Hard Problems and Soft Information

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Abstract: Finished product planning is a key business process for companies. It is about finding the balance between service levels and cost, and is therefore critical for the success of the company. In this paper the structure of the problem will be analysed and compared with literature about sales & operations planning as well as ERP solutions. In the analysis general process logic will be contrasted with idiosyncratic characteristics of the individual company. The use of different kinds of information will be discussed, in combination with the formal sign system of the computer and the social sign system of human communication.

1 INTRODUCTION

Finished product planning is a key business process for companies. This planning decouples demand from production and it is a highly determining factor both for market volume and for profit margins. On the market side customer service level and lead time are key for market share while on the production side it is crucial to keep down variable costs. In this paper a specific product group (fresh meat) for a specific market (multi-store retail chains) will be used to analyse the business processes and information flows that are in play, and it will be examined how this problem is covered in literature and by ERP software.

In this paper the paired concepts of process logic / idiosyncrasy will play an important part. Process logic will mark the necessary general structure underlying the actual business processes of the individual company. This structure will always be present in every business in a particular market, because certain structures are inherent to and inevitable in operating with these products on those markets. Alongside this there are the idiosyncratic characteristics of the individual company. Companies after all do differ, even though they operate with the same products in the same market segment. The individuality of the company is the foundation of the existence of any company on the market. As John Kay pointed out, the distinctive capabilities of the company are what distinguishes the company from its competitors and that form the foundation for the success of the company. And, again as pointed out by John Kay: “A firm can achieve added value only on the basis of some distinctive capability – some feature of its relationships which other firms lack, and cannot readily reproduce” (Kay, 1993, p. 64).

The analysis of business processes in terms of process logic and idiosyncratic characteristics has two aims. Firstly, it is a method to map business processes in a way that helps external consultants (specialists in general patterns) and internal employees (specialists in specific details) to come to a mutual understanding and a common basis. Secondly, it is about the awareness of the intangible, the understanding that not everything can be reduced to schemas and fixed rules. Information systems should not be a goal onto themselves but rather serve to improve the market position of the company, which they must do by adequately supporting the business processes. The process logic provides insight into the general structures, while the idiosyncratic characteristics provide insight into the way in which the processes actually happen within the company (including the often blurred boundaries between processes). This approach should also help in getting a feel for the distinctive capabilities of the company, competitive strengths that must be preserved and possibly enhanced in developing a new business information system.

Besides the paired concepts of process logic / idiosyncratic characteristics the analysis of the nature of the information in business processes with relation to formal and social sign systems used forms a second pillar of this analysis. Computer systems are formal sign systems, highly capable in processing declarative information, but they have trouble with vague

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boundaries, “unclean” categorisation and weighing heterogeneous norms that cannot be fulfilled simultaneously against each other (delivery in full but slightly delayed or delivery on time but slightly less than ordered? Delivery should be at the right time in the right quantity with the right quality, which ‘right’ might be relaxed in which context?). Social sign systems are much better in dealing with meaning in context, modalities, and intentions (discussed in Suurmond, 2015). In the creation of a business information system awareness of the nature of the information and the conscious choice for the right sign systems is critically important for the effectiveness and efficiency of the business processes. Of the coordination mechanisms identified by Mintzberg direct supervision and mutual coordination are much more based on informal sign systems, while the application of formal sign systems presupposes standardisation (Mintzberg, 1979). The effectiveness and efficiency of business processes is of course dependent on correct, timely and complete information (Starreveld, 1963), but also dependent on the degree to which the available information is relevant and accessible (Grice, 1989).

The paper consists of six sections. After a short introduction to the problem area, the business processes involved are analysed in terms of process logic and idiosyncrasy. This is followed by an analysis of the nature of the information used in the business processes, and the role of formal and social sign systems in conveying the information. Literature about sales and operations planning is discussed in section five, and the papers ends with a recapitulation and conclusions.

2 PROBLEM AREA

This paper is concerned with the finished product planning for the production unit for pre-packaged meat in retail chains. A typical production unit produces some 100 to 200 different fresh pre-packaged meat products on a daily basis. Incoming shop orders need to be made available ready-to-ship on the loading dock for transport, delivery reliability must be above 99.7%. The products have an internal shelf life of at most two days. Everything is produced from fresh ingredients each day. And, of course, waste and production costs must be kept to a minimum.

Many products have a fairly stable demand pattern. Demand is however highly irregular in case of promotions, product introductions (which do not have a demand history) and a number of articles that are weather-dependent. Products which have been part of a promotion in the past weeks and seasonal products also have demand irregularities.

Planning is generally done in a large Excel in which the order history over the past weeks for each distribution timeslot is recorded along with the demand prognosis for promotions and in which the planner records the amounts per product per day that need to be produced. This last list is processed further within the production planning to create production orders as well as lists for the resource, man-hour and line-hour needs. Each business within this sector has developed its own particular solutions over time, the common characteristic is the use of Excel with order history as input and production lists as output. The expected demand for promotions is mostly determined in a separate process and then made available to the planner.

3 PROCESS LOGIC & IDIOSYNCRASY

3.1 Process Logic

Every company that produces for a market in which the lead time between order time and delivery time is less than the time necessary to produce the goods will work with a (semi) finished product stock. This stock must be sufficient to fulfil the orders within the delivery reliability requirements in this market. Further, the stock has to be as low as possible because of warehouse costs and to minimise waste. Finally, production will have requirements regarding the frequency and size of the production batches. All of this leads to the following three processes that will always be found (but, more often than not, implicitly rather than explicitly):

1. Determining expected demand
2. Determining the target stock level
3. Determining the production output

The distribution pattern defines loading times for groups of orders, before the scheduled loading time the orders must be picked and made available at the loading docks. Therefore, distribution and production is organised in timeslots, in each distribution timeslot a set of orders is picked, and in each production timeslot a set of products is produced. Shops have a timeslot for ordering. Expected demand is specified per distribution timeslot, which would correspond with one or more ordering timeslots. The end times of ordering timeslots and distribution timeslots are fixed, the end time of production timeslots is more flexible.

Given the daily delivery to the shops in combination with the internal shelf life of two days at most, the full product range will be produced and distributed in a 24 hour cycle. For each day and each timeslot expected demand will be estimated, target stock levels will be set and production output levels will be set. The planning moments are:

1. After each ordering timeslot
2. Just before the production day
3. Just before the production week
4. A few weeks before the production week
5. About four to six weeks before the production week

After each ordering timeslot the planning is checked and adjusted where necessary (and possible), one day in advance production orders are generated and fresh raw materials are ordered, the week before the production week production schedules are set and suppliers will be informed about expected demand, and the same applies for the planning moment a few weeks before the production week (same information, less certainty. In the first planning moment about four to six weeks in advance of production promotions are planned (because of the increased quantities it is important to have agreements in place with suppliers regarding price and expected demand of raw materials).

3.2 Idiosyncrasies in Individual Companies

Although the processes described above in the process logic can be found in each company in this market, in organisation and actual execution a great variety exists. Often, boundaries between the processes are blurred, both organisationally and in the Excels used for planning. Much of the knowledge and information is personal and non-coded (Boisot, 1998). Many problems are either 'spirited away' by some creative and experienced old hands, or solved in informal communication. Sometimes, this is a good thing, because the problem solving capabilities of the company are much greater than one would expect from studying organisation charts and documents about process flows. Sometimes, it is good but too vulnerable because of the dependencies on one or two key figures in the organisation. Sometimes, it is bad because problems are not really solved, only moved out of perception.

4 NATURE OF INFORAMTION & SIGN SYSTEMS

4.1 Information for Determining Expected Demand

In the process 'determining expected demand' (forecasting) the single information product appears to be a list with the expected shop orders grouped by timeslot and by saleable item, and the primary source of information is demand history. However, although extrapolation from history to expected demand may lead to a convenient list of hard data, it does not tell the whole story. Firstly, demand history is never the only source of information. In case of promotions and product introductions no relevant and reliable demand history is available (although, the history of promotions and product introduction might offer useful indications), and demand for some products might be dependent on future conditions (weather) or situations (events, bank holidays). Other information sources are needed, and the information from these sources must be interpreted in context. The interpretation of the weather forecast, especially in case of a possible sudden change of the weather, is an example. The assessment of the impact of publicity (kind and scale) in case of promotions and product introductions is another example. Secondly, expected future demand is never a single value, but rather a spread. If you were to discuss expected demand for a certain product with a group of experts, they would say that demand is expected somewhere in the range between X and Y.

4.2 Information for Setting Stock Levels

Given the outcome of the process 'determining expected demand', the job of the stock planner is to set the target levels such that stock will be sufficient when demand is at the maximum level of the range, and stock will not be wasted when demand is at the minimum level. Depending on the volatility of demand and on the allowed storage life of products in stock, the planner can have an easy job (steady demand, longer internal storage life) or an impossible job (highly volatile demand, very short storage life). Impossible situations are not primarily the problem of the planner however, especially if this is a recurring issue. It is a problem of setting realistic norms for planning, probably for someone higher up in the organisational hierarchy.

It gets interesting in the border area when the planner has a difficult but doable job. In this area the planner must be creative and use all his available knowledge and information sources. The planner might collect further information from experienced demand experts in order to reduce the expectation spread, or organise extra production capacity in order to react quickly (quicker than normal production schedules would allow) in case of impending stock shortages. The planner will juggle with delivery risks and production reaction times in order to find his solution. Background information about what was possible or impossible in comparable situations in the past and informal discussions play a major role in this kind of decisions.

4.3 Information for Setting Production Levels

The third process must set production levels such that production efficiency is optimised. Lot size and production capacity are the primary determining factors. Both factors represent discontinuity. Often, products (or semi-finished products) are optimally produced in fixed amounts, due to the capacity of machinery. Optimal operation times for production lines vary in units of x hours (8 hours is a typical value), due to work schedules (people work in shifts). The combination of lot size and optimal operation times will lead to a production mix that satisfies the minimum and maximum stock levels set in the preceding process. In standard situations this can all be calculated according to fixed patterns and decision rules. In some situations not all requirements can be met at the same time. In these cases additional information is needed, either in finding ways to squeeze a little more out of production, or in making sure that some products will be produced in the required quantity, or in assessing the weight of the different norms in the given situation and accepting the additional risk or additional cost.

4.4 Sign Systems

Considered from the viewpoint of the process logic as analysed above, the information about expected demand, stock level planning and production-level planning seems pretty straightforward and a perfect fit for the domain of formal sign systems. Essentially it is about three consecutive datasets with the same structure: date, timeslot, item code, quantity. In demand this dataset represents an expectation, in stock-level planning and in production-level planning the dataset represents a target.

Considered from the more detailed analysis of the information actually used in real planning situations, it will be clear that other kinds of information and other kinds of sign systems are involved. The inaccuracies of demand expectation, actual stocks and actual production output must be dealt with; the planner works with patterns based on experience and history; risks and possibilities are discussed between planning, sales and production; and accompanying instructions are given to the operators in the shop-floor processes. Information takes the form of background knowledge, consulting colleagues, oral communication, and written notes.

4.5 Idiosyncrasies Revisited

Companies differ from each other in the way they execute their key processes, and for the production of fresh food for retailers the finished product planning is such a key process. In this planning process success on the market (delivery reliability, lead times) and internal success (minimising production costs) come together. The way formal sign systems and informal sign systems are used to support this difficult and critical process is highly characteristic for each individual company. Depending on the distribution of knowledge and experience in one company the ‘real’ decisions and adjustments might be made by production management (using demand and stock information), and the planner is no more than a rather passive Excel-driver and data cruncher. In another company, the planner plans and the shop floor executes. In a third company, production and management meet each day in order to prevent upcoming problems and smooth out existing problems. Each company can either flourish or be ailing. It all depends on the quality and the fit of the information to and from the planning process and on the quality of the persons who make the decisions.

5 SALES & OPERATIONS PLANNING

The subject of the case is the coordination between production and expected demand using finished product planning, an area termed Sales & Operations Planning in the literature and for which ERP systems provide support. It is then useful to look at what the literature says about this and to what extent literature can support the analysis of the case. First a definition from internet: “Sales and Operations Planning (S&OP) is an iterative business management process that determines the optimum level of manufacturing output". This definition fits the theme of this paper, although the term 'optimum' in the definition is an empty shell without criteria and it is a planning process rather than a management process. The definition proceeds to state that "The process is built upon stakeholder agreement and an approved consensus plan. To help stakeholders agree on a plan of action based on real-time data, S&OP software products include dashboards that display data related to equipment, labour, facilities, material and finance. The purpose of the dashboards is to provide the stakeholders with a single, shared view of the data". This is not true in the situation considered here. The planner has a delegated responsibility to solve the planning problem within the set norms and to signal when he is structurally unable to meet the norms. Occasional deviations are permitted (and delivery reliability prevails over costs), structurally both norms need to be met. Determining tight but achievable norms is a mutual undertaking in which all stakeholders are involved and in which at least commitment, if not consensus, needs to be achieved. Operational planning is very different in nature. This holds even more strongly if Sales & Operations Planning is not done on a monthly basis, but, as in the case, must be done on a weekly and daily basis.

The definition in the APICS dictionary, which should be an authoritative source given the status of APICS as an organisation ("the premier professional organisational for supply chain management", according to its website, with over 43000 members and more than 300 international partners), provides even less of a guide. Because of the language used I will cite the very long lemma in full:

(APICS Dictionary, 2008, p.121f)

> "Sales and operations planning – a process to develop tactical plans that provide management the ability to strategically direct its business to achieve competitive advantage on a continuous basis by integrating customer-focussed marketing plans for new and existing products with the management of the supply chain. The plan brings together all the plans for the business (sales, marketing, development, manufacturing, sourcing, and financial) into one integrated set of plans. It is performed at least once a month and is reviewed by management at an aggregate (product family) level. The process must reconcile all supply, demand, and new-product plans at both the detail and aggregate levels and tie to the business plan. It is the definitive statement of the company's plans for the near to intermediate term, covering a horizon sufficient to plan the resources and to support the annual business planning process. Executed properly, the sales and operations planning process links the strategic plans for the business with its execution and reviews performance measurements for continuous improvement. See: aggragate planning, production plan, production planning, sales plan, tactical planning."

This is a definition (or description) of everything and therefore of nothing. Why should Sales & Operations Planning not be about the common daily operational practice of coordinating demand and availability and about no more than that? What does something like "a process to develop tactical plans that provide management the ability to strategically direct the business …" add to our understanding of the problem?

Donald Sheldon writes in his World Class Sales and Operations Planning (co-published with APICS) "The S&OP process can have a major impact on the management of inventory" (Sheldon, 2006, p. 29). He then devotes chapters to "Creating the Demand Plan" and to "Operations Planning for the S&OP Process". For Sheldon the S&OP process is the coordination between the various subplans ("Stated in its simplest terms, the S&OP process is a monthly planning cycle where plans for both customer expectations and internal operations are reviewed for accuracy, process accountability, lessons learned, and future risk management", Sheldon, 2006, p. 2), where it should be essentially about the planning process itself. Of course there is an important role for higher level long term planning in companies to coordinate market developments, production capacities and resource needs. In this kind of higher level coordination operational norms must also be determined and adjusted, and possible measures should be agreed upon to 'land' changed norms with the relevant internal and external stakeholders. Donald Sheldon recognises the subordinate role of software: "All that is needed is a spreadsheet and good problem-solving tools and skills" (Sheldon, 2006, p. 15). The question remains, however, where the information for this problem solving will come from, and how to organise the different kinds of information flows (both formal via systems and informal via humans).

Robert Davis analyses what he calls the push-pull hybrid for supply chain management. "This hybrid model is based on the premise that you push produce and pull distribute" (Davis, 2016, p39). This analysis matches what was described above as the structure of the problem. His further analysis concentrates on what is happening in the supply chain as a whole. The chapter about inventory optimisation discusses the development of inventory policies that can be translated into algorithms and executed automatically. This approach does address the problem of how to develop ways of coping with the problem of inventory levels, but it does not address the problem of the individual planner who uses information and who makes decisions.

Shaun Snapp (S&OP in Software) describes the standard S&OP process as follows: (1) review and sign off the demand plan; (2) review and sign off the supply plan, and (3) review and sign off the financial plan. And he gives the time features as a planning horizon between 1 and 5 years, a monthly planning frequency, and a monthly planning bucket. This is not quite the horizon the companies discussed here are working with. Planning of inventory levels is not in his list of plans to sign off, Snapp discusses dynamic safety stock in the chapter entitled 'How Misunderstanding Service Level Undermines Effective S&OP'. He writes: "Safety stock is often set in companies by simply allowing individuals to guesstimate what the safety stock value should be and then provides them with the rights to make the safety stock adjustments" (Snapp, 2016, p. 105. This is followed by the remark that in his experience he never saw this working well, and "Stock levels should not be controlled by manually adjusting the safety stock. Instead, safety stock should be dynamically calculated and automated, and only changed as a result of changes in the variability of supply or demand" (Snapp, 2016, p. 107). The last part of course is true (from 'only changed as…'), but the first part presupposes that variability of demand is represented perfectly in the computer system, with all relevant information taken into account. This clearly cannot always be true. And, if manual adjustment of demand forecast is allowed, planners very quickly learn the trick how to adjust demand in order to get the safety stock level they want.

The ERP systems of course offer solutions for S&OP. Hamilton in his book about MS Dynamics AX, paragraph 10.1: "You can automatically calculate the safety stock requirement based on variations in historical usage and the desired customer service level" (Hamilton, 2016, p. 236). A bit further in the same chapter, in paragraph 10.7: "When using the min-max coverage code, you specify the item's minimum quantity and maximum quantity for each relevant site/warehouse. The minimum quantity represents the average daily usage multiplied by the item's lead time" (Hamilton, 2016, p. 253). So, you either have safety stock, taking variation of demand into account; or you have a min-max policy where average demand represents the minimum stock needed? Dickersbach gives in his book "Supply Chain Management with SAP APO™" the following structure of the demand planning process (somewhat shortened in my representation): (1) Forecast; (2) Check on plausibility of the forecast; (3) Production planning. Inventory planning is not mentioned at all. (Dickersbach, 2009)

A picture of confusing, vague and contradicting terminology in combination with conceptual weaknesses arises from the works mentioned above. Neither in the literature nor in the software clear structures of the problem area are defined. A concrete example of the translation of this messy approach into actual customer requirements is the following set of questions for candidate software suppliers by a company in the food industry:

- "How will stock adjustments automatically influence production schedule?"
- "Sequence of production is determined by the scheduling process. Disruptions in other processes (up and down) lead to automatic rescheduling of production capacity; manual adjusting to schedule needs to be validated and recorded as an exception"
- "How will the production schedule be adapted in case of (1) late delivery of raw materials"; (2) delays in production runs; (3) changes in available stock caused by quality inspections; (4) rush orders; (5) break down of production lines;
- "Reject of the output of finished product at the end of the production line, how will the system adapt?"

These questions show a model-based and reductionist approach to the sales and operation planning process. The production system is provided a forecast from the central ERP system (just one value, no information about spread), processes this to an optimal production plan, and any deviation or disruption results in adjustments to the production plan. A fully deterministic production is assumed, as well as full and real time information about the actual situation on the shop floor.

This approach encounters a number of related fundamental objections: (1) production is not deterministic, as a result production results will always deviate from planning which leads to the next question: what constitutes a deviation? (2) product registration never fully coincides with production reality, the view on the computer screen is in the best case an abstraction of the shop floor reality (details are not available or omitted) and in other cases a distortion of reality (for example by enforcing classifications in search lists that have not been sufficiently thought through). And, imagine what this approach would mean for the primary processes on the shop floor: a continuous flow of changes in production planning, which will go at the expense of effectiveness and efficiency.

6 RECAPITULATION AND CONCLUSIONS

The problem area is about how to combine agreed service levels with minimising costs. The Sales & Operations Planning literature clearly indicates the comprehensive character of the problem, different viewpoints have to be taken into account. In structuring the problem field the literature is less helpful, firstly because of the confusing use of terminology, secondly because of the time horizon of months and years, and thirdly because of the lack of attention for the day-to-day work and challenges for the people involved in planning. Software, as could be expected, does not help either. It offers toolboxes of statistical instruments, dashboards, and algorithms without much notion of how to apply which instrument in which situation. The fact that a planner is responsible for his decisions, and that the planner has to combine information from many sources in order to deal with variance, inaccuracy and conflict of norms is not discussed in the literature.

Essentially, the problem area is about two main control loops decoupled by a third intermediate control loop. The first main loop is about service levels, available stock and expected demand. The second main loop is about production output and efficient production. The intermediate loop is about stock control, firstly for decoupling variance of demand from smooth and efficient production processes, and secondly for dealing with all kinds of disruptions, deviations and inaccuracies in both the business processes itself and in available information about the business processes.

The approach is about finding solutions that do justice to both the structure of the problem (process logic, formal sign systems) and to the intricacies of the particular company that must organise its information in such a way that its competitive power and distinctive capabilities are enhanced (how it has found its own ways of dealing with the challenges, idiosyncratic characteristics, social sign systems). Human judgement and human communication must be combined with computing power.

In terms of the coordination mechanisms of Mintzberg we see a combination of standardisation (and formal sign systems) and mutual adjustment (with social sign systems). Standardisation and rigid definitions of data help to organise information flows and to automate the processes of determining demand, setting stock levels, and setting production levels in standard situations. Dealing with conflicting norms in non-standard situations, however, is about mutual adjustment and human responsibilities. Squeezing out that little bit extra is about human creativity and problem solving.

To conclude with Kay: distinctive capabilities are about the characteristics that distinguishes the individual company from its competitors, and that can not be readily copied. The challenge is to find the right combination of formal and social sign systems that addresses the needs of actual planners in actual companies and that builds on the existing competitive power of the company. The high level talk of the literature nor the reductive approach of ERP software helps here much.

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