EBOOK

Introduction to Visual Scheduling for Microsoft Dynamics NAV

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What is visual scheduling?

Interestingly enough, when you look up "visual scheduling" in a search engine, you find two types of sites: One with a medical/ educational flavor and the other with a more business/ enterprise related flavor. Although the focus of this Ebook is on visual scheduling from an enterprise perspective, it seems to be worthwhile broadening the perspective for the purpose of this introduction.

Using a visual schedule is an empirically proven recommendation for parents of children with autism spectrum disorders (ASD)[1]. In that regard a visual schedule tells the individual what is going to happen and in which sequence. As such, it provides the children with a clear structure both helping to cope with incidents that appear as unexpected to the children and enabling them to make decisions about the next step on their own without the need of their parents telling them.[2] Consequently, a visual schedule yields the following benefits:

- It utilizes the children's visual strengths and hence provides a receptive communication system to increase understanding.
- It supports learning new things as children get used to mastering tasks that they perceived as unexpected.
- It increases the individual's flexibility.
- It helps the individual to develop independence and resulting self-esteem.

An amazing collection of examples of visual schedules can be found on http://www.pinterest.com/aacandat/visual-schedules/

I guess you already sensed it: There are some obvious parallels between using a visual schedule to help and guide children with ASD and using a visual schedule in a business context. Nevertheless, I want to shed some light on what visual scheduling means for an enterprise.

Let's start with the **difference between planning and scheduling**. To me planning (e.g. of production orders, projects or service tasks) is about working out what to make, when to make it and in some applications where to make it. It works with sales orders or projects, forecast demand as well as item, stock and other data. It works in 'buckets' or 'periods' of time, maybe by day, maybe by week, maybe by month or more probably a combination of all of these depending on

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[1] E.g., see: http://www.iidc.indiana.edu/?pageId=394
[2] E.g., see: http://www.specialed.us/autism/structure/str11.htm

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how far the plan is projected into the future. Say the next 2 weeks by day, next 2 months by week and next 12 months by month. In turn, scheduling is about the execution of a plan – the sequence in which operations or tasks are to be carried out on what resource(s) at what time and it takes into account more complex constraints that matches the real constraints. It is also more interactive. When resource availability changes, materials availability changes, when demand changes an interactive schedule allows generating 'what if' alternatives before the decision is made to change the schedule and consequently execution. So you are managing individual orders or tasks and individual resources in close to real time. Both – planning and scheduling – have a role to play. In fact, you may want to integrate the two. A planning tool should feed the scheduling tool which in turn feeds back to the planning tool. However, here I solely focus on scheduling in the discussed meaning of executing a plan in the shorter term.

Now that *scheduling* is defined, I can spend some more thoughts on *visual scheduling* and will do this by again looking at different terms – in this case the **difference between advanced scheduling and visual scheduling**. Advanced scheduling (and planning) typically refers to the manufacturing industry and describes the art of allocating raw materials and production capacity in an optimal way to meet the demand. Advanced scheduling typically uses finite capacity scheduling that assumes a fixed capacity for resources and will not load more than that resource's capacity. Hence, the schedule is generated by applying techniques for solving combinatorial optimization problems such as linear programming, advanced mathematical formulas, and heuristics to create the best (possible) schedule for the manufacturing processes. These algorithms have the ability to simultaneously take into account capacity and material constraints (and often also competing priorities) when generating the production schedule. In contrast, visual scheduling is not necessarily limited to the manufacturing industry. It always requires the existence of an underlying ERP system (or similar) that generates a task- and time-oriented plan (like a production plan, a project plan, a service jobs plan, etc.) in the above sense. Visual scheduling then represents this plan in an intuitive visual manner (even it is not optimized), highlights dependencies and conflicts and lets the user manually develop and change the (short-term) schedule based on the information provided. Other than advanced scheduling, visual scheduling does not necessarily need an underlying model (e.g. of the shop floor) to produce the best plan and hence does not struggle with always needing to update the model to the changing reality. Hence, visual scheduling is a methodology in which changes to a schedule are implemented by manually changing elements of the schedule's visualization. Visually scheduling applies the art of data-driven visualization so that it helps users to focus on the decision-relevant information. The below screenshot gives an example of a visual schedule.
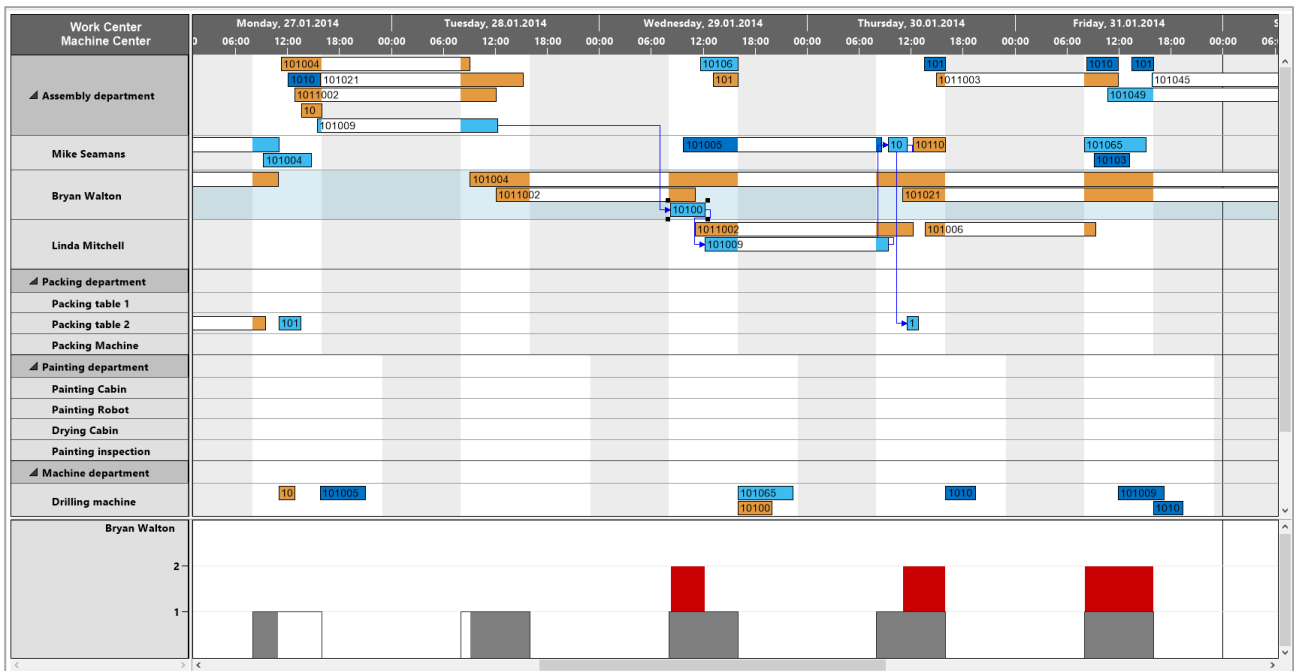
As such, a visual schedule

- Provides a comprehensive overview of a time-related, resource-oriented schedule with dependencies.
- Highlights conflicts and keeps the user focused on the decision-relevant data.
- Enables corrective actions in terms of drag & drop changes to the schedule.
- Keeps the user (and not the system) in the driver seat.

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Why visual scheduling is important

One of the key instruments to enable visual scheduling is the (interactive) Gantt chart, which is the ideal representation of time-related scheduling data with dependencies. In today's business environment, we all experience a few key (and widely discussed) trends, which I want to summarize quickly:

- **Data growth**. It is no secret that the volume and variety of both structured and unstructured data is ever increasing. Consequently, conventional databases, tables and spreadsheets have become too complex to be used immediately as decision support tools. Instead, users need and expect a graphical "condensation" of all this data to see and understand patterns and dependencies faster.

- **Shorter decision cycles**. The speed of markets' changes has significantly grown, and hence the need to rapidly react. As consequence, the requirement to review data and make decisions changed from being a regular need in defined intervals (years, quarters, months) to becoming a frequent need. Time frames for decision making processes are shorter, and intervals are smaller. As a result, users require more information faster (see: data growth) at one glance. This also drives the need for intelligent graphs.

- **Decentralized planning & decision making**. The power to take control and to make decisions (within a given range of responsibility) has been moving down in the organizational hierarchy at rapid pace. The distribution between task workers and knowledge workers has been shifted to the knowledge workers and virtually everybody is not only expected to execute, but also to contribute to decision making and to managing. However, not every person in an organization is a planning expert and hence intuitive tools are needed to support people coping with the increased decision making responsibility.

These key trends all had an obvious impact: the boom of the Business Intelligence (BI) tools happening in the past 10 years. However, as great and as smart BI tools are, they always "only" support analytics and a one-way communication between the user and the data. Of course, the user can slice and dice the data and can drill down to better understand cause and effect, but data never gets changed with BI tools. It remains static.

Somewhat hidden by this BI "hype", I also observed these general trends to cause the renaissance of the Gantt chart to happen. You ask "why"? – Well, the above discussed trends have led to a situation in which analytics and decision making have started to merge. Likewise, planning and decision making merge. Hence, especially when it comes to (time-related) scheduling data, users

no longer can work with static data: they need data to be interactive, and they need a bidirectional communication with the data. This is supported by interactive Gantt charts – no longer used for long-term project planning, but for short-term visual scheduling.

Consequently, visual scheduling is an important technique for short-term scheduling scenarios as it helps achieve operational agility.
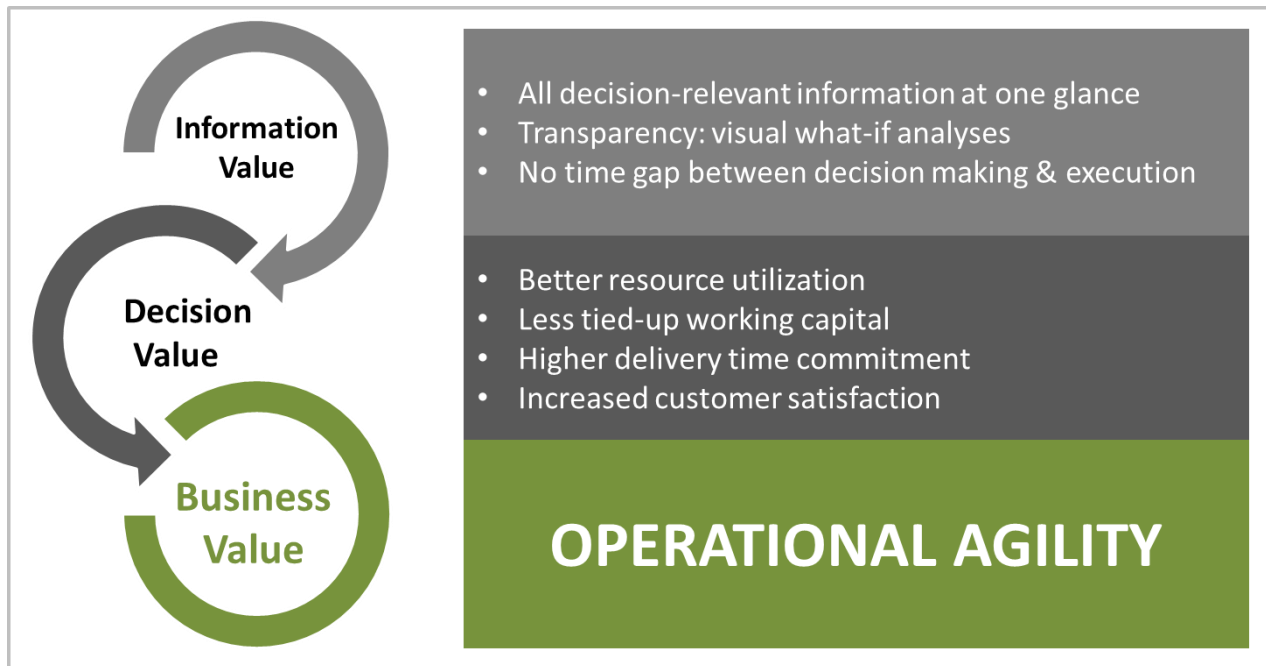
In that regard, visual scheduling yields a threefold value:

- **Information Value.** A visual schedule in form of a Gantt chart shows all decision-relevant information at one glance: tasks, capacities, dependencies, conflicts. As a Gantt chart allows a bidirectional communication between user and data, this transparency enables schedulers to do visual what-if analyses and to compare the effects of alternative scheduling decisions. Ultimately, the user can decide for one of the scenarios and just change the schedule's data so that there will be no time gap any more between decision making and execution.
- **Decision Value.** This transparency and the improved capability to understand cause and effect translate into a decision value. The visual schedule helps in the short-term to better utilize resources and capacities which contributes to a reduction of the degree that working capital is tied-up. In addition, the visualization of tasks, dependencies and milestones also helps making better delivery time commitments which obviously has a positive impact on customer satisfaction.
- **Business Value.** Ultimately, if you look upon Gantt charts and visual scheduling as a means to work on your short-term schedule, it will help you gain operational agility.

I fundamentally believe that the described evolution of the Gantt chart has made it more important and more meaningful than ever before: It is no longer a (somewhat static) tool to visualize long-term projects and report back progress; it is a dynamic technique to visualize and manage short-term tasks with dependencies and constraints.
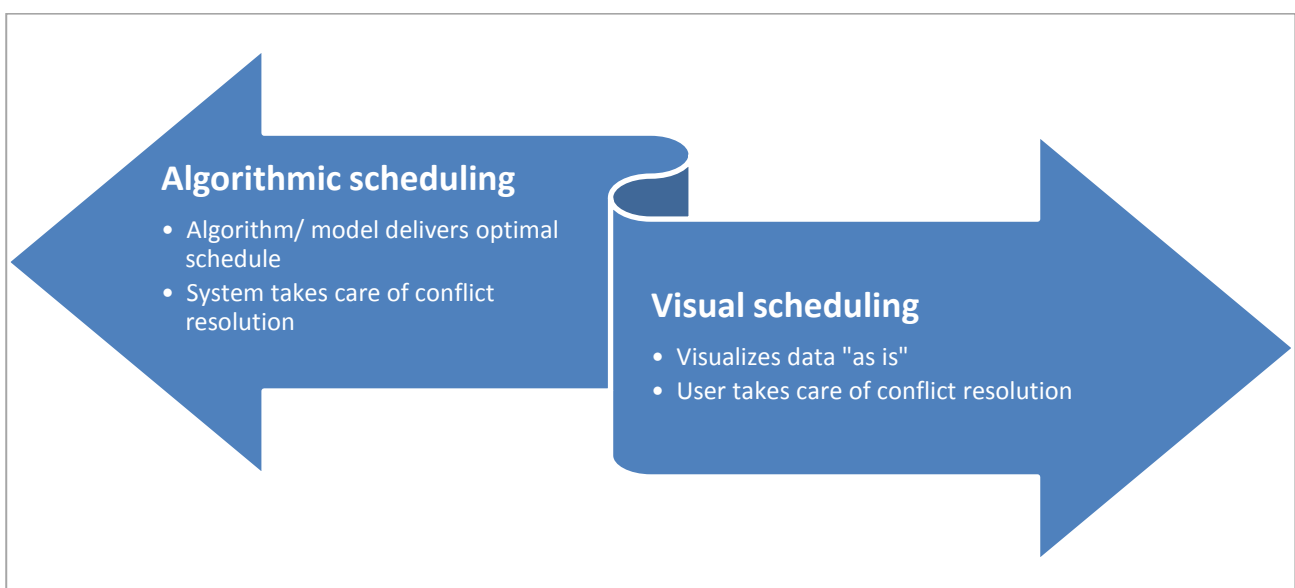
However, for a Gantt chart to fully unveil its capability to create operational agility, you also should be prepared to explicitly accept "grey areas" in your schedule, and your scheduling process. The meaning and purpose of these grey areas will be discussed in the next chapter of this Ebook.

What is the importance of a scheduling grey area?

The concept of "scheduling grey areas" originates from the fundamental differences between advanced/ algorithmic scheduling and visual scheduling.

With an algorithmic scheduling system, users (or their consultants) create a precise model of the shop floor – with all dependencies, constraints, relations, alternative product routings, priorities, business rules etc. This model is then fed with plan data from the underlying ERP system, and the scheduling system derives the optimal schedule to execute the plan. It is the nature (and the undoubted strength!) of the algorithmic system to resolve – as good as possible – all scheduling conflicts, and to provide the optimal schedule. Conflicts do not exist per se in the schedule delivered by an advanced scheduling system. If they happen, the next scheduling run will resolve them again – and again deliver the optimal schedule based on the input information and based on the defined shop floor model.

In a visual scheduling system, the decision authority is with the user: the visual scheduling system works as a kind of 'assistance system' helping the user to understand the current situation with all their issues and conflicts, as well as potential strategies to resolve these. It does not necessarily rely on an algorithmic/ model intelligence. It takes data from an underlying (ERP) system and visualizes the plan/ schedule calculated by the system. However, the visual system knows about conflicts (e.g. delivery time violations, capacity conflicts, missing material, etc.) and is able to intelligently visualize these conflicts. It is then the task of the system's user to manage the conflicts and either change the schedule or take appropriate counter measures to deal with the conflicts.

Algorithmic scheduling

- Algorithm/ model delivers optimal schedule
- System takes care of conflict resolution

Visual scheduling

- Visualizes data "as is"
- User takes care of conflict resolution

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So – why do I think that the inability of a visual scheduling system to generate a conflict-free schedule is something useful?

This is because I believe in the existence of scheduling grey areas. My experience from working with many SMB companies around the globe tells me that even the best (and probably most expensive) shop floor model never can cope with reality: data always seems to be too imperfect to feed the "perfect" algorithm and the current production conditions seem to change too fast so that systems always seem to be 'behind' the shop floor reality. In that regard, the scheduling grey area should be defined as the **area in which the scheduling system's settings, configuration and model does not meet the reality and in which a human scheduler is sitting in the driver seat with the need to make agile decisions**.

Here are three typical scenarios in which the scheduling system user would make a decision "against" the rules he has previously defined for his shop floor model. He would not do this because the models are stupid, but he would do it because there are scheduling grey areas which exist in reality, but outside the model.

- **Machine speed dilemma.** Imagine the following scenario: A product (P1) is produced in a sequence of three operations (O1-3) on three machine centers (M1-3). Typically, an ERP and/ or scheduling system allows you to define the delivery date, the routing, the required and used material for P1, set-up time, run time for O1-3 on M1-3 as well as wait/ transportation time between O1/2 and O2/3. Of course, you can also define priorities and constraints so that the scheduling engine can determine the best start/ end dates for all three operations given the already existing schedule. This may lead to the situation that O3 finishes at the end of day, so that the next operation for a different product on that machine center will need to start the next day.

  It goes without saying that the above mentioned definitions – especially the set-up and run times – always have to be average values. They depend on the experience the manufacturer has made with that particular product on that specific machine in the past. Well, it is not so uncommon that once in a while the machine operator recognizes a slightly better "condition" of the incoming material on M3 for P1 and therefore, despite the system's settings and based on his experience he decides to run the machine faster than the average. As a result, he manages to complete the product faster than expected so that he can free up capacity on M3 later that day. Consequently, the machine operator can start with the next operation although this was not foreseen in the "optimal" schedule.

  When working with grey areas – and allowing capacity conflicts rather than trying to "optimize them away" – a visual schedule could have just shown two operations in parallel on that machine at that particular day. With the knowledge of a human being about reality being different than the average reflected in the model, this scenario would not have

resulted in a schedule with a capacity conflict. Instead, the schedule would have shown much more realistic completion time information.

- **Delivery time dilemma.** Again, let's imagine a scenario. There are two production orders P1 and P2 from customer C1 and C2. Both have a similar order date, and both need to be manufactured on the same machine M1. Also, the delivery date for P1 and P2 is the same. This is actually quite common: You have production orders that compete on resources so that a deadline can be met with the current conflict resulting in a delay for one of the two production orders.

    The typical way to deal with this scenario is to define rules deciding which production order should get processed first, and for which production order a delay can be tolerated. Of course, there is a wide range of potential rules that could be applied here. Let's assume that the system is set up in a way that in case you have competing production orders, you will prioritize

    (a) The production order with the earlier due date.

    (b) The production order where you got the order first (kind of 'FIFO').

    (c) The production order from the more important customer measured by total revenue with the customer in the past 24 months.

    In the described scenario, rules (a) and (b) would not come into effect as both order and due dates are the same for P1 and P2. Hence, the system would prioritize the production orders according to the past revenue with the respective clients. So far, so good. This all makes sense.

    In most scenarios, this rule would work just like people on the shop floor and management would have decided. However, imagine customer C1 to be one with whom you made a very good business in the past. In fact, you not only made great business with them, but you were able to build a strong (even personal) relation with this customer. In turn, customer C2 had been buying from your competitor for the past years. Due to some recent quality weaknesses of his previous supplier, he decided to grant a first order (P2) to you – with the perspective of becoming a future large client. Now think of the scheduling system deciding to prioritize P1 and to complete P2 late. Your first delivery to C2 would be late. Most likely, this would destroy the opportunity of building a long-term relation with C2.

    When working with scheduling grey areas and giving decision control to humans and not to the scheduling algorithm, the visual scheduling system would provide you with a conflict alert highlighting P1 and P2 with their respective delivery dates. You would then rethink the situation, and decide to call C1 with whom you have a trustful relationship. You would explain the situation to him and ask him if just this once he would agree with a delayed delivery in order to help you build another strategic customer (which, since a stronger supplier always is a good thing, would also be of interest for C1). Presumably, C1 would

agree so that you would be able to take both orders and manage to win C2 as new customer.

- **Capacity utilization dilemma**. A non-optimized schedule regularly shows capacity conflicts at resources (e.g. at machines or people). As unwanted these conflicts may be in general, sometimes they are just small enough to be accepted by humans. Imagine a scenario with two production orders (P1 and P2) being allocated to the same machine (M1), with P1 starting at noon and running until the end of the shift that day and P2 starting in the afternoon and running for one hour until the end of the shift that day as well. As M1 can only handle one production order per time, the "overbooking" during the last hour of operations at that day would create a visual system to give a (visual) warning to the user. Remember: With an algorithmic system, these capacity conflicts do not exist per se.

  Knowing that both P1 and P2 have tight delivery schedules and do not allow for any delay, the production scheduler now has to make a decision between two choices:

  (a) Accept the delay (if there are no alternative machines to take care).

  (b) Ask the machine operator to work an extra hour that day to get both P1 and P2 done in time.

  Again, the scheduling grey area opens a degree of freedom with respect to decision making which does not exist in a rule-based advanced/ algorithmic system.

In essence, many conventional algorithmic scheduling systems often are hard to understand as the core element – the scheduling algorithm – is a kind of black box. Typically, it requires a massive amount of training to even operate these systems. However, even well trained operators not necessarily understand what is happening when they start the scheduling engine. This makes it hard to impossible to understand and systematically correct operational flaws in the manufacturing process. What's even worse: If the scheduling engine is fed with suboptimal data, it generates suboptimal scheduling results. They can hardly be spotted (as users tend to accept the results rather than to understand them), which can result in bottleneck floor operations. Also, due to the inherent complexity driven by the underlying model, an algorithmic scheduling system that had been implemented once is hard to change. Hence they tend to become inflexible. As result, over time the likelihood increases that the reality on the shop floor will change and the algorithmic systems then fails to reflect this change.

In turn, the visual scheduling approach explicitly works with a clearly defined "scheduling grey area". This enables the user to better react to unexpected changes or to adapt the schedule to reality (rather than trying to explain why reality is different than it should be according to the underlying model).

Why do Dynamics NAV users need visual scheduling?

As enterprise resource planning (ERP) system, Microsoft Dynamics NAV helps small and medium-sized companies to better manage their accounting and finance processes, supply chain, and operations. It provides users with a real-time view of their entire business. Running a successful business depends on the ability to gain insight into business data and extract and present information in a meaningful manner. Recently, Microsoft enhanced the business intelligence capabilities available with Dynamics NAV to support users making informed decisions. These enhancements relate to reporting, charts and KPIs as well as ad-hoc queries and analyses.

The value of adding charts to an ERP system is manifold:

- **Charts help to picture the business**. They provide a visual model for business data, and – at least equally important! – for data dependencies. We all know the saying, "A picture is worth a thousand words". Showing even complex business data and their dependencies will help even less experienced users to better understand the data.
- **Charts help to understand the business**. It is not just about understanding data. The data are a representation of the business, and hence understanding data means understanding the business. Charts can show trends, correlations, conflicts and issues. The more flexibly the user can interact with the data (e.g. slice and dice), the higher the information value of the charts.
- **Charts help taking actions**. Intelligent graphs help users to find the crucial data points within a huge data set. They help focusing not on all, but on the relevant information. As such, charts can help visualize conflicts and hence trigger actions.
- **Charts help taking the right actions**. Identifying an issue is one thing, but defining the appropriate counter measure is another challenge. Charts can be interactive and can enable the user to create what-if analyses on the fly so that he can assess the potential outcomes of alternative actions; especially if graphs also work with data dependencies. Hence, the user can make an educated decision rather than acting on best guesses.

However, these business intelligence enhancements are centered on (standard) financial, accounting, customer, creditor and supplier information. Task- and time-centric scheduling data as they are used for production, resource, project or service schedules still are presented to the users solely in tabular forms.

Hence, users of the manufacturing, the jobs, the services and the resource planning module fully lack the visual model of the business data which is relevant to them to achieve their goals. They

need to maneuver through tables, cards and pages leading to situations in which they literally spoken do not see the forest for all the trees. Within the standard Dynamics NAV system, the users of the mentioned modules cannot easily understand the consequences of potential decisions, and they do not get visual alerts that help them focus on the relevant data.

Actually, the system itself bears a lot of valuable and relevant data also for production schedulers, project managers or service dispatchers. These data theoretically allow the users to answer questions like:

- What will happen to my production order if I squeeze in another urgent order before, which came in unexpected? Will I be able to keep delivery commitments for both orders?
- What will happen if I start my production late? Will this create capacity conflicts with another production order that is supposed to run at the same machine?
- A project task runs late: Is this task already on the critical path and will this delay have an impact on the overall schedule or not?
- The fulfillment of a service order runs longer than expected. Will the service technician be able to complete all service orders today? Or do I need to send another technician out so that we can keep all commitments made to our customers for that day?

In reality, finding the answers to these questions often is like searching the needle in the haystack.

And of course, there are more questions like this. They all are related to the question whether Dynamics NAV enables users of the manufacturing module, the jobs module and the service module to achieve the needed level of operational agility. Definitively, data is there to get there. However, data is hidden in and spread across pages, tables and cards: It simply takes too long to understand the data, the business and to make the right actions. You also can phrase it like this: Dynamics NAV is a data treasure, but when it comes to time-related scheduling data, it provides no fast path for users to get to this treasure.

Hence, users of Microsoft Dynamics NAV definitively can benefit from visual scheduling solutions – these solutions help them to unleash the potential of the data treasure that NAV comes with.

How to best achieve visual scheduling in Dynamics NAV

Before answering the question how to best achieve visual scheduling in Dynamics NAV, I want to quickly recap why users need visual scheduling capabilities. These capabilities are always related to time-oriented and resource-centric planning data which have dependencies. By visualizing these data (using data from multiple NAV tables) in an intuitive manner, users better understand the schedule, the constraints, the issues and the dependencies. They yield an *information value*. This information turns into a *decision value* as the visual scheduler helps the user focusing on the decision-relevant information thus enabling immediate corrective actions. The faster these corrective actions are triggered, the better the improvement of the operational agility will be. So ultimately, the decision value turns into a *business value*. This scope of visual scheduling helps identifying **basic requirements that any visual scheduling solution should meet**:

- Data used for visual scheduling must combine relevant information from various NAV tables.
- Data must get filtered, aggregated, and be represented in an intuitive manner.
- The data presented should be context-sensitive and come with a kind of "auto focus" on the decision-relevant information – based on the user's current decision need.
- Operational agility only can get achieved if the user can change the data – hence the communication with the user and the data must be bidirectional; data must be interactive.

The above-mentioned scenario is not supported by standard NAV – neither for production orders, nor for jobs and project data, nor for service orders and nor for resources and capacities. That's why it can only be achieved by adding functionality to the system, which is typically done by using an ISV solution. With the introduction of the role-tailored client, Microsoft also launched the so-called Client Extensibility Framework which enables ISVs to provide their solutions as pure and fully integrated add-ins. So, one essential decision that has to be made when answering the question "how to best achieve visual scheduling" is the **decision between using an ISV add-on or an ISV add-in**. This in turn leads to the question of how to define the difference between an add-on and an add-in solution[3]:

- **An add-on is less secure**. Add-ons typically work with their own database and hence send data to third-party systems, which can leave your system completely vulnerable. Add-ins in

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[3] See a more detailed analysis in our blog post http://blog.netronic.com/microsoft-dynamics-nav-differences-gantt-chart-addin-and-addon

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turn remain entirely within Microsoft Dynamics NAV and hence the often critical and sensitive data do not leave your environment.

- **Add-ons require more training**. Typically, add-ons come with their own branding, user interface, and menu structure. As such, they provide a completely different user experience compared to Dynamics NAV. Training a user to work with an add-on is very similar to training them to apply an entirely different software system altogether. Add-ins, by contrast, work directly within the system and enable users to fully stay in the environment in which they have been trained anyway.

- **Add-ins seamlessly integrate**. An add-in is basically increased functionality within a system while an add-on is something that is patched over the system. Patching something over a system can create system incompatibilities, confusion and general disarray. A properly built add-in is an enhancement that many would be unable to tell did not come with the original software system. It feels like a natural puzzle piece of the entire Dynamics NAV system.

- **Add-ins offer quick deployment**. Typically, an add-in allows for a fast and easy deployment, and the installation may take only a few clicks. It requires no adjustments of the standard NAV, which makes it a rapid-fire solution that can be up and running for the benefit of the users in a matter of an hour.

- **The scalability advantage of an add-in**. Add-ins integrate into Dynamics NAV and hence do not require any kind of "overhead code" such as menu bars, backend databases, integration and synchronization. They typically come with much leaner code. Hence, add-ins can get enhanced and can grow in a much more agile way.

Finding 1: All of the above let us come to the conclusion, that we recommend implementing visual scheduling within Microsoft Dynamics NAV as an add-in product.

The phrase "product" – rather than "solution" – leads to another question that has to be answered when deciding how to best achieve visual scheduling within Dynamics NAV: The question of product vs. solution, resp. **high degree of standard vs. high degree of customization**. This issue relates to whether you want to accept the NAV standard as is, and provide additional functionality to all NAV users – or if you will enforce the user to significantly move away from the standard by providing a much customized solution. Answering this question has two dimensions: (a) the first dimension is related to the general purpose of visual scheduling and the second dimension (b) is related to the specific business processes which are subject to visual scheduling.

(a) The essential purpose of visual scheduling is to provide the users with an intuitive picture of their schedule so that they can see scheduling issues at one glance, and can take corrective actions immediately. The key phrases here are "intuitive" and "users". In this context we are talking about a precisely defined group of users: the users of Microsoft Dynamics NAV. They all have in common

that they very well know one specific ERP system (Dynamics NAV), for which they typically have received a lot of training, so that they are familiar with the NAV data, data structures and the meaning of the respective data. It should be no surprise that a solution based on the standard the users are used to, is more intuitive to them than a solution for which they would have to learn new data fields, new data semantics, a new data model, etc.

Finding 2: The less the visual scheduling add-in requires changes to the Dynamics NAV standard, the more intuitive it is for the users.

(b) As I outlined before, the best way of providing a visual schedule is to deliver the schedule's data by using the Gantt chart technique. A Gantt chart is a common technique which is not tied to a specific use case: Its base elements (time scale, resource table and graphical part) can be applied to multiple scenarios ranging from production scheduling over project management and service staff scheduling to fleet and logistics planning. So the question arises if visual scheduling for Dynamics NAV should get achieved by a "one size fits is all" approach or if it should have some kind of "industry flavor".

Again – applying a strong focus on the requirement that visual scheduling should always be intuitive seems to be the key to answering this question. Although the visualization technique (Gantt chart) is the same across multiple functional areas, the underlying business processes, planning & scheduling workflows and decision criteria needs differentiation. A production planer has a different job description and different job goals compared to a service staff dispatcher, who in turn deals with very different questions than a project manager. The specific needs of these different personas are reflected also in the specific Dynamics NAV modules, which are designed to best support the various tasks of people working in different functional areas. Consequently, a production planer user is used to the production and capacity data model and data. Likewise, a service dispatcher is used to service orders, service item lines, resource allocations etc. To them, a visualization technique is much more meaningful if it (a) directly relates to the specific data they use to work with on a daily base and if it (b) is tailored towards their specific scheduling and planning needs.

Finding 3: Although a Gantt chart is a common visualization technique, it is recommended that the visual scheduling solution is focused on one specific functional planning and scheduling need.

Summing this up, visual scheduling for Dynamics NAV can best be achieved with:

- An integrated Gantt chart add-in product,
- which stays as close as possible with the Dynamics NAV standard,
- and at the same time has a functional focus in terms of the NAV module(s) it is based on.

# How to visually schedule production orders in Dynamics NAV

The purpose of visual production scheduling for Microsoft Dynamics NAV is to enable manufacturing users to better understand the production schedule, constraints and capacities. This helps them manage production orders, operations, items, material and capacities so that delivery time commitments can be met and capacity conflicts are avoided. Following the requirement that a visual scheduling solution should best be based on the unchanged NAV standard, a visual production scheduler always should work on the results of the standard NAV material requirements planning (MRP) process. These results should be visualized in an intelligent way so that users quickly see issues with the schedule, and can take corrective actions immediately. As the underlying data model of the manufacturing model is quite complex, we recommend applying multiple views on the same data.

These views should address different questions like:

- Which production orders will be finished in time, and which will be late?
- In which work and machine centers do I have capacity issues, and which work and machines could help balancing the workload?
- Do I have sufficient material in stock to start working on the production order earlier?

These different kinds of issues which a production scheduler can face should lead to different views of a purpose-made visual scheduling add-in for Dynamics NAV.

A **production order view** should enable users to answer delivery date-related questions. It shows data by production order status, production order/ production order line number and works with symbols to visualize delivery dates. In addition to this, the user should be able to drill into specific production orders, and understand their routing and the work and machine centers that are scheduled to complete this specific production order. This overview will also provide information if the production order already is on a kind of "critical path" or if the associated work and machines still have some "buffer" to cope with potential delays in preceding operations. The below screenshot illustrates such a production order view.
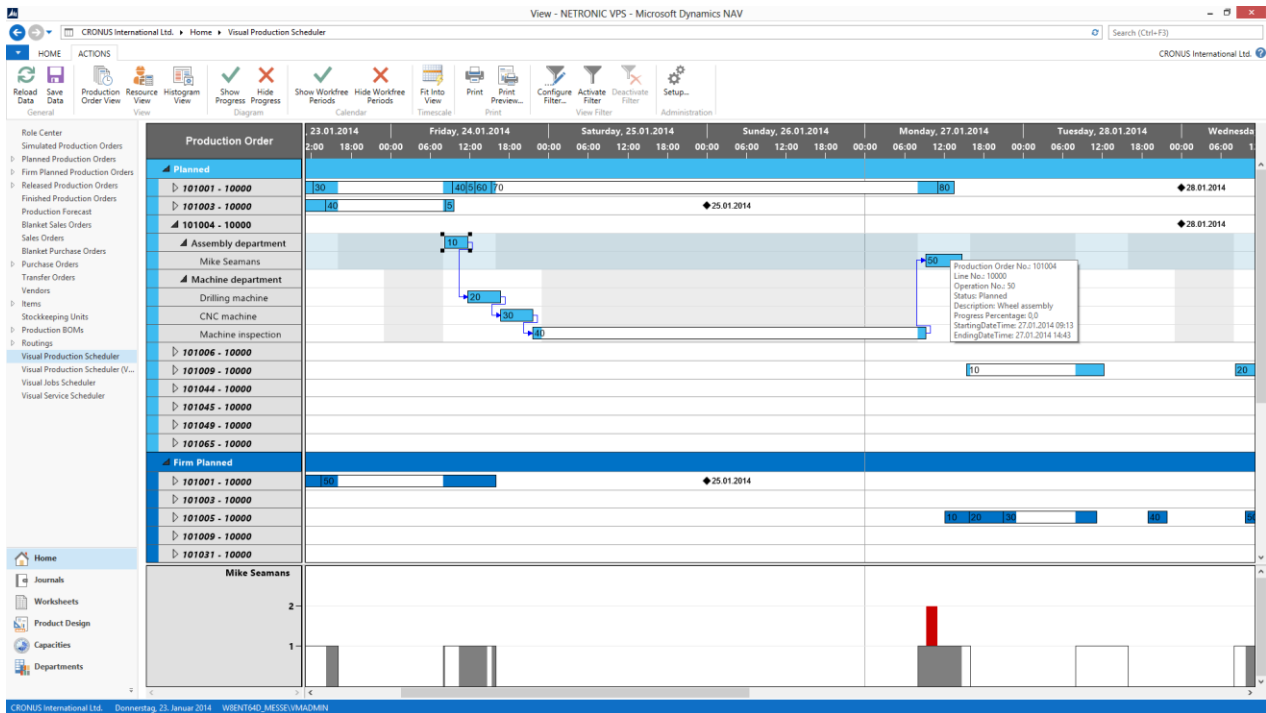
A typical scenario when working with data in the above shown production order view is a drag & drop rescheduling of the operations by moving them right (later start date) or left (earlier start date). While the first movement should trigger an automatic visual warning in case the delivery time is violated, moving to the left is trickier: Starting a production order earlier is only possible if the required material, items and components either are available or can get purchased or produced in time. This is the reason why we strongly recommend complementing the production order view by a production order specific **bill-of-material view** as is shown below.


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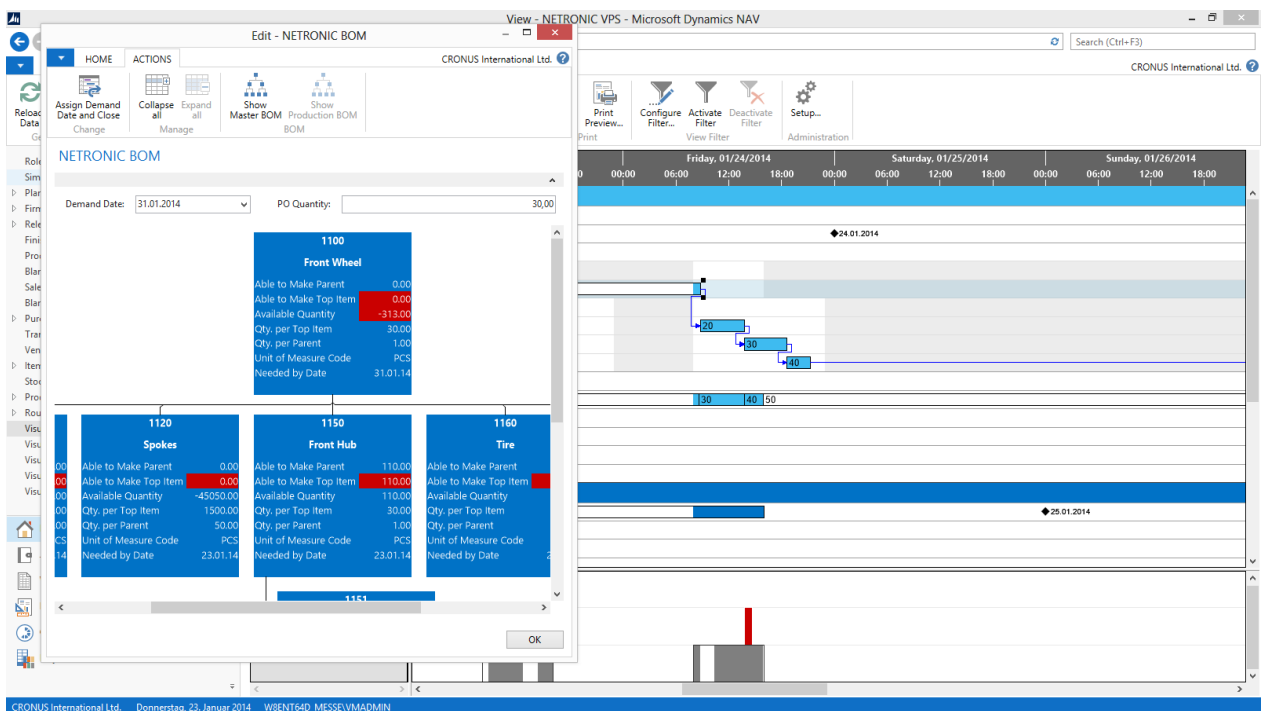
It is just as crucial for all manufacturers to understand the capacity utilization of all work and machine centers. Hence, a visual scheduling solution should also provide a **resource view** that shows all manufacturing data structured by the respective capacities. It should also include some information from the production order view (e.g. coloring of the respective bars depending on the status of the production order, or visual alerts in case an operation is moved past the due date). A "histogram" – i.e. a capacity load chart – can complement a resource view e.g. by showing the capacity load and giving overload alerts for those work/ machine centers which currently have the users' attention.
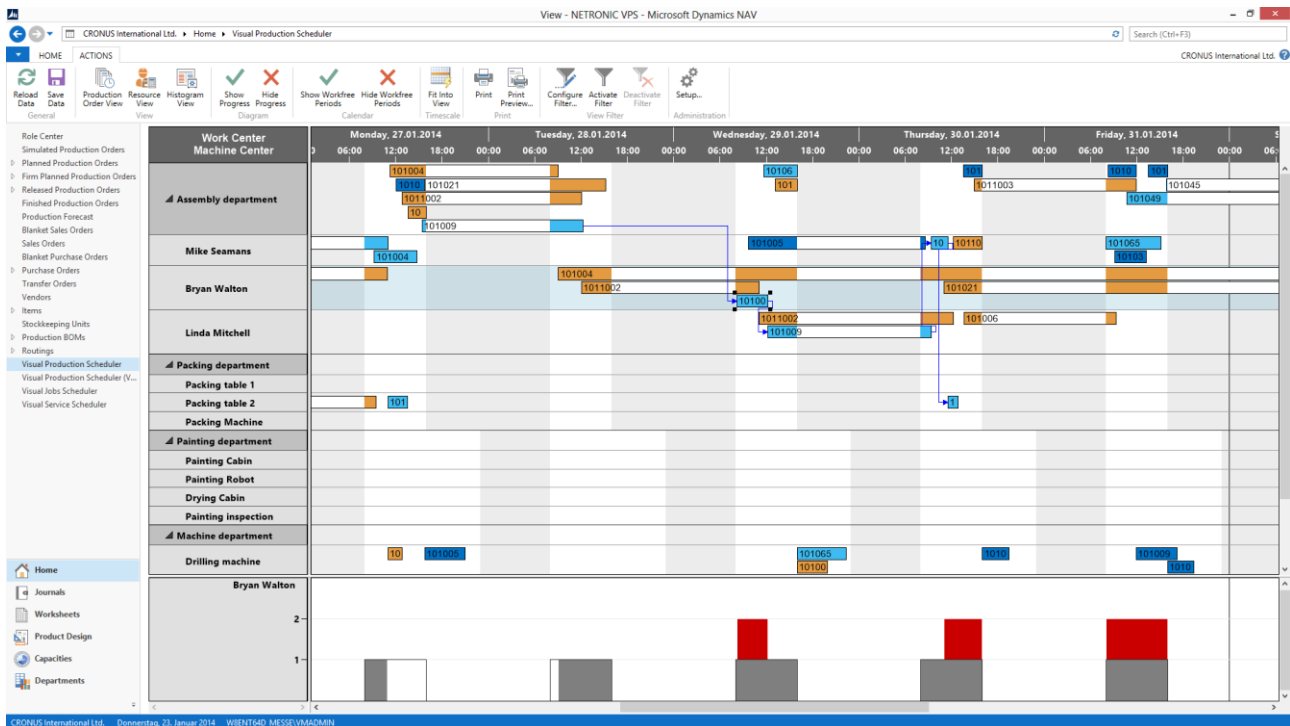
Actually, these capacity load charts are a very slick representation of each work or machine center's load. Especially plant managers or production supervisors, who not necessarily need to change the production schedule, may use a collection of these histograms as a report. This **histogram view** tells them at one glance, which work and machine center will face capacity issues based on the current production schedule.
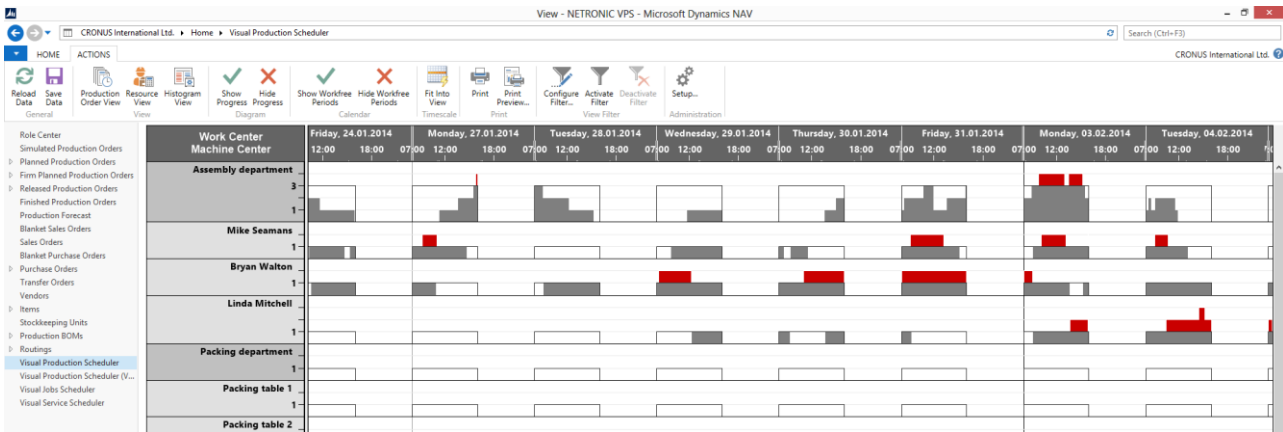
These views help manufacturing users of Microsoft Dynamics NAV to better understand production orders, production order lines, operations and capacities. In these cases, the inherent drag & drop capabilities of a visual scheduling solution also enable the users to better manage the schedule. This is especially true, when the drag & drop interactions are supported by **immediate visual alerts** that help the users making the right (re)scheduling decisions so that the Visual Production Scheduler is not just an interactive Gantt chart. Apart from the time-related position of production orders and their allocation to capacities it also shows the workload of the resources. When a production order is moved exceeding resource capacities, a visual warning will be displayed enabling you to react immediately. This way, you can keep dates and capacities in check any time!
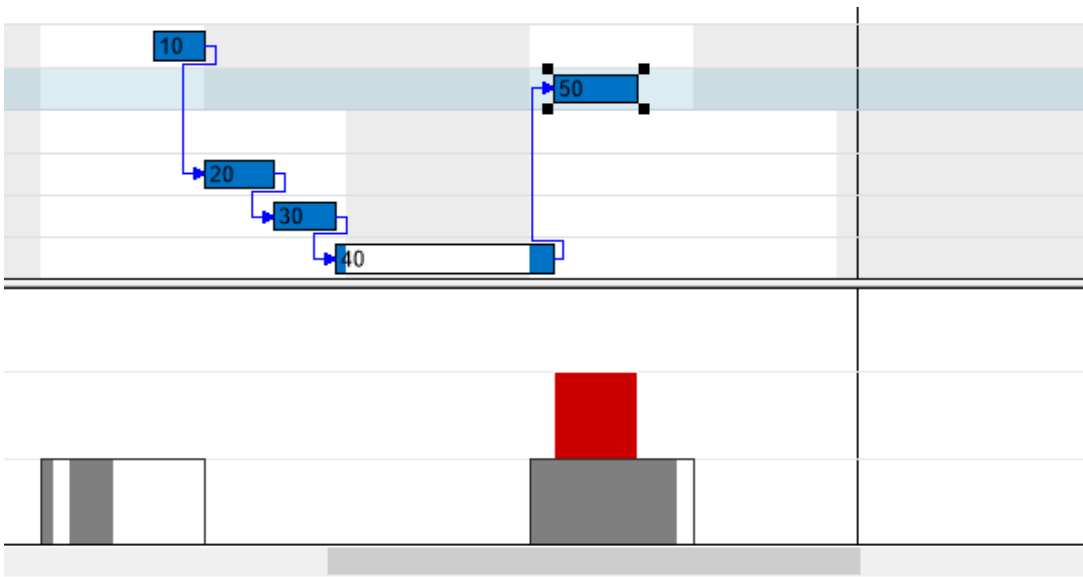
So ultimately, a proper visual scheduling solution for manufacturing users of Microsoft Dynamics NAV should

- Be based on the unchanged standard NAV manufacturing module.
- Represent the result of the NAV MRP run.
- Provide different views from various angles on the same data.
- Deliver rapid answers to the most crucial questions of a production scheduler's day-to-day work.
- Work with intelligent and context-sensitive visual alerts.

# How to visually schedule jobs, job tasks and resources in Dynamics NAV

Typically, a common project management system allows visualizing the project plan, the timeline, milestones and resource allocations with a Gantt chart. Nevertheless, both the jobs and the resource planning module which are designed to help Microsoft Dynamics NAV users to manage projects do not offer any kind of project visualization. Although you could export data from Dynamics NAV and use external products to visualize them, that is not the most suitable way since you would have to deal with two – often not very much integrated – software applications. Besides, when using this method, it often happens that only project reporting will be realized and not the interactive project planning taking into account the available resources.

If you want to close this gap in an integrated manner, it is recommended that you enhance your Dynamics NAV system with an add-in which is based on the unchanged standard NAV project structure and data model of jobs, job tasks, job planning lines and resource allocations. This data model can best be understood, if you look at it from two angles and provide answers to (at least) two questions:

- What is the timeline of my project, and how will changes/ delays of certain tasks affect my (crucial) milestones?
- How busy will my project teams be in the coming weeks/ months: Where are still resources available? Which people will be very busy? And how will a change in a task's date change my overall resource situation?

The different questions lead to different views on the data that should be applied in any visual project management solution for Dynamics NAV.

A **project Gantt chart (jobs view)** should show the data by job status, jobs, job tasks, job planning lines and resource allocations. It should provide users with the capability to drill down from a high-level view to a detailed view understanding both the project structure and the dependencies between single job tasks or even planning lines. Of course, as a project management tool (and not a static "report generator") it must enable the user to change the schedule by simple mouse interactions, i.e. drag & drop of jobs, jobs tasks and job planning lines. A sample project Gantt chart is shown in the screenshot below.
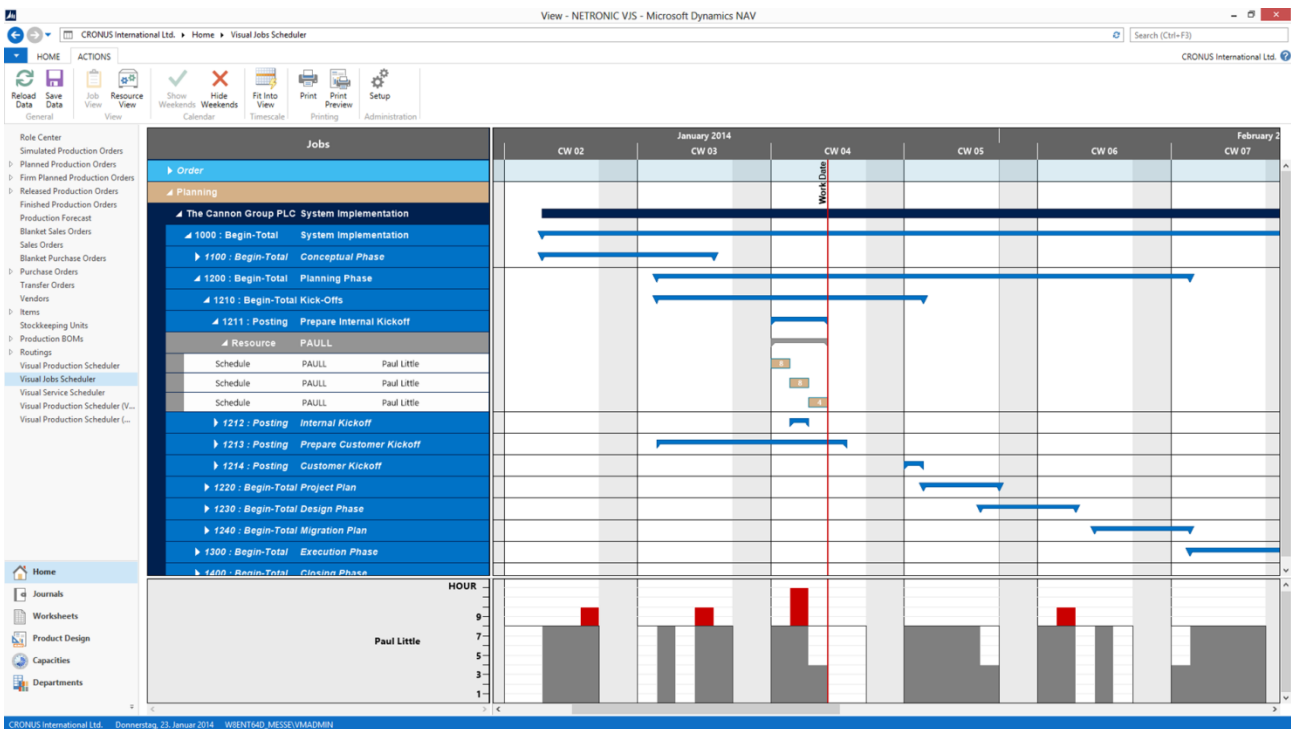
The above description of a typical project Gantt chart revealed one obvious lack of functionality within the standard Dynamics NAV jobs module: NAV completely misses the capability to define dependencies between job tasks or job planning lines. This is something where a visual project scheduling tool can provide a great value to better manage and change projects within NAV. Firstly, simply defining dependencies with the mouse in the Gantt chart enhances the information value of the visual schedule. Secondly, once these dependencies are defined, they can get used automatically move all dependent tasks if a predecessor is moved. This increases the decision value of the visual schedule.
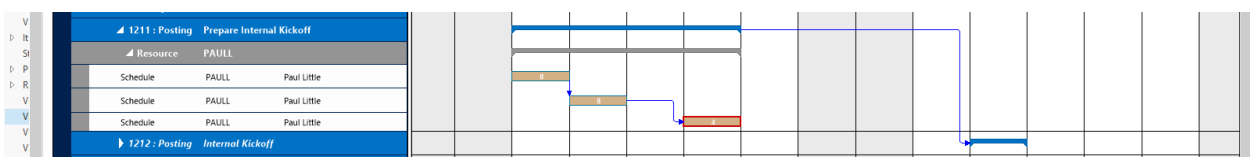
In addition to looking at the entire project and the task and planning line dependencies and as such keeping the milestones under control, a project manager also always has to manage resources and resource groups. This is where a **resource Gantt chart** comes into play when designing a visual project scheduling product for Dynamics NAV.

Of course, it should show the project data by resource groups and resources, and it should visualize the resource utilization in a comprehensive manner and highlight resource conflicts at one glance. The latter can best get achieved with a so called "histogram" which is a special charting technique to show the workload of a resource or resource group over time. As the project Gantt chart, also the resource Gantt chart must enable the user to change data via drag & drop.

Above all, it must allow reallocating tasks from one resource to another. A sample of such a resource Gantt chart is shown below.
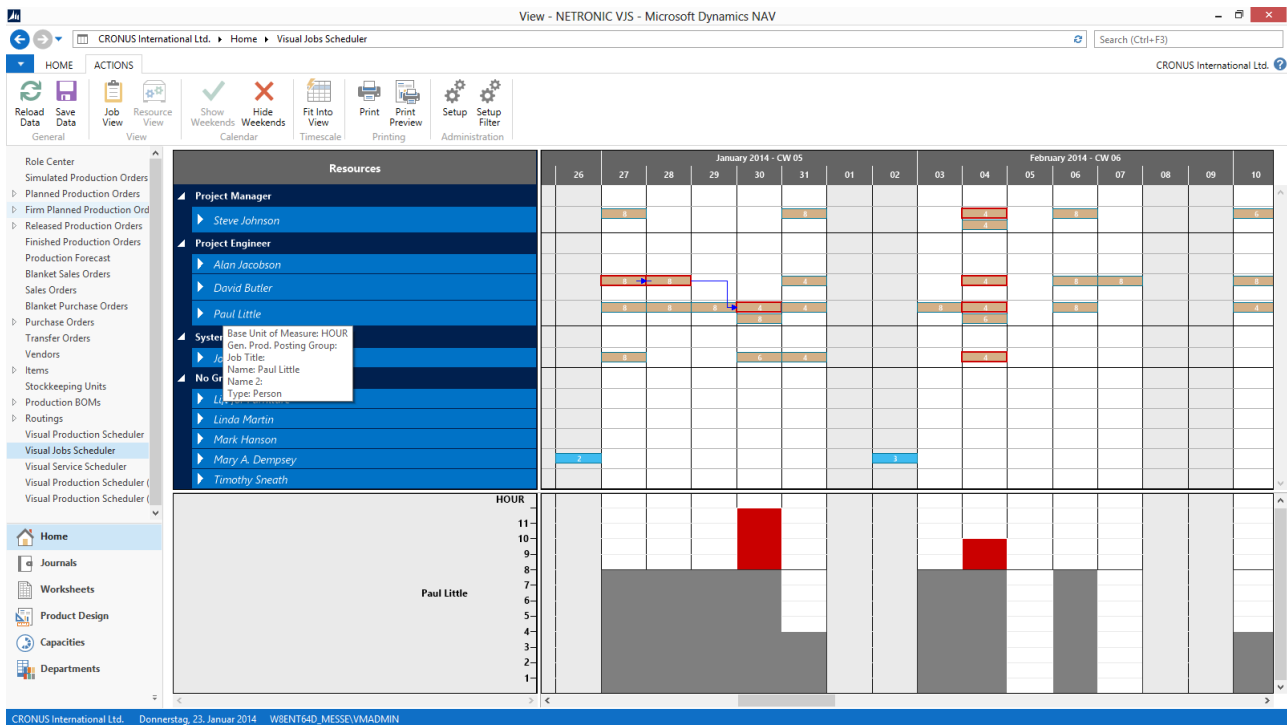
The histogram below the Gantt chart shows when and to which degree resources are (over)loaded. It also updates automatically: If moving a job task results in an overload, an optical warning will be given so that you can react immediately. Of course, this happens in real-time giving the user an immediate feedback on the consequences of his schedule changes.

Summing this up, a comprehensive visual scheduling solution to better plan and manage jobs and projects within Microsoft Dynamics NAV should

- Be based on the unchanged standard NAV jobs and resource planning module.
- Provide different views from both a project and a resource perspective on the same data.
- Enable users to interactively create, define and save dependencies between job tasks and even job planning lines.
- Deliver immediate answers to the typical milestone- and resource-oriented questions of a project manager's day-to-day work.
- In order to achieve this, apply intelligent and context-sensitive visual alerts.

How to visually schedule service orders and resources in Dynamics NAV

The standard Dynamics NAV service module seems to support—at least—two different roles when it comes to managing service orders:

(a) A sales and/ or service contact person creates a service order including some basic information such as customer name, service item(s) and associated SLA (response date).

(b) The dispatcher then is to assign these service orders to service technicians and to plan for the time that working on these service items should take.

A visual scheduling solution tailored towards the service module should support the day-to-day work of the service dispatcher. There are at least two different kinds of information which are relevant to him:

- Which are the service orders that are not yet allocated to a service technician? How urgent are they and are there any SLAs with the customer in terms of response time?
- What are the schedules of the service technicians? When are they "booked" to be at a customer? Who of them is available to take an urgent task? How will their schedule change if tasks are moved?

A proper visual scheduling solution should therefore combine a visual representation of the service schedule for all service technicians with a view on the yet unassigned service orders. There are actually two types of views that I recommend taking into account – depending on the definition of priorities of the dispatcher and the underlying business need.

If the SLA and meeting the response date is the key concern, I recommend working with a **two Gantt chart view**. This view should actually show two Gantt charts on one screen: In an upper Gantt chart, the Dynamics NAV user should see the service tasks schedule for every service resource with the bar color indicating the priority of the service order. In a lower Gantt chart, the user should see the not yet allocated service orders or the service item lines, respectively. A symbol should indicate the response time. The timelines of both Gantt charts should always be synchronized and the user must be enabled to drag & drop service item lines from lower Gantt chart to upper Gantt chart. When service orders or the service items lines are allocated to the (upper Gantt) service staff schedule, the dispatcher should have the capability to change the duration of the service task by simple mouse actions. Likewise, he must be able to move service

tasks from one technician to another. A sample visual schedule applying the "two Gantt chart view" is shown below.
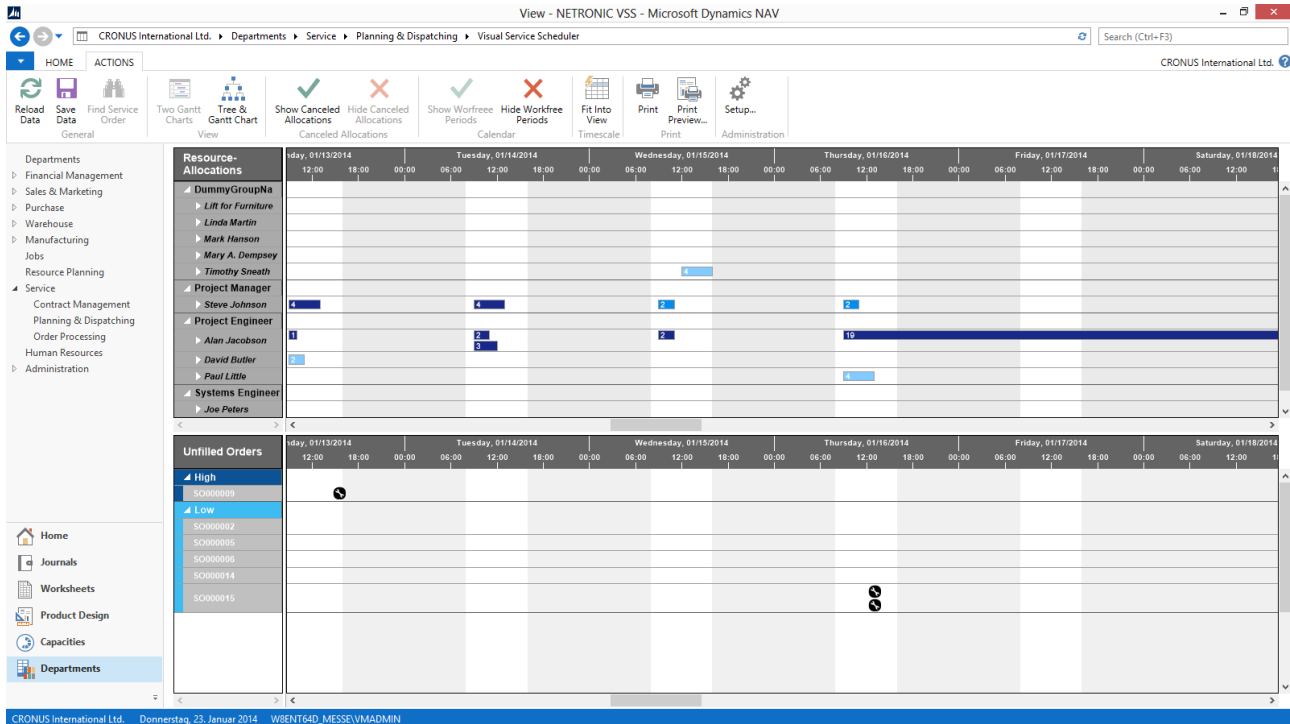
However, meeting SLAs and keeping response dates is not always the highest priority in any service organization. I also am aware of cases, in which the dispatcher's key concern is to achieve best possible resource utilization. In that case, I recommend a combined **Gantt and tree chart view**.

As before, the Gantt chart should show the service task schedule for every service resource. Due to the fact that SLAs no longer are key priority, the second Gantt chart should be skipped: Not yet allocated service orders should be shown as list right to Gantt chart; or better: as a tree-structure list which is sorted by priority and/ or response date. This type of screen set-up then frees some space for a histogram below the Gantt chart which allows the user to see the resource utilization for resources and resource groups. In a view like this, the user can drag & drop service item lines from the tree chart/ task list into the Gantt chart. Of course, he should still be able to move service items lines vertically, i.e. from one resource to another and to interactively change the duration of service tasks.

By click on a resource or resource group, the Dynamics NAV user sees the resource utilization as histogram below the Gantt chart. This helps him to immediately understand the impact changes in the service schedule will have on the overall resource utilization. The below screenshot illustrates this alternative visual service scheduling view.
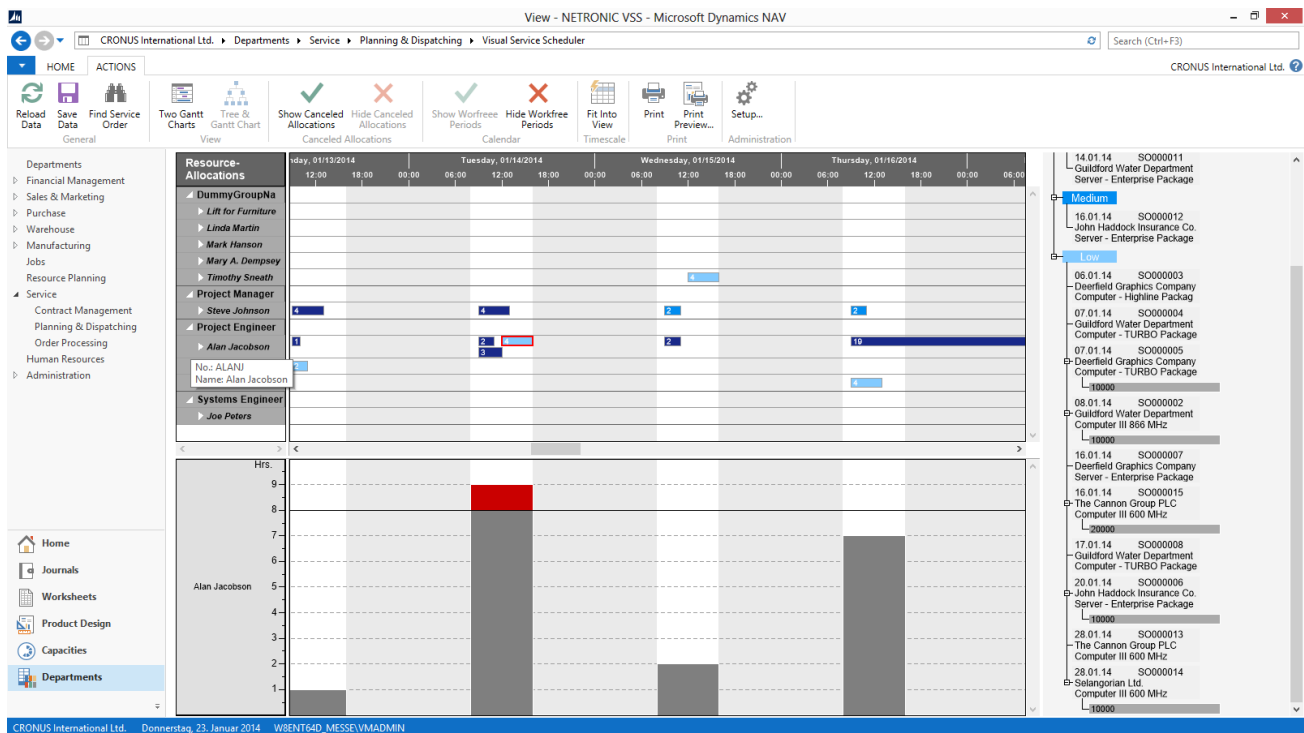
A proper visual service scheduling solution should also facilitate some advanced interactions on top of the drag & drop changes: The dispatcher user should have the option to cancel already allocated service orders from the service schedule and let them appear again in the "not yet allocated" area. Likewise, the user should be enabled to split service order allocations and separately manage and schedule the individual bars in the dispatch board.

Hence, when designing or looking for a visual service scheduling product to be used within Microsoft Dynamics NAV, please make sure that you follow an approach that:

- Is based on the unchanged standard NAV service and resource planning module.
- Provides different views supporting different dispatcher's priorities (SLAs vs. resource utilization).
- Enables users to allocate service orders to service staff, change and cancel allocations, and split service orders.
- Works with intelligent, context-sensitive visual alerts.
- Supports the service dispatcher coping with his day-to-day job.

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7 visual scheduling best practices

I have written this Ebook to introduce the idea of visual scheduling to you – especially with respect to the specific requirements of a user of Microsoft Dynamics NAV. There are some key thoughts which I had discussed from various angles, and which I used throughout this book. They are kind of cornerstones or basic principles of any visual scheduling approach.

In total, they can get summarized as the 7 visual scheduling best practices.

1. Stick to visual scheduling; do not try to build an automated system with some visualization

There are fundamental differences between a visual scheduling and an advanced/ automated scheduling system. These differences are way more than just the question if scheduling algorithms are applied or not.

(a) They relate to the degree of freedom users have to change and "own" the schedule.

(b) They relate to the explicit and implicit assumptions about the quality of the underlying data. Remember: visual scheduling can work with data 'as is', whereas good algorithms can only produce good results if they are fed with high-quality data.

(c) They ultimately also relate to the ease-of-use and ease-of-implementation.

Consequently follow the basic ideas of visual scheduling and provide the user with a solution that he can understand intuitively, can get running instantaneously and that keeps him in the driver seat with the help of applying context-sensitive intelligent visual alerts.

2. Apply the concept of a scheduling grey area instead of working as "black box"

Any scheduling scenario – no matter whether manufacturing, service or projects are concerned – has a plethora of parameters, undefined variables, frequently changing relations between the parameters and regularly altering priorities. It is an admirable approach to reflect all of this in one model, and reflect this model in a software solution. However, ask yourself how stable your environment is and how often you would have to change the model. An alternative to always follow reality with your model (with all the related significant efforts and investments) is a solution that does neither require perfect data nor a perfect model. A proper visual scheduling solution is centered around the idea of "scheduling grey areas" as those areas that are not properly built into any model, but that rely on the experience and the intelligence of the system's users. With such an approach, the likelihood that the user fully accepts the system seems to be much higher than with a system that works as a kind of "black box".

3. Rely on the user's intelligence and help with context-sensitive visual information

Come on, we are no longer in the century of task workers following the Taylorism principles. We are in the era of information and knowledge workers and there is no reason to assume that users of a scheduling system are different. They do not need a system telling them what to do and when. We should accept that they know their tasks, their processes, and both the explicit and implicit rules of achieving their goals. They require systems that help them better achieve their goals – e.g. by giving them visual warnings and alerts. These warnings should always relate to their respective "scheduling grey area" and therefore should be context-sensitive. That means that the visual scheduling tool should understand the underlying business processes and be designed to help the user focus on the decision-relevant information.

4. Focus a specific use-case, and do not follow a "one size fits it all" approach

Of course, a Gantt chart is a common tool and a widely applied visualization technique with showing the timeline at the top, typically the resources at the left and the respectively allocated tasks and their duration at the center of the chart. However, a Gantt-centric visual scheduling application should never follow the "one size fits it all" approach as the supported business processes and use cases significantly vary. It makes e.g. a big difference if you have an MRP engine that produces the schedule and you use a visual scheduler to present the MRP result to the user giving him the opportunity to make manual changes, or if you have unplanned service orders that you need to assign to service technicians and where you also need to calculate and plan the duration of the tasks manually. Hence, let the design of your visual scheduling approach follow the underlying business logic.

5. Closely integrate as add-in to an ERP system rather than loosely attaching as add-on solution

Typically, visual scheduling always is an enhancement on an existing (ERP) system: It works with data from the system (e.g. production orders, resource calendars, routings, BOMs, etc.) and helps the user to better understand the data and manage the related operational processes. In today's environment, users simply seem to have no more time to invest learning the underlying ERP system and multiple add-on solutions, which all are branded differently, which all have own menus and commands, and which all come with a different user experience. The closer you can integrate a visual scheduling enhancement into the system, the better for the user as he will be familiar with the visual scheduler from day one and require little to no training to effectively use it.

6. Use a product that does not require changes to the NAV standard

Carefully watch what Microsoft is achieve with its route-to-repeatability approach for all channel partners: if you work in an environment, where you are asked to sell repeatable products on the always latest technology platform rather than individualized solutions based also on legacy

versions of the same platform, make sure that complementary products to Dynamics NAV do not work against this efficiency strategy: If they require massive changes to the Dynamics NAV (and massive could already be implementation times of a few days), they will prevent you from fully unleashing the efficiency tools that Microsoft provides to you. Hence, I highly recommend working with add-in products that do not require changes to the NAV standard, and that can get implemented and running in less than an hour.

7. Do not create static reports, allow users to work with and change the data

Sure thing: A visual scheduling product is different than a business intelligence tool. It does not only provide a one-way access to the data so that you can analyze and slice & dice them. It must allow a bi-directional communication with the data so that users can make changes to the underlying schedule, get visual feedback about the impact of the changes and as such improve the overall schedule.

Conclusion and additional resources

After reading this Ebook, you now should have a profound understanding of how to best add visual scheduling capabilities to Microsoft Dynamics NAV. However, knowing is not enough and we all know the proverb …

" *Seeing is believing.* "

Hence, we highly recommend that you actually apply your new knowledge. We have worked hard trying to implement all described best practices how to achieve visual scheduling capabilities for Microsoft Dynamics NAV into our visual scheduling add-ins:

- Visual Production Scheduler
- Visual Jobs Scheduler
- Visual Service Scheduler

So: have a look and schedule your online demo now. After the meeting, we are happy to provide you with a complementary demo version so that you can test our add-ins in your own Microsoft Dynamics NAV demo environment.

GET AN ONLINE DEMO HOW TO APPLY VISUAL SCHEDULING TO DYNAMICS NAV

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