Supply Chain Forecasting & Planning: Move On from Microsoft Excel?

PREVIEW  Surveys of business use of forecasting support tools reveal that Microsoft’s Excel spreadsheet software continues to reign supreme in smaller organizations. As Sujit Singh explains, there are many virtues to this solution; however, the balance of pros and cons begins to tip as organizational size and complexity increase. Sujit provides a comprehensive examination of the efficacy of relying on Excel to support the forecasting and planning functions and then describes the gains and costs of moving up to a best-of-breed planning application.

MICROSOFT EXCEL

Microsoft Office’s Excel spreadsheet software is the predominant application of choice for businesses starting supply chain planning and forecasting applications. Whether by design or necessity, it retains a large part of its market share well beyond the start-up stage; in fact, some estimates attribute 50-70% of the total supply chain planning market to Excel. Its strengths include low cost (it is perceived as free since it is part of the Microsoft Office suite), ease of use (it is a known commodity), versatility, universal availability, and good basic functionality.

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Excel's most important advantage is that it enables experimentation and tinkering, valuable tools for those managing the planning process. In planning, the ability to do rapid-fire experimentation on various possibilities is very important. It should be noted, however, that Excel poses serious limitations when compared to more robust and full-featured software applications designed specifically for advanced supply chain planning.

Here, we explore the pros and cons of Excel usage and find some guidelines for deciding when Excel is useful – and when a company needs to graduate to an advanced planning solution.

EXCEL: IN THE BEGINNING, THE OBVIOUS CHOICE

Imagine a small manufacturing company, selling a few products to a few customers, that has acquired an order-taking/tracking software to keep tabs on transactions and due dates. As complexity increases and the need for planning accelerates, someone creates a simple spreadsheet with products in one column and time periods shown across the columns. In such a spreadsheet, a planner copies and pastes or types in the actual history in the historical months and then begins to type projections in the future months. Some high-level assumptions about capacities (the company can make and sell roughly 7,000 units per month) allow planners to quickly see whether they are above or below the acceptable amount.

Here is where Excel’s rich feature set, for lack of a better word, excels – the software allows neophyte users to customize it to their liking. A colored cell here, a subtotal there, and voila, they have a planning spreadsheet in operation. Everyone (which at this stage might only be a couple of people) opens the same spreadsheet on a shared drive, reviews the same data, and makes decisions based on that same data. Very soon, they realize that it is good to get input from multiple people, and an email/phone/chat-based collaborative process begins to take shape. Every month, all that needs to be done is to copy/paste the new data and keep planning the future months. Toward the end of the year, it can get a bit more exciting when
deciding to add the next year’s months, but the process remains manageable overall.

Excel can also assist in developing the company’s planning/forecasting in the early stages, as well as create internal planning disciplines. Because of the easy availability of Excel and its relative simplicity, such a spreadsheet can appear almost overnight. It could even take on a name of its own, such as “Jane’s spreadsheet” (Jane being the creator, of course). In such circumstances, every aspect of planning is within Jane’s grasp – for example, it’s easy to make a copy of the spreadsheet, change some of the numbers, and compare the results to do a what-if scenario.

Time passes, and the company adds to its business (a new plant, new products, etc.); the planning worksheet gets expanded either by adding new rows of data or by adding new worksheets. Perhaps two different worksheets might be used to plan the East Coast and the West Coast operations.

Excel is excellent when it comes to a data-based personal productivity tool. As long as the planning process remains personal, no other software comes close to what Excel can provide. In the early days of the company, this is usually done on personal initiative, very often by one of the founding members. As a result, a forecasting/planning spreadsheet can often be created by Jane in just a few evenings’ work.

**WELL-KNOWN SHORTCOMINGS**

Despite these advantages, there are certain well-known shortcomings of Excel-based applications, which, while not the main thrust of this discussion, I have listed for the sake of completeness.

- The server crashes and the planning spreadsheet is lost. This concern can be mitigated by keeping backups. However, there can be a significant time loss if the saved copy is not the most current one because of the need to paste the new information into the spreadsheet once again.
- Jane wins the lottery or finds another job. Good for Jane – but unless the company has thought ahead, it is unlikely that anyone else is trained and ready to take over managing the spreadsheet. While this could apply to any system, the notion that Excel skills are easily and readily available can lead to overconfidence in the ability to pick it up on short notice. To be fair, however, if this was a discipline issue at the company, then the Excel program would potentially provide for a faster recovery thanks to a flatter learning curve compared to that of a full-blown specialized solution.
- It is very hard in Excel to keep track of what one is doing. Why was this cell excluded as an outlier but not that one? Why was triple exponential smoothing used on this time series but double on that one? What exactly was that analysis that was done three months ago, the one that management liked so much they are asking for it again?
- In a point related closely to the above, unless a very good versioning system has been set up, it is impossible to find out
when, how, why, and by whom a given cell was last changed.

• Problems can occur when integrating with other systems (upstream or downstream). Though Excel now has connectivity tools that allow connections to a variety of data sources, this is one of its least-known and used features, resulting in stale data. Sometimes linked data sources change and the planner has to adapt the Excel spreadsheet, as the data source may not even be aware of the link.

• Keeping the spreadsheet data up to date takes considerable time. This is not limited to copy/paste; a majority of the time it involves retyping the data from one system to another. This is probably one of the program’s biggest flaws. Should your planners spend their time planning or updating data onto spreadsheets? Absent the above-mentioned integration, Excel tools force users to do more data management and less decision making and anticipating business conditions.

• Since spreadsheets are easy to create, each department might decide to start its own. This could – and when it happens, often will – result in different plans across different departments within the same company. This is especially problematic if the sales and operations departments operate from different plans.

• The spreadsheet may have errors – and unfortunately, it probably does. A study at the University of Hawaii (Panko, 2008) found that “errors in spreadsheets are pandemic.” The authors added, “In general, errors seem to occur in a few percent of all cells, meaning that for large spreadsheets, the issue is how many errors there are, not whether an error exists.” Since the average spreadsheet contains thousands of information-bearing cells, a “few percent” may translate into dozens of errors. In many noncritical applications, these errors may be considered a reasonable tradeoff for the affordability and ease of use offered by Excel spreadsheet software. However, when the errors result in serious supply chain miscalculations, the costs can be devastating. Examples of this abound (Krugman, 2013; Wailgum, 2007; Wolf, 2012). For instance, a miscalculation in the quantity of a key part can produce a domino effect, causing a delay in assembling the final product. This then leads to missed production deadlines, lost orders, rush shipping charges, and damage to the company’s reputation.

• It is difficult to grow Excel into other types of analysis. Let’s say that Jane wants to view trends across many types of products and then find which ones are significant outliers for further review. This is not always possible in Excel, or at least very cumbersome, because the business has to settle on a few key attribute-based views.

• It takes too much discipline to maintain a rolling planning horizon in an Excel spreadsheet. As a result, most planning spreadsheets have an “accordion” time horizon. Periods decrease to three or four towards the end of the year and then increase to 15 or 16 to include the next year. This is not good for planning and forecasting.

SIGNS THAT EXCEL IS INADEQUATE
When a company is in its early stages, Excel’s limitations are likely to be outweighed by its convenience and affordability. Unfortunately, as the company grows, these limitations become more serious. The above-mentioned shortcomings of Excel applications alone are enough for some companies to look on the market for a best-of-breed software solution. Another company may be more tolerant toward Excel for a time, and then at last reach a stage where it becomes impossible to plan using Excel due to a variety of other complexities. Here are a few:
Amount-of-Data Complexity
As business grows, the data grows; the business that grows in volume and revenue with little or no corresponding increase in data intensity is a possibility, but remains rare. Increased data intensity adds complexity to the planning and forecasting operation. For example, the numbers of products or customers have increased, or new attributes need to be summarized in future data (perhaps by a key ingredient or market characteristic), or users may want to switch from monthly to weekly time buckets to improve planning.

“Cost of Failure” Complexity
If the business is simple enough that a mistake made today can be corrected tomorrow, the solution is easy. However, if the mistake made today leads to being stuck with the wrong inventory for a long time, then a more complex planning paradigm is needed, one requiring detailed checks on all projected inventories. In some ways, this is an offshoot of the amount-of-data complexity.

Multiple Users Complexity
Over time, the company hires more sales reps to sell to different markets. These reps know the most about the forecast because they are closest to the customers. Depending on the company, one of two things might happen. First, the reps email Jane with the latest information, which she types into the spreadsheet; second, the sales team agrees to update the numbers themselves. Both these approaches are risky. In the first, errors creep in as typing mistakes. In the second, Jane has to worry about controlling access to different rows of data in the Excel spreadsheet; she cannot program this logic, then she has to rely on the reps to type only into data rows assigned to them. Again, typing mistakes happen. It’s even possible for a business which mails spreadsheets around for input to lose track of version control and submit the wrong spreadsheet to corporate headquarters for the annual budget. And then there is this question: Who controls the need for new product/customer combinations required for new forecasts?

Data Security Complexity
This is also caused by multiple users. For any number of reasons, data access might need to be limited by, and to, certain individuals.

For example, a sales representative should see only her own data, possibly forcing the demand planner to create multiple spreadsheets with subsets of data. This again increases the risk of errors.

Business Conditions Complexity
Two customers buy the same product under different names (and prices) for confidentiality and/or profitability reasons. The supply planner needs to see the consolidated data, but the demand planning team still wants to have the detailed customer-level view for forecasting. To enable this, Jane must now use advanced Excel features, which she may or may not know how to do.

Planning Process Complexity
Management might insist on updating the spreadsheet with all open orders so that planners have a view of what is already committed. On the one hand, Jane can copy/paste or type in the information, again a tedious and error-prone process. On the other hand, Jane can figure out how to do the programming to read the data from source, but this is prone to programming errors as well as higher cost in terms of Jane’s time.

Mathematical Complexity
Capacity is no longer a straightforward number because the product mix has a significant impact on the total throughput. Now Jane has to do matrix calculations to accurately project the capacity usage in the future. At the very least, this requires programming via formulas, thereby increasing odds for errors. Or Jane may want to experiment with more complex forecasting models such as ARIMA and Box-Jenkins. Unless she can use (and has the budget to buy) a few high-end add-ons, she will have to program some rather sophisticated formulas that don’t really fit well to Excel’s cell-based philosophy. As the spreadsheet becomes more complex, errors in data and calculations are more difficult.
to uncover. Further, researchers have found that the statistical formulas in Excel can be quite error prone (McCullogh, 2006).

**Scenario (or Uncertainty) Complexity**
The company needs to evaluate various what-if planning scenarios based on certain assumptions. The complexity arises not from the need to run these scenarios (which presumably can be done via multiple copies of the spreadsheet) but rather from the need to compare and contrast these scenarios and then be able to make decisions based on the comparison. Any changes in data content in one scenario also need to be copied into all the spreadsheets.

**“Everything Is Connected” Complexity**
As businesses grow more and more complex, most decisions have consequences in other areas. For example, a start-up company has enough capacity to meet all demand; a mature company, however, might have to make decisions on whom to short, based on profitability and other less tangible measures (such as a strategic account or a loss-leading sale). This process requires an optimization-based tool, or at the very least an engine that does these multitudes of calculations in a loop.

In addition, there are business requirements that cannot be attempted in an Excel-based application because of the amount of work required:
- Need to implement a collaborative process for demand planning where various groups are updating the forecast (sales reps, marketing, sales managers, demand planners, etc.)
- Need for aggregation and disaggregation of user inputs on the fly. For example,
  - a sales rep updating the forecast for individual customers might want to do a quick reality check of the aggregate at the product level;
  - a sales manager with multiple sales reps reporting to him might look at the aggregate number and decide to turn it down at the high level itself. Built-in disaggregation routines in advanced forecasting and planning systems can proportionately decrease the forecast at lower levels.
- Need for flexibility to view and edit data at multiple levels
- Need for engines to do recursive calculations
- Need for realignment of product and customer names as they evolve or are acquired
- Need for netting open orders from the forecast before sending it to the schedulers
- Need to incorporate other streams of data such as inventories, bills of materials, and manufacturing costs
- Need to assimilate an acquired company’s data into planning
- Need for speed in replanning. Today, most businesses need to have trigger-based dynamic planning, which requires a system that quickly goes through the steps of planning if the appropriate condition is breached.

While all of the above can be programmed in Excel, typically it is not done because of the investment of time and effort required. As these requirements come to the fore, the original design of the spreadsheet may seriously hinder implementing some of these features. Off-the-shelf forecasting and planning systems typically (though not always) have built-in functionality to address these needs.

In companies with these complexities and needs, planning with Excel forces the planners to focus primarily on the next big issue. There is only a skeleton planning process in place. The people themselves are the only thing between the company and the next disaster. As personnel are increasingly rewarded for putting out fires, it creates a culture that is even more focused on firefighting. Very often, this means there is no real planning in the business.

**THE NEXT STEP: MOVING UP**
If you decide your company has outgrown the Excel-based planning application, what is the next step? Most companies go for a best-of-breed advanced planning and scheduling (APS) application. These can be based on a proprietary database or on a database management system (DBMS). Examples of
DBMS include proprietary databases as well as Microsoft SQL server, Oracle, and DB2. These systems provide a way to deal with the complexities described above on the DBMS end of things. At the same time, these solutions should still be easy to use and integrate with the user’s desktop.

These applications gather data automatically from other systems throughout the company, not only at a preset frequency but also on demand, and they hold it on a centralized server where it may be accessed by many users. More importantly, they offer true business functionality, including specialized support for a wide range of supply chain processes, including inventory management, manufacturing, and value-chain collaboration. They also provide multiple security levels, allowing access based on roles.

DBMS-based applications are not included with the purchase of a laptop; at the same time, most large companies have a few SQL servers running as part of their enterprise systems.

DBMS applications can provide business value far exceeding their cost. Compared with Excel, solutions based on database management systems offer significant advantages:

- **Visibility**: Compared to Excel, a DBMS does a better job of sharing data across users. Data visibility is greatly improved along the supply chain and in the various groups such as sales, operations, finance, commercial, etc.
- **Safety**: In Excel, any unsaved data may be lost if a system crashes. Databases write data to the hard drive immediately and are usually backed up regularly at a corporate level.
- **Volume and speed**: High volumes of data bog down Excel; DBMS applications routinely manage high volumes of data.
- **Related data**: Storing related data together in a single table or spreadsheet is unwieldy and invites errors. Databases easily link tables of related data, such as customers and their orders.
- **Future growth**: A DBMS is a foundation to further extend the supply chain processes because it enables other advanced tools like planning and scheduling.

By leveraging the functionality of a database-grounded APS application, a company’s decision makers can immediately detect data and mapping errors. In addition, they can see how data relates across attributes.

And there are several planning benefits that are not available in the spreadsheet world.

- Integration to other corporate systems (such as ERP, MES) is more reliable because it can be automated. This is significant because forecasting and planning require reliable input of past data to allow projection into the future.
- Mathematical calculations (e.g. for statistical forecasting and requirements planning) are usually more efficient in these systems because of the use of a programming language more suitable for intensive calculations.
- Collaboration is better because these systems are designed for multiple users. This means that there is user-based security to allow partitioning of data for read/write access. This eliminates the error-prone copy/paste methodology that exists in a spreadsheet world.
- Accountability is enhanced because these systems can keep track of who did what and therefore provide an audit trail.
- Participation from collaborators is higher because the system is easier to use.

- **Alerts**: A DBMS enables rule-based alerts that can be emailed to users, thereby making them aware of the problem sooner and enabling quicker corrective action.
Furthermore, something of value can be provided to the person providing the value input (such as reports, alerts, and exceptions), and nonperformers can be tracked through the tracking system. This is a good example of “carrot and stick.”

- What-if scenario planning is better because the system can keep track of multiple versions of the plan. This enables a business to better understand the inherent uncertainties in their plans and to better prepare to deal with them.
- Accuracy metrics are easier to calculate and maintain because it is easy to keep past plans and compare plans to actuals.
- Management participation can be higher, especially if management-level views are created in the system. Management usually requires a graphical (MS PowerPoint-like) view that can sit on top of the tabular (MS Excel-like) view. This again has a positive impact on the overall level of participation from the collaborators.

Deciding to switch from a homegrown Excel application to a vendor-provided APS tool is not easy. For starters, many people and departments (including planners and other users, IT personnel, and management) need to be convinced that switching is the way to go. Next, the timing needs to be right. A manager who thinks that the business has outgrown Excel-based tools may still need to wait for the right political and economic climate within the company before proposing the idea. For example, the disruptions caused by a natural or market event might make the case for a change, or the arrival of a senior executive with experience in these types of applications could also tip the scales. On the other hand, a major and ongoing global initiative to upgrade the company’s ERP system may call for patience in asking for a new forecasting and planning system.

Even when the timing is right, there are other factors to consider. A best-of-breed APS solution that runs on a DBMS is usually a significant expenditure, including software and implementation costs. Jane and her planning team will require training, incurring further expense. Future upgrades will mean additional financial investments as well. In addition, there is the danger that the selection committee might settle on a solution that does not adequately fit the company’s needs. Moreover, it has often been observed that a centrally picked software solution ends up being supplemented by user-developed Excel spreadsheets for doing the actual forecasting and planning. If this happens, the entire investment going through the implementation could be a net loss. A slightly different variation of this might see the committee pick a solution that is a good fit now but is not flexible and adaptable towards future needs. As a result, it fails to adapt to changing business conditions and the associated forecasting and planning processes.

**TO SWITCH OR NOT TO SWITCH?**

Managers deciding to move to a database-founded APS system should take several factors into account. First, they should carefully evaluate the time and risk involved in sticking with the spreadsheets. Second, they should weigh the costs of making their most experienced planners/forecasters crunch numbers when such personnel should really be thinking of multiple possible scenarios and ways to deal with them. Third, the tendency of human beings to resist change and stick with a known entity (the Excel spreadsheet in this case) should also be factored in. Lastly, management should evaluate the complexities as they currently exist, as well as the complexities in the near future.

**AND KEEP IN MIND...**

The supply chain planning and forecasting field is poorly understood and undervalued in many companies because it deals with future and uncertain data, and this makes many people uncomfortable. Thus, the role of software is important to support people...
in this process (Smith, 2009). It is also worth remembering that supply chain departments sit between two very powerful line organizations – sales and operations – and consequently expend time and energy trying to manage the strong “gravitational pull” of both. For these and many more reasons, top management is often wary of investing in supply chain planning systems. Once you have decided to move to a database-built forecasting and planning system, recognizing these realities increases the odds of getting your project(s) approved. Perhaps the best advice is to pick a system that can be implemented incrementally; the benefit of the first deliverable may well pay for the whole project.

REFERENCES
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