CRITICAL MANUFACTURING
SIMULATORS
COMPARISON

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SIMULATORS
COMPARISON
STEPS TO FOLLOW

1. Establish the commitment to invest

2. Clearly state the problem

3. Determine the type of tool required

4. Do an initial survey

5. Develop the list of requirements

6. Choose some tools

7. Carry out a detailed evaluation

1	Arena	
2	FlexSim	
3	AnyLogic	
4	Simul8	
5	In-House Solution	

SIMULATORS COMPARISON
DETAILED EVALUATION

Trials/Demos

Experimenting the software, doing some examples and demos.

Direct Contact

Direct contact with the vendors in order to get informations they don't provide in the website.

Information from Site

Each product website has some relevant information about the software.

Web Search

More but discarded solutions were found through web seacrh.

Papers and Journals

Consulting some papers and journals in the field was one of the best methods to gather information.

Guides

To learn how to proper work with the software, the application guides and some videos were studied.

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SIMULATORS
COMPARISON
SOLUTIONS

SOLUTIONS
ARENA®

Intro

- Object-Oriented
- SIMAN
- 60 Modules (Common, Support and Transfer)

Background

- Released in 1993
- Manufacturing, Packaging, Supply Chains, Health Care and Military
- 300,000 Users WW

Customers

- Novartis, Bayer, Pfizer
- FHB, CIB Bank, GE Money
- Vodafone, T-Mobile, Hungarian Police

Price: 19.300 € + 3.500 €/year (Maintenance)

Advantages and Extra Features	Limitations and Disadvantages
Most well-documented simulation software in the market	**Doesn't allow WCF communication**
ODBC data compatibility	Unintuitive and has a poor GUI
Import AutoCad drawings	Simulation consumes too many computer resources
VB scripting, automation and macro recorder	Debugging is a pain
Easy to automate and easy to collect statistics	Most expensive tool of the chosen ones

SOLUTIONS
FLEXSIM

Intro

- Open-GL (3D) drag-and-drop
- Incorporates a C++ IDE and compiler in the graphic modeling environment

Background

- Released in 2003
- Manufacturing, Logistics and Distribution, Transportation, Oil field processes and Networking data flow

Customers

- TRW, Bechtel, General Mills, Swisslog, Caterpillar, DHL, Goodyear, Corus, Michelin, ThyssenKrupp, Johnson Controls and Multiserv

Price: € 16,500

Advantages and Extra Features	Limitations and Disadvantages
Perform database queries to import data into FlexSim using SQL	**Doesn't allow WCF communication**
Send messages (with parameters) between objects	Second most expensive tool of the choosen ones
Support DDE (Dynamic Data Exchange)	Has too many resources and tools that will not be needed
3D Simulation and very clean GUI	Lack of objects to use in the simulation (maybe it is possible to create some)
Support any connectivity that C++ offers (including DLLs)	
Use sockets to send and receive data (useful for Scada)	

SOLUTIONS
ANYLOGIC

Intro

- 3 modeling approaches
- Extend simulation with Java / UML-RT
- Stock&Flow Diagrams, State&Action charts, Process flowcharts

Background

- Released in 2000 and last version in 2007
- Market and Competion, Healthcare, Manufacturing, Logistics

Customers

- Toyota, Panasonic, Rolls-Royce, IBM, Louvre, Intel, Delloite, UEFA, General Motors, Johnson & Johnson, US Navy, Volvo, HP,
- Red Cross, NASA, ...

Price: € 13,950

Advantages and Extra Features	Limitations and Disadvantages
Allows three types of modelling: Agent Based, Discrete Event and System Dynamics	**Doesn't allow WCF communication**
Because of that, allows all types of simulations (Discrete/Continuous, Micro/Macro Level, ...)	Difficult to use, requires a large study of documentation and tutorials
Simulator with the most well-known clients	
Extend default models with Java	

SOLUTIONS
SIMUL8

Intro

- Dynamic discrete simulation
- Work itens (Entities, Queues, Activities, Exit, ...)

Background

- Founded in 1994
- Business, Manufacturing, Health Care, Public Sector, Supply Chains, Energy and Call Centers

Customers

- Chrisler, Ford, Fidelity
- McDonald's, NIBCO, Gatwick Airport
- HP, American Red Cross, Inland Revenue

Price: $4995

Advantages and Extra Features	Limitations and Disadvantages
Has an excelent customer support, which is always good (including web demos of the tool)	**Doesn't allow WCF communication**
Most cheap commercial tool	Few modeling components
Creation of a class of models (template models) that can be easily tailored to different systems	Poor documentation/web-tutorials

SOLUTIONS
IN-HOUSE

Advantages and Extra Features	Limitations and Disadvantages
Allows WCF communication	Solution that doesn't have market proofs
Probably the cheapest solution	Can become obsolete if not upgraded regularly
Can be adapted to meet all Critical needs and requirements	High risk of developing software from scratch
Solution adapted to the Critical coding guidelines	Only works with Critical's software
Can be adapted to each new product developed by Critical	Will not have the level of functionality compared to a commercial-off-the-shelf product

ID	Name	Description	Risk	Cost (in man/hours)
T01	Technologies' Study	An initial study of the technologies to be used has to be made. This includes the study of cmNavigo, the programming languages to be used, the Stress Test and MasterData already developed and the different simulators in the market.	High	64 - 8 days
T02	Architecture Design	Since this is a one man job, the arquitechure will serve more to explain to the client what's the global vision of the solution, nevertheless this is an essential step of every project.	Low	32 - 4 days
T03	Technical Requirements	The requirements already agreed are only macro-tasks, the technical ones are yet to be discussed.	Medium	16 - 2 days
T04	Model Development	In order to achieve the best simulation possible, it's necessary to have a robust simulation model behind. So is devoted enough time to choose the best approach, as well as the design of the model for that approach.	High	80 - 10 days

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ID	Name	Description	Risk	Cost (in man/hours)
T05	Solution Development	Design and development of the simulator and respective integration with cmNavigo. This macro-task will be divided as specified on T03.	High	360 - 45 days
T06	Tests with Test Data	It is important to validate the application with test data to be able to understand if each module is operating correctly. There will be two stages of validation with test data, the first one to validate the model and the second to validate the simulator.	Medium	40 - 5 days
T07	Tests with Real Data	The validation will only be completed when it is possible to simulate a real factory with precision. In order to do that it's necessary to test the solution with data from a real company.	High	80 - 10 days
T08	Documentation	The final documentation is the final step of every project. All of the steps that lead to the development of the solution have to be documented and an user-manual has to be written.	Low	64 - 8 days

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SOLUTIONS
REQUIREMENTS

	Arena	FlexSim	AnyLogic	Simul8	In-House
RF01	✓	✓	✓	✓	✓
RF02	✓	✓	✓	✓	✓
RF03	✗	✗	✗	✗	✓
RF04	✓	✓	✓	✓	✓
RF05	✓	✓	✓	✓	✓
RF06	✗	✗	✗	✗	✓
RF07	✓	✓	✓	✓	✓
RF08	✓	✓	✓	✓	✓

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REQUIREMENTS
COMPARISON

	Arena	FlexSim	AnyLogic	Simul8	In-House
RF09	✘	✘	✘	✘	✔
RF10	✔	✔	✔	✔	✔
RF11	✔	✔	✔	✔	✔
RF12	✔	✔	✔	✔	✔
RF13	✘	✘	✘	✘	✔
RF14	✔	✔	✔	✔	✔
RF15	✔	✔	✔	✔	✔
RF16	✘	✘	✘	✘	✔

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SIMULATORS
COMPARISON
CONCLUSIONS

Commercial

In-House

- ☐ Price + Maintenence
- ☐ Company Support
- ☐ Wait for Upgrades
- ☐ Ready to Use

- ☐ Man/Hours
- ☐ In-House Support
- ☐ New Features Whenever
- ☐ Still Developing

All commercial simulators have the same big issue: **they don't allow direct communication with cmNavigo**, but some can work with dll's.

- Is it better to invest in an off-the-shelf product that has market proofs or develop one from scratch that is built arround cmNavigo?

- Will CM be dependent of an external company if choose a commercial simulator?

- Can an one-man-simulator have the power of one built by one large company?