SYNCHRONIZATION OF PLOTTING BOARD AND COMPUTER BASED SIMULATION IN THE FRAME OF LOGISTICS PROCESS REENGINEERING

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Abstract

The warehousing processes contain many hidden opportunities for cost-effective process development. Cost and performance optimization is possible with reengineering of algorithms, assignment decisions, scheduling and sequencing solutions without infrastructural investments. The only objective and cost-effective way of development is modelling in validated and flexible simulation environments in active cooperation with the partner. In our essay, we introduce our innovative modelling and reengineering methods and environments continuously developed in Szabo-Szoba R&D Laboratory at Széchenyi University Győr. Our LPR solution combines the advantages of the performance measurement, plotting board, the computer simulation, by considering the feedback

Keywords: simulation, logistics process reengineering, innovation

1. INTRODUCTION - IMPORTANCE OF MODELLING

The main challenges of modern logistics and supply chain management are providing high level quality service for customers according to the ever-growing and ever-changing demands, optimizing low series production and distribution in various environments, managing stocks in lean and agile production systems, eliminating the bullwhip effect, applying different trade-off solutions for minimizing infrastructure investment, distribution and warehousing costs and maximizing capacity utilization. The wide variety of products, the challenges of fluctuating demand, the appropriate inventory management and the application of modern production and distribution strategies require flexible innovative thinking and special management skills from experts: to be able to construct and manage an effective, well-balanced manufacturing and distribution process in supply networks.

The learning-by-doing method, based on personal experience (dialectic approach) is able to help in the education and training to get these innovative and cooperative skills. The main purpose of our learning-by-doing simulation projects in Szabó-Szoba R&D Laboratory is to construct special real-life environments for training on the field of logistics: modelling the product and information flow in a supply chain, taking care of shipments, material handling and order picking processes of a warehouse or a factory (Bancsó et al. 2013).

In these creative environments all the actions are provided by participants – focusing on the evaluation of the results and the whole process of logistics performance measurement. During the learning-by-doing trainings participants can get practical knowledge and develop many innovative skills to be able to construct, observe, design and re-engineer sustainable and efficient logistics processes (Bancsó et al. 2013).

Modelling has key role in logistics system design and further development. Based on models and simulations it is easier and cheaper to discover problems and bottle necks of logistics processes. Furthermore these are the only objective methods for finding optimal and adaptive solutions, or test the available alternatives (Bódis at al. 2012).

The most known modelling method in daily practice is the computer simulation. The WaNDa warehouse and distribution plotting boards and simulation equipments are unique and can provide innovative approach for participants, to get real-life experiences about warehouse activities on the learning-by-doing way (Bódis at el. 2012).

Both the plotting board and the computer simulation based modelling solutions have unique advantages and disadvantages. The our simulation equipment synchronizes the two modelling solution, what makes the user possible to model warehousing systems and problems, collect alternative solutions, measure and evaluate the performances and demonstrate for the partners on visible and understandable way.

The measurements are also important and essential equipment during WaNDa training simulations. It gives the possibility to evaluate the defined and tested alternatives.

2. PLOTTING BOARD AND COMPUTER BASED MODELLING

The plotting board modelling methodology is constructed for simplified processes and layouts based on real systems, algorithms and database. This instructive environment support the brainstorming methods, helps to the participants generate various ideas and alternatives (Bódis et al., 2012).

The physical nature of plotting boards gives huge advantages. It is possible to compare different layouts, rack settings, palletizing problems, capacity utilization, routing, storing and order picking algorithms. So the participants can perform immediately huge amount of alternatives by hands without time-consuming programming requirements. On the other

hand, the real efficiency of complex processes is measurable after huge amount of operations. It is very time consuming, so impossible to perform in frame of trainings.

The computer simulations make us able to model complex logistics systems based on mathematical, statistical methods and algorithms. Parametric structure and refreshable database help to synchronize the model with the actual situation for each project. The system can continuously collect statistics and generate charts in real-time, which data mean the basis of the comparisons of alternatives (Bódis et al. 2012).

In our essay we introduce our innovation cycle that synchronise the plotting board and computer based simulation solutions.

3. THE WaNDa PLOTTING BOARD MODEL

WaNDa (Warehouse aNd Distribution) is an extremely interesting and representative model for logistics students and training participants to learn and understand relations and coherencies in supply networks and warehouses. It has also importance in industrial application. Operational efficiency of the companies is strongly affected by the design decisions, but it can be very expensive or impossible to change the design decisions once the warehouse is actually built. WaNDa environments are able to demonstrate all the impact of these decisions on the overall warehouse performance (Bódis et al. 2012).

The WaNDa interactive equipment is usable for the following functions:

- Educational trainings for demonstrate warehousing problems, tradeoffs and search possible solutions with the help of learning-by-doing
- Industrial and educational trainings for demonstrate importance of modelling and optimization.
- Interactive cooperation with industrial partners to get to know the processes and best practices of the actual system. The participants will realize the problems and bottlenecks of their own system. Furthermore they can decide the further cooperation in Logistics Process Reengineering projects and define the way of the innovation process.
- It is a valuable environment to support the brainstorming process. The consultants and partners can collect and immediately evaluate possible alternatives. In this way, they prepare previously evaluated alternatives for the detailed modelling.
- Demonstrate defined solutions for directors, managers and employees. The interactive way of demonstration result, they can believe more in the new processes.

4. INNOVATION CYCLE

The measurement and evaluation of the real warehouse is usually the first step of the innovation processes. The deep knowledge of the developed system is essential. It is required to the effective and usable results of the logistics re-engineering processes. Sometimes the measurements started after interactive training, where the importance of innovation is realized. The main aim of this previous training is to get to know the actual solutions, processes, best practices and problems together with the partners.

Figure 1 Consultancy cycle of innovation



Source: Vöröskői at al., 2013.

The interactive training and modelling environment has couple of function during innovation cycle, where the plotting board and the computer simulation are synchronised. This is the field of the active cooperation between consultants and partners.

During the detailed modelling processes the consultants make much deeper computer based simulations about the previously prepared and evaluated alternatives. These models are constructed with real scaled layouts and running with detailed programmed algorithms. These can test long time intervals and computationally intensive solutions. Furthermore it is possible to automatically generate all kind of statistics to compare alternatives.

The innovation and development projects are never a linear process. These require continuous feedbacks and round by round development. In my consultancy cycle, each element has two-way cooperation with each element. Each element has special added value for the processes. The final solution has to work in the simulation model, has to be visible and understandable in the interactive environment and has to be valuable and usable in the real system. The development and the fine-tuning processes are impossible without continuous round-by-round tests and feedbacks (Vöröskői et al. 2013).

The following chapters will describe the details of the consultancy cycle elements.

4.1. Real warehouse operation

The first step of each innovation process is the measurements of real physical processes and analysis of measured data and the possible operational databases. First of all, the consultant should get to know the partner's processes and logistics system. It happens during combinations of meetings, industrial visits and interactive trainings (Vöröskői et al. 2013).

Based on previous information, our Elli3 android based measurement tool will be customized to actual system. The innovation team defines the required measurements of the physical processes and the previous workflow of the measurement process.

Elli3 is an android based application developed in Szabó-Szoba Laboratory for monitoring the time request of all pre-defined operations with automatic time stamps. The examination of the workflow display-interface is adapted to the pre-defined actions appears to be measured - the assessor will tap to activate each key, and the device records the sequence of events with timestamps (Baladincz et al. 2013),

By using our Elli3 tool we can discover many hidden parameters of product and information flow. Based on the results and analysis we can classify the main features of the operations and the product structure.

Figure 2: Elli3 screen for monitoring order picking processes



Source: Baladincz at al. (2013)

The measuring team is still collecting information about the processes and refining the measurement system during the testing process of the adapted Elli3 system. The measurement can't influence the processes, the measurement colleagues have to build personal relation with the operators, so that they feel: it is not a test, we will help them. Equal treatment of the operators results valuable data and further exact information about the processes. In this way the innovation team will know what the operators really do, what are the best practices? The measured data and experiences continuously need work up between measurement events. It is a previous check of the data and essential to define how many further measurements need until the first analysis.

The first step of the analysis is to collect the latest documents of the real database to complete the measurement data. Based on data sources and personal experiences the innovation team define the possible bottlenecks and problems.

The measurement system will be upgraded for the defined problems to collect specified data and experiences. It results a measurement cycle what is going while the innovation team is getting strong knowledge and enough data for designing the partner's analogue model.

In the frame of the order picking development projects, the time requirements of picking movements (travel, search, picking, administration, so on) are measured. As a result we can show the time distribution of elementary processes and we are able to define the time-consuming operations. Furthermore the involved order picking positions are logged, what makes us able to analyse the possible time and distance savings in routing and product allocation. Otherwise the partners' database should also be analysed, concentrating on the

actual problem. After the necessary amount of measurement and analysis, the consultants have enough experience about the system for the modelling processes.

4.2. Interactive training and modelling environment

The next element of this innovative consultancy cycle is to collect and evaluate alternatives in simplified and synchronized interactive modelling environment (plotting board and computer simulation), what supports the brainstorming process. All possible solutions will be tested and evaluated in the analogue model. Only the valuable alternatives get option for the time-consuming detailed modelling, what results time saving in the innovation process.

The operation in the interactive environment starts with the analogue version of the actual processes of the partner. After the first operation round they will evaluate the process based on personal experiences and automatic measurement of the system. They will define the problems and start a brainstorming to collect solutions. Then a decision is made and the changes will be implemented into the model. The participants test the new solution and start again the innovation cycle of the interactive environment (Vöröskői et al. 2013).

The participants continue the alternative collection process while find 2-4 alternatives for detailed modelling.

4.3. Detailed modelling

During this step of the innovation process, the consultants build detailed computer based simulation model for each defined alternative with individual programming. This model is more complex, it based on the real scaled layout, real resource capacity, real amount of storage capacity and so on. Furthermore the computer based simulation makes us able to run the model in a long term interval. So the detailed modelling environment is good for seeing how the defined solutions will work in the real industrial system (Vöröskői et al. 2013).

The detailed simulation models makes it possible to refine alternatives, implement and evaluate new ideas, what result a new cycle in this level of the innovation process.

4.4. Global innovation process

Innovation is not a linear process, continuous feedbacks and round by round development are essential for valuable results. The 3 main element of the innovation process has continuous feedbacks with each other. The final solution has to be fit in both environments.

The defined alternatives are evaluated and refined in detailed simulation models. The find new solutions tested and evaluated in the interactive plotting board environment. This cycle is going while the partner and the consultants are not sure about the find solution is ready for the real operation.

After the implementation process, the upgraded real system will be measured again to check the efficiency and effects of the solution. Then the problems and the bottlenecks will be defined again and continue the consultancy cycle for continuous development of the system.

The continuously developed interactive environment is good for demonstrate system changes for operators, managers and directors also (who did not take part of the

development process). It results, that the colleagues will believe in the solution and support the implementation process (Vöröskői et al. 2013).

5. CONCLUSION

In our essay we have presented our innovation cycle, like a possible frame and tool to develop logistics processes.

The innovative consultancy methods support the continuous Logistics Process Reengineering projects in active cooperation with the partner. The system, processes and problems are modelled in an interactive plotting board model based on measurement of the real processes. The possible alternatives are collected and previously evaluated in the interactive environment together with the partner. The defined alternatives are refined and compared in detailed computer based simulation models. The continuous feedbacks and round by round development make us able to implement a well prepared and evaluated solution.

The described interactive training and modelling environment synchronises the plotting board and computer based modelling environment. It supports the alternative finding processes and makes us able to evaluate possible alternatives without programming.

The interactive environments are developed continuously project by project, what make us possible to model more and more logistics problems. Furthermore the computer based administration process development is in progress to the more flexible modelling.

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