

REPORT SURVEY SCHEDULING SOFTWARE*¹

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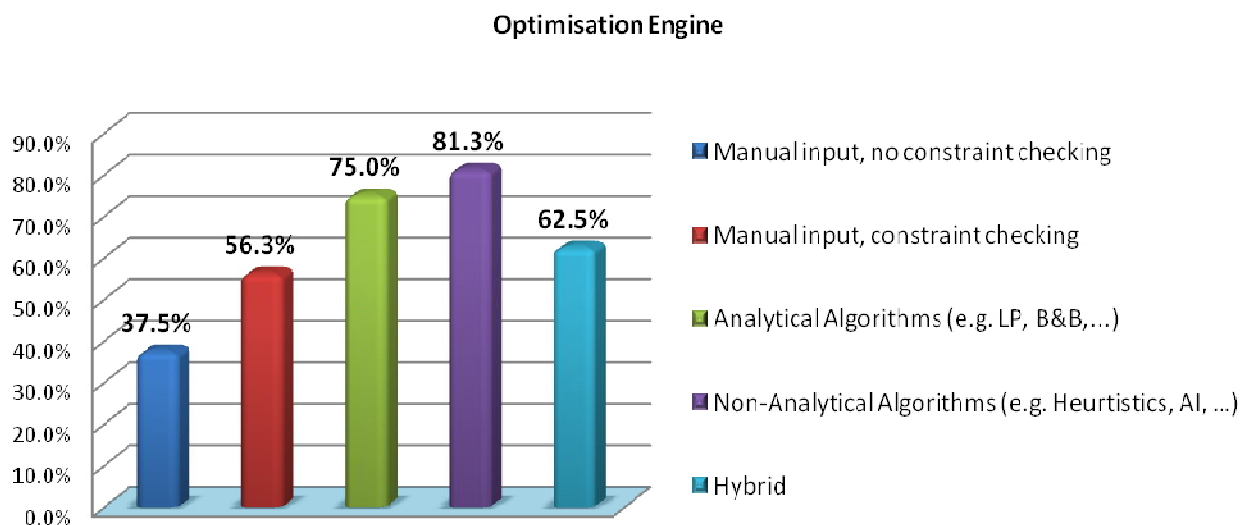
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Introduction

This survey deals with typical features of a scheduling software. In order to gain a general overview on the scheduling software market the study was sent to 72 manufacturers of scheduling software using an online survey tool called 'Thesistools'. Due to changes in businesses of the respondents, no available time, etc. 26 vendors answered during a period between June and September 2009. Only 16 of them completed the survey and were useful for this research. Although the low number of responses gives doubts about the statistic significance, this study can give a first impression on what is available on the market and how far the product evolved. Furthermore, the topics discussed in the questionnaire can be an interesting first approach to improve different possibilities of the software and moreover for customers to look at different topics to be investigated when considering buying a scheduling tool. The complete survey can always be requested to the authors.

Technical features

Optimisation engine used by the scheduler



The most popular optimisation engine appears to be **non-analytical**. Around half of the schedulers also provide in manual input engines (whether or not with constraint checking). 62,5% of the software uses a hybrid engine which is a combination of analytical en non-analytical algorithms. Consequently, 12,5% and 18,8% provide only analytical and non-analytical algorithms respectively (whether or not with manual input). Analytical tools, like linear programming, demand lots of calculation effort and are thus seldom the only optimisation engine.

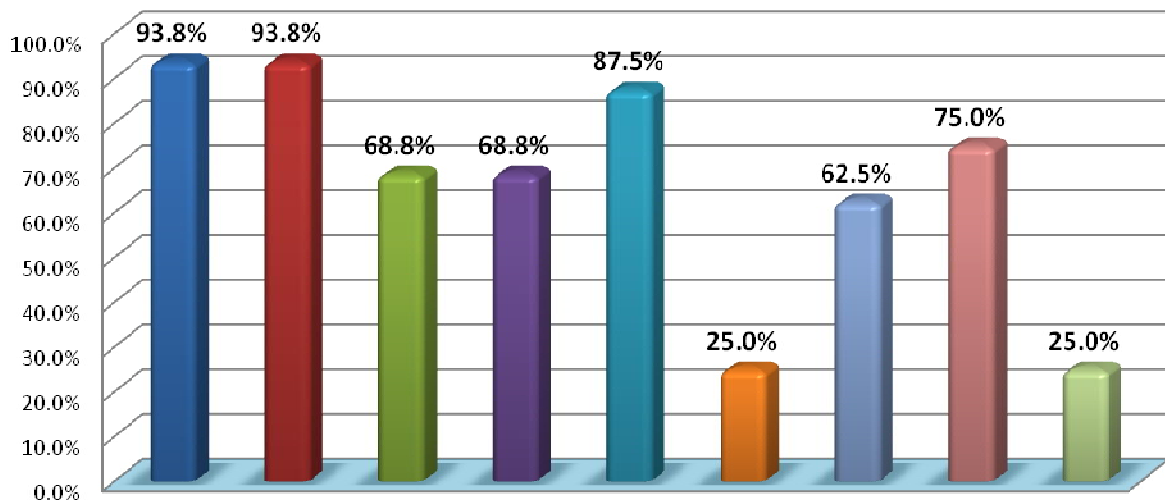
¹ This survey report is written within the **PWO Project: Production scheduling of batch processes**

Software features

Graphical User Interface

Drill down possibilities on charts and graphics, graphical icons and a colour code were **all supported** by the software developers. Drag and drop is available in 94% of scheduling software tools.

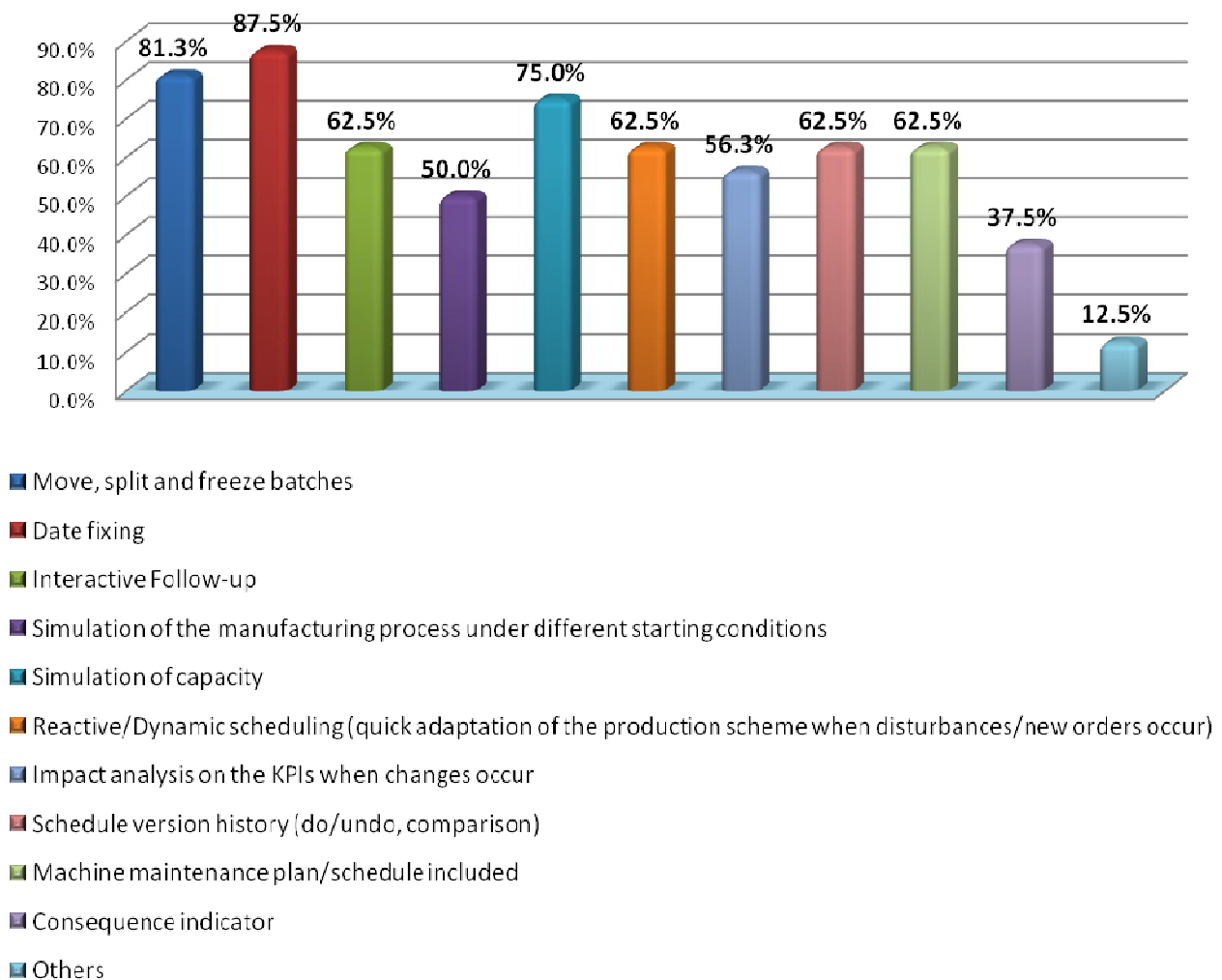
GUI makes it possible to generate:



The graph above makes it obvious that a Gantt chart is a frequently used graphical representation tool in a scheduler. Together with the workforce occupation level and a bottleneck analysis, these are the most often generated possibilities. Also, network diagrams are not often presented in the software. Famous tools like a KPI dashboard and traceability drill down are not always supported.

- Gantt charts, single job flow display
- Gantt charts, total job flow display
- KPI dashboard
- Material levels
- Workforce occupation level
- Network diagrams (e.g. PERT)
- Traceability drill down
- Bottleneck analysis / Waiting timeplot
- Others

Interaction Modification Capabilities



Above figure indicates that the software has pretty mature capabilities concerning interaction modification. However, not all interaction modifications are supported by all the software tools.

The top 3 supported tools are:

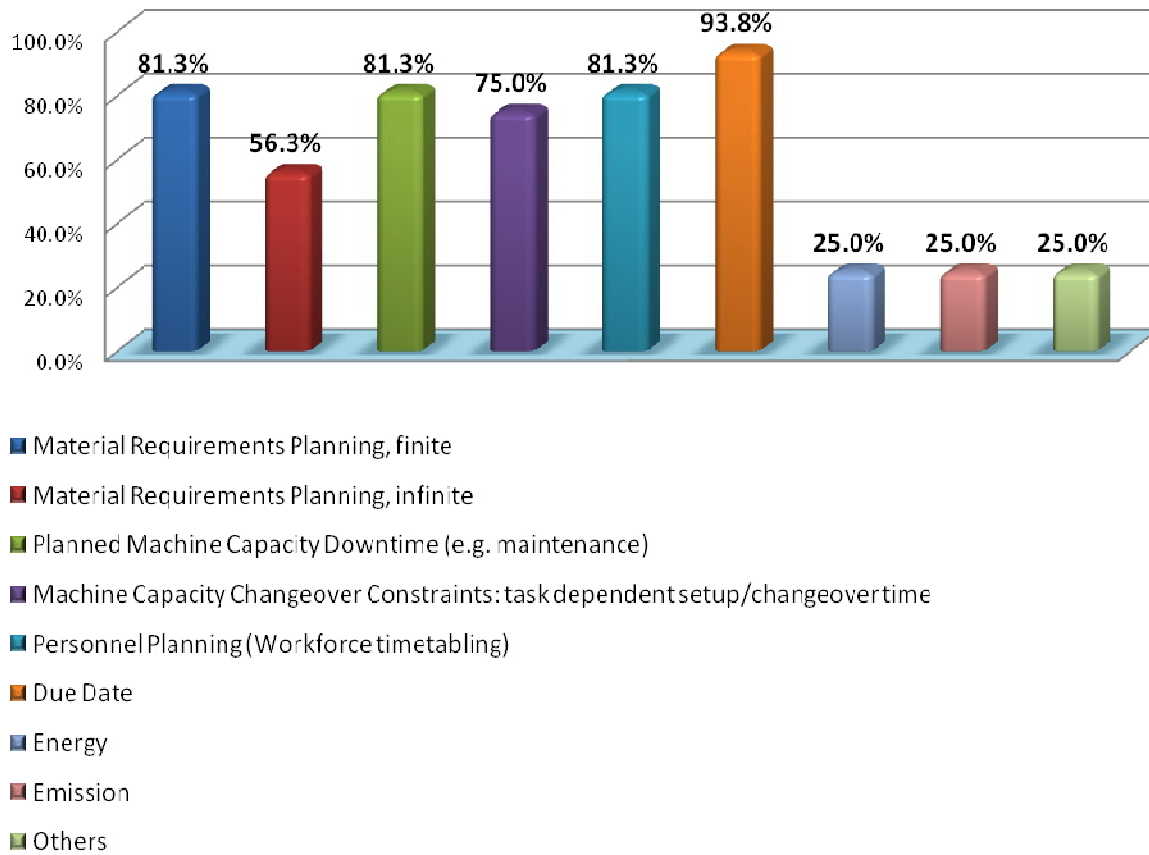
1. Date fixing: **87,5%**
2. Move, split and freeze batches: **81,3%**
3. Simulation of capacity: **75,0%**

Less supported are:

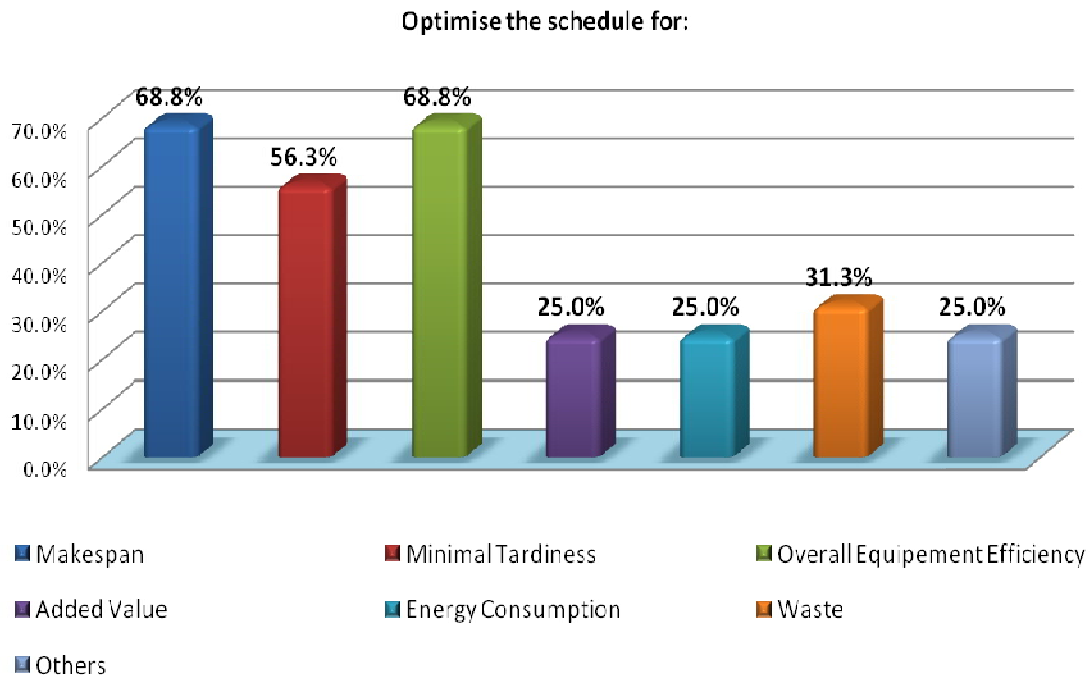
1. Consequence indicator: **37,5%**
2. Simulation of the manufacturing process under different starting conditions: **50,0%**
3. Impact analysis on the KPIs when changes occur: **56,3%**

Optimisations

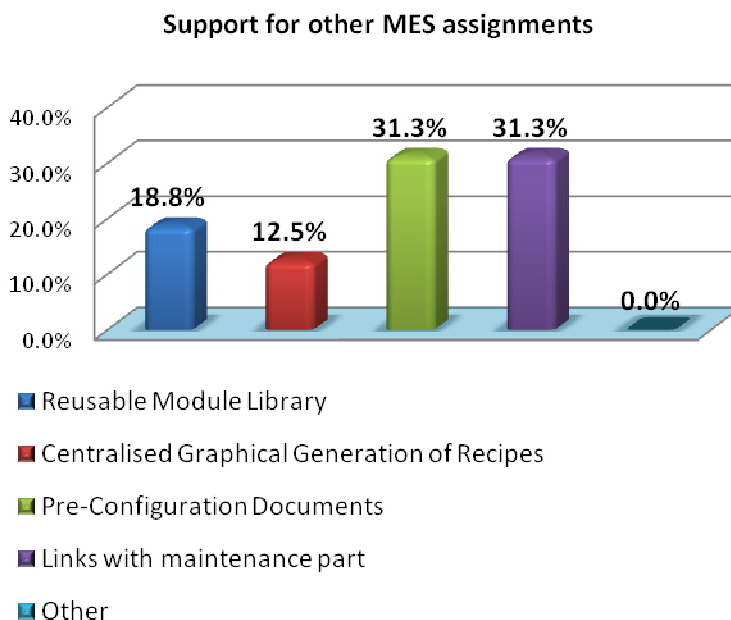
Optimisation constraints possible to implement



This graph shows a distinct lacuna concerning environmental issues. Apparently only one out of four scheduling software tools provide a possibility to put some constraints on environmental issues such as energy consumption and emission. The most provided constraint is the due date. This is indeed a very important issue in scheduling. Moreover, the scheduling software provide more support in finite MRP compared to infinite MRP. Looking at the evolution of scheduling, this fact can only be encouraged.



The weak support of the environmental issues is also noticeable in the graph above. Around 25-30% of the scheduling tools are designed to optimise the schedule for energy consumption and the amount of waste. The makespan, minimal tardiness and overall equipment efficiency are the most familiar optimisation objectives.



A strong link with MES assignments is not noticeable when looking at the graph on the left. Maintenance and document management seem to be the most supported parts. None of the scheduling vendors indicated other MES assignments they could think of which may indicate a low relationship with the whole MES framework.

Integration/Compliance Possibilities

93,3% of the scheduling software is compliant with OS windows

20,0% of the scheduling software is compliant with Linux.

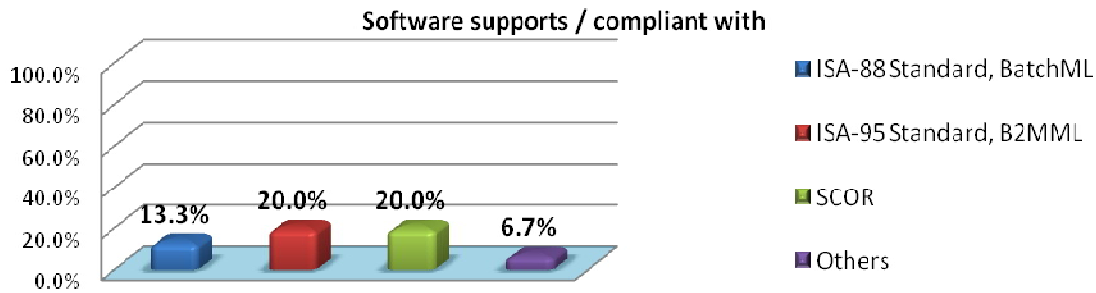
6,7% of the scheduling software is compliant with Mac OS X

73% is part of a total solution

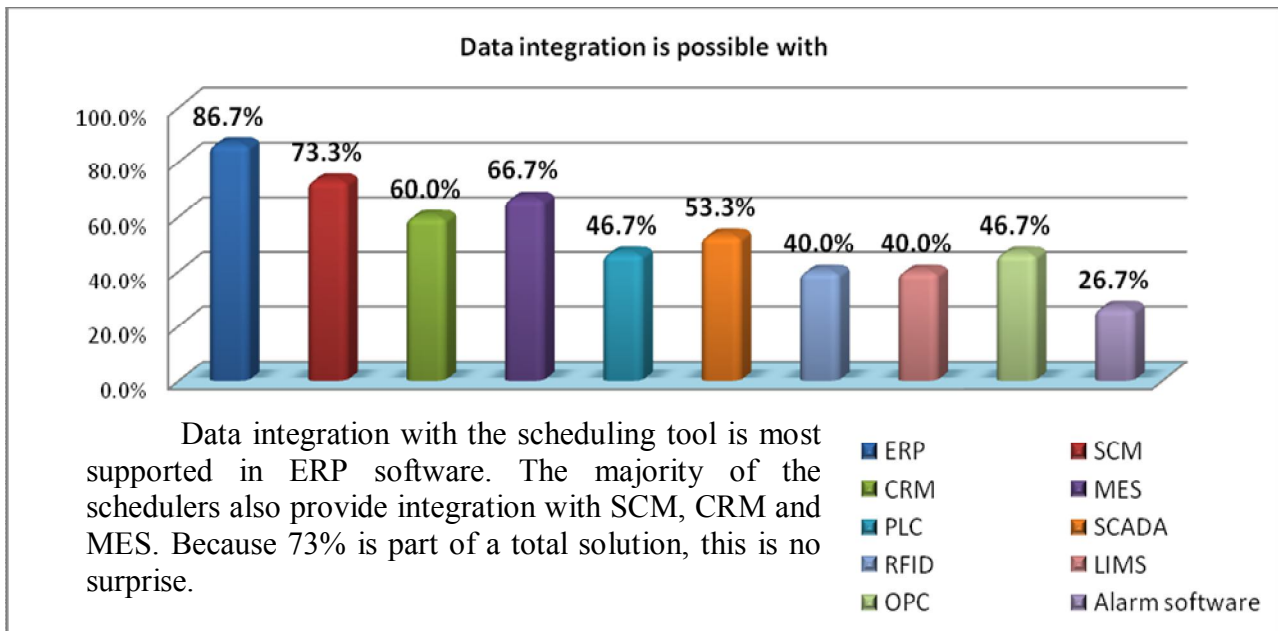
64% of them can also be used as a module

27% is only 1 solution

75% of them can also be used as a module

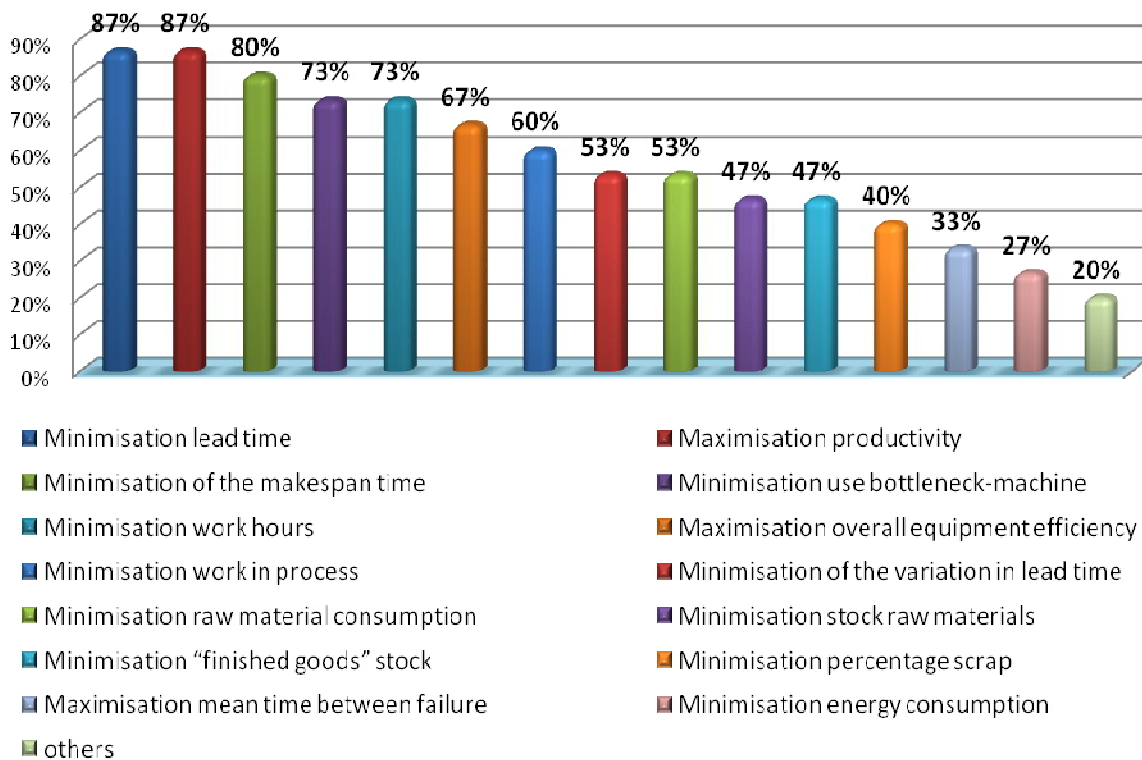


This graph shows the current insufficient support of scheduling software regarding to standards. Approximately **only one out of five** scheduling tools are compliant. The fact that ISA-95 is still under “construction” could be a reason for this low number.



Key Performance Indicators

Software allows the choice or combination of following Key Performance Indicators



Top 3 less supported KPIs:

1. Minimisation energy consumption: **27%**
2. Maximisation mean time between failure: **33%**
3. Minimisation percentage scrap: **40%**

Again the support towards environmental issues is not frequently offered.

Top 3 most supported KPIs:

1. Minimisation lead time: **87%**
2. Maximisation productivity: **87%**
3. Minimisation of the makespan time: **80%**

The emphasis concerning KPIs is on the production time and productivity. Thus, how quick orders can be produced. Issues not belonging to this core question (stock, variation in lead time, scrap, ...) are often not supported in the majority of schedulers.

Software Operator Capabilities

-1 out of 3 vendors indicated an associate, master, engineer, or phd education level as a minimal recommended level.

-1 out of 3 vendors indicated that a high school / secondary education is sufficient.

- 1 out of 3 vendors indicated that education level is not relevant.

Software Implementation

Recommended extra training:

Logistics: **13,3%**

Supply Chain Management: **13,3%**

APICS/CPIM: **13,3%**

APICS/CIRM: **6,7%**

APICS/CSCP: **6,7%**

Not relevant: **66,7%**

Others: **6,7%**

Recommended experience:

50%: Less than or equal to one year

50%: Less than or equal to three years

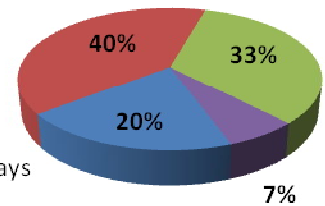
Software training time:

■ Less than or equal to one day

■ Between one and, or equal to, three days

■ Between three days and, or equal to, one week

■ More than one week



All of the scheduling vendors pointed out that the implementation time of their software will take **no longer than one year**.

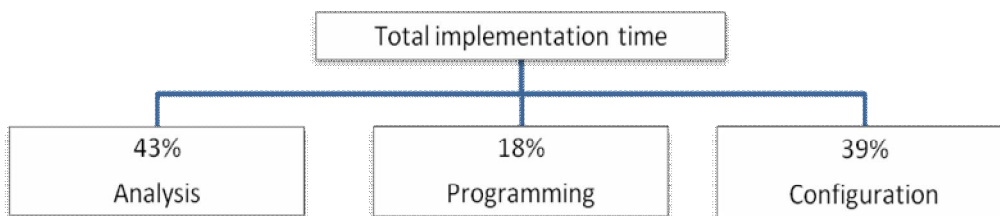
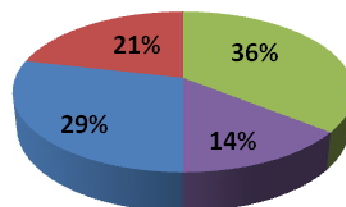
Total implementation time

■ Less than or equal to one month

■ Less than or equal to three months

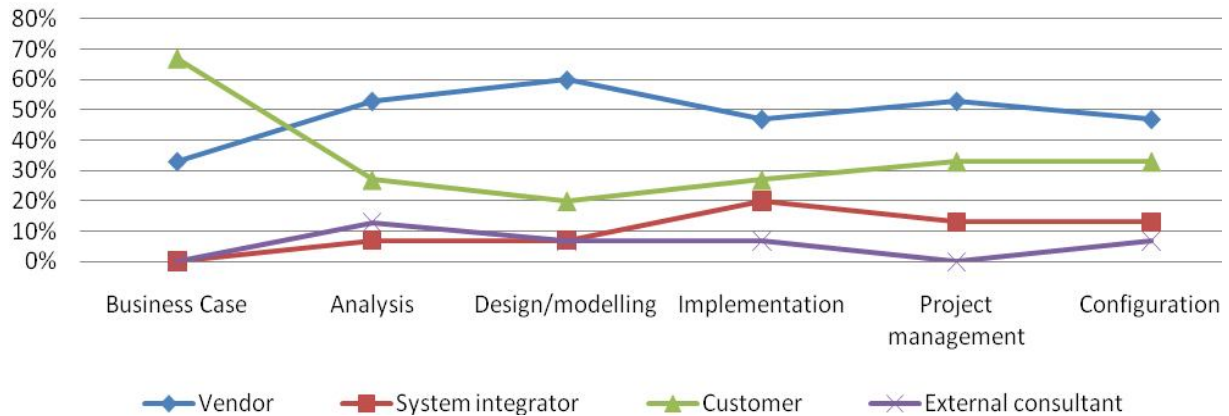
■ Less than or equal to six months

■ Less than or equal to one year



Most of the implementation time is spent on analysis and the configuration of the software. Developing a scheduling software that has a lot of standard options and elements can be an explanation for the relative low number of programming time spent. Consequently ad hoc solutions are uncommon.

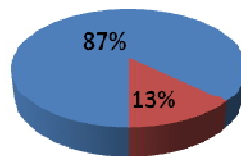
Who takes the lead in the project phases



Vendors and customers are the biggest participators in every project phase. The customer provides data and information and has therefore a big part in making the business case. Furthermore the participation of an external consultant is limited. During the implementation the participation of a system integrator increases.

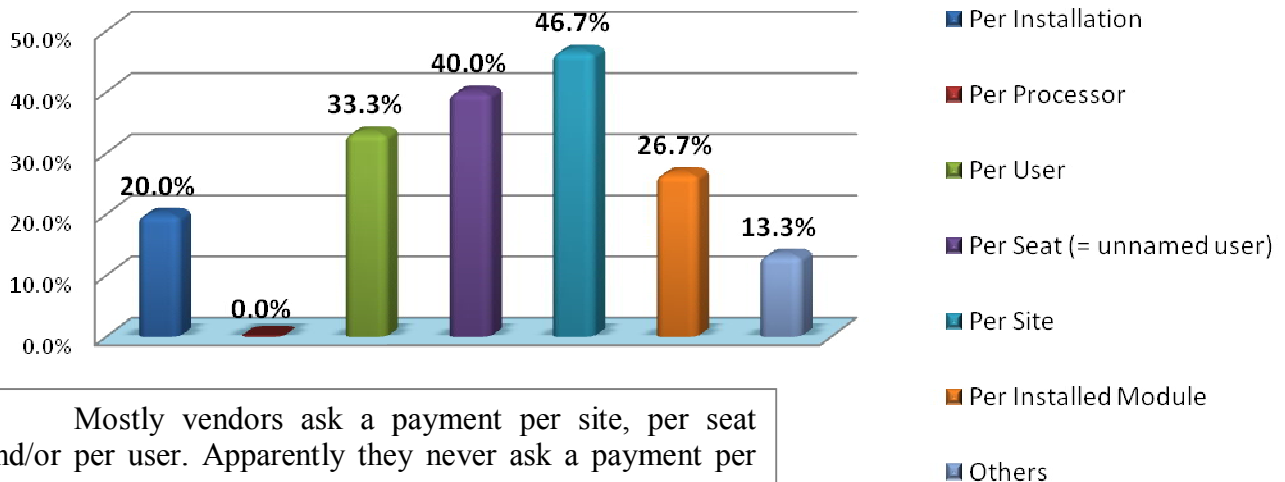
A roadmap for implementation projects is present

- Yes
- No



Almost 9 out of 10 scheduling software vendors have a roadmap for implementation available.

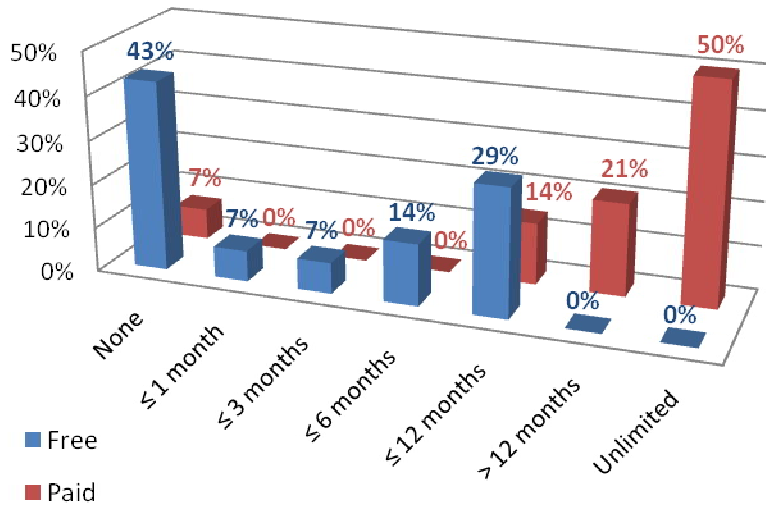
License payment



Mostly vendors ask a payment per site, per seat and/or per user. Apparently they never ask a payment per processor.

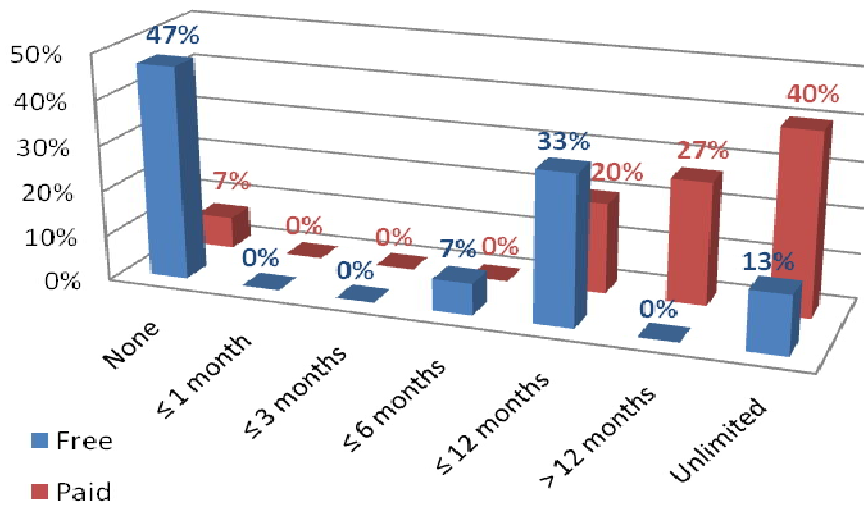
Update and support period

Update period



43% of the vendors do not give any free update period. If they do give a free update period, the duration is often less than or equal to one year. When paid for updates, the customer can usually obtain updates for a period equal to or longer than one year. 7% of the vendors offered their update periods for free and another 7% did not provide in updates. 36% provide only a paid update period and 50% of the software vendors offer a combination of free and paid periods

Support period



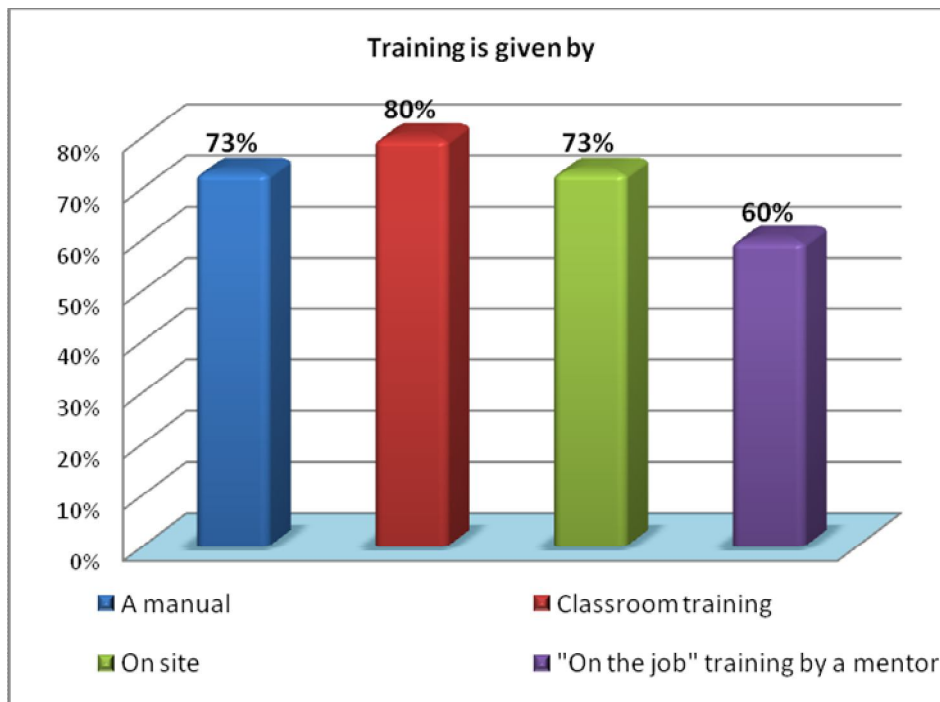
Compared to the update period a similar trend in the support period is noticeable. Paid support periods are usually provided in a timeframe above or equal to one year. 47% of the vendors who sell scheduling software provide in support only when customers pay for it. Another 47% offer support services combining free and paid periods. 7% of the software vendors offer support for free.

Contract features

Installation contract features are used by 67% of the vendors. Moreover, 73% makes use of functional contract features. **Only in 13%** of the software vendors offer performance contract features.

After Sales

All the software vendors indicated that support is provided within the next office day. **53%** of them even provide support **within 4 hours**.



Most of the support happens online through **e-mail or websites** (93%). 4 out of 5 support is also given through a call center and 3 out of 5 support is provided on site.

Classroom training is the most popular training method to learn the scheduling software. Half of the vendors offer a combination of the four different training methods.

Conclusion

This report discussed different features of scheduling software. Information was gathered by sending out a survey to different scheduling software vendors. As a result a brief overview of the scheduling software market was described. Although the number of respondents for getting a statistically significant survey has not been reached, it can give a first indication of the situation of scheduling software and a stimulus or incentive to enrich this research.

While today's scheduling tools mostly make use of non-analytical algorithms, they are often combined with analytical algorithms resulting in a hybrid approach. When buying a scheduling software, the users can expect a mature graphical user interface that supports colour code, moving, splitting and freezing batches. Also dragging and dropping on charts is a favourite feature. Combined with the GANTT chart, a popular way to graphically represent the schedule, these are the core tools of a scheduler. Some interaction modification capabilities like data fixing and simulation of the capacity are frequently offered, on the other hand lower attention is made towards consequence indicators and simulation of the manufacturing process under different starting conditions. However, the survey brought forward that an

average scheduling software tool possess mature capabilities concerning interaction modification.

Most of the software is part of a total solution which can explain the relatively high number of data integrations with other software. Moreover, in 67% cases the scheduling tool can also be used as a module. When implementing the software 87% of the vendors indicated they possess a roadmap for implementation. This implementation always appears to take less than one year. Analysing the problem and configuring the software both take around 40% of the implementation time. The other 20% is spent on programming. This low need to program ad hoc indicate the high maturity level of scheduling software. Implementing scheduling software not only asks time and effort from the vendor. In every project phase (business case, analysis, design/modelling, implementation, project management and configuration) the vendor and the customer are the most important participators. System integrators and external consultants take on average a minor part in the project participation.

Every tool supports English and 73% of them can be bought all over the world. Most of the vendors sell their software asking a payment per site, per seat and/or per user. Although support and update periods are mostly offered using a combination of free and paid periods, 38% and 47% of the vendors only provide updates and respectively support when customers pay for it. In contrast to installation contracts and even more functional contracts, performance contract features (for example a reduction in time to market) are not regularly used by vendors of scheduling software. Extra training, apart from the software training (for example in Supply Chain Management) is not found relevant by almost 70% of the vendors. Moreover, 1 out of 3 indicated a high school education as sufficient education level and 1 out of 3 even indicated educational level as irrelevant. Software training takes mostly no longer than one week and is typically given using a classroom. However, other training methods like on site, on the job and a manual are also often used. The survey showed a qualitatively high level of after sales service provided by the vendors. As with the training, support is more often than not given using a combination of different options. The level of support is mostly a combinations of online, call centre and on site from which online is the most popular.

The survey showed some remarkable gaps regarding the support on environmental issues. Only one out of four schedulers is able to implement constraints about energy and emission. Furthermore, around 70-75% are not designed to optimise the schedule for energy consumption and the quantity of waste. Topics concerning the time and amount of production are placed more central. Another gap is the compliancy regarding standards. More than 80% of the scheduling software is not compliant with the increasing popular ISA-88 and ISA-95 standards (probably because ISA-95 is not yet finished completely).

Concluding this survey showed that the average software scheduler is pretty mature. Basic and popular features are almost always provided. However, there is still a lot of space for improvement. Standards like ISA-88 and ISA-95 are not supported enough by the vendors of scheduling software. Also connections with MES assignments seem to be in an initial period. In a world that emphasises more and more the importance of a green economy and environment, scheduling software still

has a long way to go. A reaching hand from governmental institutions can be a step forward in supporting different environmental features in scheduling software.