	3.9
Utilizing simulation will shorten the overall time of product development from idea to market	3.8
Enables operator training without a physical machine → speeds up the development of operator skills	3.4
Customer’s test driver’s feedback can be considered before the machine is built, making it easy to make changes	3.6
Able to enhance application dimensioning and proactive maintenance	3.3

The tables formulate a force field analysis. Force field analysis is a widely used managerial tool that can analyze the hurt points of organizational changes and implementations of new procedures (*e.g.*, Ajimal, 1985). In this case, the force field analysis can be used to find out the important aspects to concentrate on if the purpose is to increase the popularity of the simulation modeling procedures within the company. For change to take place, the driving forces must be strengthened, or the resisting forces weakened.

Table 5. Resisting forces against the simulation functions/efforts in the companies

Forces against change	**Avg.**
Resource requirements, the most important of which is the encounter between financing, skilled persons, the time spent, and the right target of application	4.1
Building models is laborious and models often should be very quickly operational and meet the needs of your business	3.9
Workload required by simulator development	3.8
Sometimes the lead time required by the simulation work can be a problem in a fast- paced product development project	3.8
The development and maintenance of models in product development projects should not be more cumbersome than the current practices	3.8
Finding the characteristics / data of the devices so that the ideal device is correct with the right accuracy	3.6
Technical challenges slow down the use of simulation	3.6
Multiple parallel simulation and modeling tools in use → finding interfaces and a comprehensive platform is challenging	3.5
Multiple machine types are simulated so that you cannot easily combine subassemblies	3.5
“Selling” simulation practices to people in different departments/fields is always very challenging	3.3
Engaging colleagues / decision-makers in the need for a simulation project → references and examples are required	3.3
Because of the amount of work required, the costs are too heavy to allow for large-scale utilization in a smaller company	3.1
Lack of knowledge; modeling requires knowledge of several different areas	3.1

4.1 Benefits of using simulation in the long term for the customer and other stakeholders

During the second round, the panelists were asked their opinions on the benefits for the customer and other stakeholders of using simulation methods in the long term. The group members commented that if simulation modeling can accelerate the development of new features for new products, it also benefits the customers. Stakeholders and customers have the chance to be a part of the development phase by providing comments and ideas as they use and test the simulators. Generally, the group members agreed that, with the help of simulation modeling, the likelihood increases that products will better match customer needs and that company stakeholder understanding will improve. This could occur if the stakeholders are given the opportunity to use the simulators. They should also be able to freely give feedback about their experiences to the product development teams.

One participant commented that, in the long term, simulation models are coming ever closer to the customer's operating environment and becoming a process in which everything is part of a virtual model. Most likely this will provide a completely different chance to increase productivity benefitting both the customer and the developers. The need for customer-specific configurations will also probably increase.

In addition, one participant noted that a customer benefit could result from the decrease in operation interruptions. Maintenance can become need-focused, thus decreasing costs. Solidly designed and maintained up-to-date system solutions could benefit the customer. According to questionnaire responses, the expert group assumes that customers will gain a better comprehension of the products and their suitability to satisfy needs if they can take part in simulator testing of the new products under development.

In the second Delphi-round, the group was also asked about the ways to measure and evaluate the long-term business-related impacts of simulation activities. One answer highlighted the fact that if these simulation models are used in preemptive maintenance, their impact can be easily pointed out. For example, the truthfulness of automated error notifications, the amount of maintenance stops needed for a solution, and the amount of customer error notifications serve as good measuring points. The following measures and evaluations were noted as having potential.

- *Through turnover and volumes* – Key parameters such as the number of new products, service sales, or changes in market share could be compared between projects that use simulation activities and those that do not.
- *Prototyping and product problems* – The number of prototypes needed and unforeseen product problems during prototype testing could showcase the success rate of simulation during the development phase.
- *Product development schedule and cost* – How simulation activities affect the time it takes to run a product development process and the amount of testing required could be examined.
- *Customer satisfaction* – Customer satisfaction could be monitored via customer feedback and polls, by measuring the number of new customers, and by recording the loss of existing customers.

- *Preventive maintenance* – Quantifying the volume of unforeseen malfunctions, the truthfulness of automated error notifications, the amount of maintenance stops needed, and the amount of customer error notifications received would help to define how simulation activities affect preventive maintenance operations.

In addition, the participants were asked how to identify and get commitment from customers who want to cooperate in simulation activities. The participants stated the following viewpoints.

- Customers should be prepared to share necessary information and should also be willing to commit their resources to generating, upkeeping, and developing the models.
- By remaining in contact with the customers, the manufacturer should be able to figure out who is most likely to impact the project. The customer is not always the end-user, for example, in the case of dealer networks, big dealers have a desire to influence.
- You get the customer to commit through results and open cooperation. Commitment comes from successful cooperation.
- Often a consulting company hired by the customer demands a model of the overall solution.
- A customer commits once they can see the impact possibilities and are able to participate in the development.
- This could depend on the customer, but simulators should be able to convince the customer of its benefits. Simulators should include indicators about things like productivity that can measure the added value.

4.2 The business-activity related effects of simulation

In the second round, the panelists presented their opinions on the long-term effects of simulation work on company business. These opinions were taken to the third round of the Delphi questionnaire where the panelists evaluated these business effects according to two criteria: costs efficiency and achievability. First, the panelists were asked to estimate the effects of simulation on business activities and their cost and efficiency related impacts. Resources, such as time and money, must be invested to realize business-related benefits. The panelists used a grading scale of 0 – 6. (0 = very small, …3 = decent, …6 = very big). Then, the panelists were asked to evaluate how realistic it is to expect that these impacts could be achieved. The grading scale was 0 – 6. (0 = difficult to achieve, …6 = easy to achieve). Table 6 presents the suggestions for the business-related achievements for the company resulting from the implementation of simulation in the long term. The “*Mean*” is the calculated average of the given grades, and *SD* is the standard deviation.

Table 6. Suggestions for business-related achievements of using simulation in the long term

Business-related achievement	**Costs-efficiency**		**Achievability**	
	Mean	***SD***	***Mean***	***SD***
Efficient use of simulators in software testing and development	4.8	0.26	4.4	0.25
Agreed upon/Understood specs at an early stage	4.6	0.16	4.3	0.14
Stronger support of product design and new product development through simulation	4.6	0.16	4.3	0.18
Involving customers, customer support and other stakeholder groups in the design project through concept simulation → gaining information about customer needs through their involvement in the design process	4.4	0.18	3.7	0.22
Speeding up product development and testing by utilizing simulation	4.4	0.18	4.6	0.14
Advanced simulation platform provides product development a more in-depth understanding of the product and its uses	4.4	0.22	4.1	0.17
Customer can be involved in the product development and testing at an earlier stage → more versatile information transfer and the overall improvement of understanding	4.4	0.22	3.8	0.27
Unrestricted testing and validation of new ideas for further development	e	0.16	4.4	0.14
Presenting product properties is easier	4.3	0.18	4.1	0.23
The increase in sales and production volume through improved products	4.3	0.19	3.6	0.16
Better risk management in product design	4.2	0.20	3.2	0.17
Simulation connects different functions within the company in a better way	4.0	0.18	3.2	0.19
Supporting sales and marketing activities through simulation	3.9	0.24	4.3	0.22
You can simulate how the product functions in customer's processes through simulation → ability to add in new services	3.3	0.19	3.1	0.17
Managing real-world systems through simulators (digital twin)	3.3	0.29	2.2	0.25
Simulation can find new potential business opportunities while managing the solutions of current endeavors	3.1	0.27	3.0	0.21
Product customization in project deliveries can be controlled more efficiently	2.7	0.28	2.3	0.30
An advanced simulation platform can improve the methods of preemptive maintenance: monitoring the condition of systems, ability to focus maintenance in a better way and find the root of the potential problem	2.6	0.18	1.9	0.09
Forming new customer relationships while managing the old ones through the utilization of the simulation platform. The ability to sell services that provide more value	2.2	0.19	2.3	0.24

5. Conclusions

The overall benefits of simulation seem to be centered around product development. The basis of simulation goals related to product development is to gain a more in-depth understanding of the model and its uses to apply it in the best possible way when the opportunity arises. Moreover, simulation technologies were seen as a way to directly improve product quality or as a way to enhance the functionality of one area such as the control system while reducing product development time. The heavy reliance on physical prototyping within the manufacturing sector was noted, and the industry experts emphasized that more research was needed into what type of simulation model or hardware would provide the same degree of product validation.

The expert panelists also expressed interest in customer integration, which was seen as something that could directly bring extra value to product development. They understood the importance of the customer experience to their business, and therefore they felt that developing user interfaces based on feedback gained from their product end-users was important. Developing new ways to further integrate customers into the product development processes was considered a potential future goal.

The experts indicated that user satisfaction can be increased by involving potential customers in the earlier phases of product development. It is better to involve users up front in the design phase and not just later in model testing. With earlier user involvement, designers can construct their models with more and more attention paid to customer wants and needs, and customers can gain more appreciation as to what is and is not practical or possible. For example, if potential users request a vehicle functionality that is not achievable. Real-time simulation carried out during the design phase will demonstrate to the customer that this function is not practical or possible and prevent the pursuit of an unachievable design requirement saving both time and money. Involving users early will produce an outcome that is more functional, more precise, and more customer oriented.

The main driving forces behind the adoption of simulation technology in manufacturing were all centered around its potential to improve all aspects of product development. The resisting forces are mostly resource-based. Successful implementation demands a heavy investment of both time and resources. The technical complexity of simulation as well as an overall lack of knowledge by management was also considered to be an impediment.

Real-time simulation models make it possible to elevate all specifications and packages (*e.g.*, a hydraulic or steering package) to maximum functionality. With digital twinning, models can be designed and analyzed to determine the part interconnection efficiencies of a new product design resulting in significant decreases in time spent on production and for maintenance. Real-time simulation models can reveal the weaknesses and strengths of a proposed product vehicle before the design has been finalized and a prototype built. Furthermore, simulation models offer the opportunity to inexpensively and safely train future users.

The most cost-effective and achievable benefits of simulation also centered around product development. The experts felt that the resulting overall improvements to the development process would lead to faster development, higher product quality, and better risk management. Using simulation methods to cultivate new customer relationships or to enable product customization was less interesting to the experts and seen as hard to achieve. Despite the lack of interest in customization, the customer aspect of simulation still showed promise to the experts. They felt that simulation could be used by marketing and sales to enhance customer presentations. The potential to incorporate customers into product development was also something the experts felt was achievable and cost-effective.

In this paper, we brought together expert estimates of the potential impacts and added value brought by the implementation of simulation systems in manufacturing. The paper also examined the suitability of the Delphi method used to the gather the data needed to carry out the research. A four-phase Delphi process was designed that comprised anonymous written survey rounds. The research process was laborious and took about three months. The planning, the time it took for panelists to reply to the questionnaires, and the time needed for the analysis of the responses took a lot of time. The characteristics of the Delphi method; such as participant expertise level, response anonymity, feedback, and its iterative nature; guaranteed that the research process proceeded well. The expert panel clearly brought the manufacturing industry and digitalization/modeling expertise needed to complete the research.

The combined opinions of individual experts formed a surprisingly smooth description of the expected goals and benefits of simulation modeling as well as the barriers and long-term business-related benefits. The easily achieved consensus may have been a result of the relatively homogeneous background of the participants. A limitation of this research is that the panel did not include people from different backgrounds and experience, *e.g.*, professionals with experience in a variety of organizations, a diverse work history, variation in age and education, *etc*. Had the panel of experts been more heterogeneous, it is more likely the results would have been more confrontational, insightful, and creative.

In conclusion, the Delphi study helped to increase the understanding of the theme. The result was easily exploitable material, such as a force-field analysis. Delphi results are always impacted by the strong group of experts involved in the contribution of the research process as well as careful planning and execution. The research provided a theoretical contribution by showing once again the suitability and strength of the Delphi as research method.

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