

**Demand Seasonality and Mitigation of Its Impact on Customised Production System:
Exploring Aggregate Planning and Mutual-Outsourcing for a New Zealand Company**

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Abstract

The seasonality of demand of XYZ Company places a significant strain on its human resources and production capability. It results in overcapacity during the 1st half, while it limits its capacity during the 2nd half of the year. This paper explores how XYZ can smooth its existing seasonal demand or the sales pattern. This paper has examined various aggregate planning techniques, but some of them have been discarded by the company based on various local factors. From discussions with the company's Operations Manager and General Manager, a potential solution is identified for further investigation including undertaking work outsourced from other manufacturers to fill XYZ's unutilised capacity during low demand season. Research is conducted into the aspects of outsourcing to identify the drivers behind the other companies' outsourcing activities and how XYZ could go about securing those outsourced jobs to maintain a stable workforce within its operations. The paper recommends that XYZ should pursue mutual-outsourcing to mitigate the impact of its seasonal demand pattern. Further, a marketing brochure and a common website should be developed and promoted to bodies such as Chamber of Commerce, Manufacturers' Associations, and other businesses to help identify the type of jobs XYZ business is capable of doing. In support of the brochure, a statement of evidence of previous jobs should be included to encourage negotiations between the prospective collaborative companies for mutual-outsourcing.

Keywords: Aggregate Planning; Mutual-Outsourcing; Seasonality; Customised Product

1. Introduction

XYZ is founded as a small joinery factory in the beginning and is now considered an internationally recognised leader in turnkey retail store development. XYZ's products and

solutions are sold all over the world and the company has partnered with global brands like McDonald's, BP and Coca Cola as well as domestic companies like New World and Countdown. The company has complete design and manufacturing capacity and specialises in customised retail food display solutions. It positions itself as an innovative, customer focused organisation producing the highest quality product by utilising state of the art engineering and information technology. The innovative culture of the company is based on the strong values of its founder including a passion and drive for excellence, loyalty and long-term relationships with key partners.

1.1 The Problems and Issues

Approximately 120 people are employed by the company, which is managed by a Board comprising both internal and external directors. In addition to the CEO, the day to day operations are overseen by the General Manager. XYZ faces a strong seasonal demand pattern resulting in high sales from the second half of the year (July to Dec), representing approximately 65% of the company's annual sales. However, the first six month (Jan-June) is a lean period in which production and human capacity is underutilised due to low sales of the products. A major attempt to smooth out the seasonal sales pattern by increasing sales into Europe and the UK met with limited success as a similar sales pattern is experienced by them. A smoothing technique has already been applied which involves production employees in the low season to work 4 days and get paid for 5 days, while in the high season they work for 6 days and are paid for 5 days. Despite this technique, the number of production employees is still required to increase from 80 to 100 from the low to the high season. The problem with the recruitment of these additional employees is compounded by the lack of available skilled staff, a 3 month training period, and the seasonal employment which is not attractive to the potential employees.

It is obvious that the company can operate at full capacity in the high season as this is where the majority of the company's profitability is generated, while maintaining the ability to minimise the wage bill in the low season, where trading performance is close to break-even only. As a result of the difficulty in recruiting skilled workforce, an ideal solution for the company is to maintain a stable workforce throughout the year. In the light of this situation, the company is interested in exploring other alternatives and recommendations.

According to the XYZ General Manager, the company's future remains in the

manufacture of customised products for the global corporate customers, where XYZ is able to differentiate itself from its competitors who primarily manufacture mass standardised products. According to Vonderembse and White (2004), for a company to remain in business, it needs to be able to compete in the marketplace and win orders from their customers based on order-winning criteria such as: ability to meet customers specifications, price, quality, delivery speed, delivery reliability, and flexibility (range of products provided).

1.2 Objectives and Approach of the Research

The objective of this paper is to analyse and mitigate the long-term capacity related problems for the company with seasonal sales pattern by providing a range of potential alternative solutions. The paper will investigate into various aggregate planning techniques and will recommend a potential planning strategy to minimise the costs, while still enabling the company to retain or have access to a constant pool of skilled workforce throughout the year irrespective of seasonality in demand.

2. Literature Review

Aggregate planning is the process of determining the company's production, inventory, and personnel levels for 3 to 12 months ahead. It typically focuses on manipulating several aspects of operations viz. aggregate production, inventory, and personnel levels to minimise the costs over the planning horizon (Martinich, 1997). Organisations that have substantial investment in capital equipment require high percentage of capacity utilization to be successful in the global market, which means that effective aggregate planning combined with other factors including tight scheduling, efficient employees, and appropriate facility scheduling are critical (Heizer & Render, 2011).

Vonderembse and White (2004) have found that planning is a manager's most important job and more specifically planning in relation to the development of a competitive strategy.

According to Stevenson (2012), a competitive strategy related to effective capacity planning must achieve a match between the organisations long-term supply capabilities and its expected level of long-term demand.

Similarly, Brown et al. (2005) state that the first challenge of capacity planning is to be

able to maximise utilisation, and the second is to match production output with market demand. Additionally, Buxey (2005) observes that most businesses follow chase strategy as they subscribe to 'just-in-time' approach. Managers do not look for a perfect solution, rather strive to eliminate or reduce the most significant marginal costs.

Stevenson (2012) has found forecasts to be the basis for many decisions and essential tool for matching supply and demand. An operations strategy must be formulated to support the overall business strategic plan and should focus on the specific capability of the operation to maintain its competitive edge or competitive priorities which Reid and Sanders (2003) list as cost, quality, time and flexibility. Capacity planning requires knowledge of the organisation's current capacity of various processes and the level of utilisation often expressed by equation (1) as a percentage (Krajewski & Ritzman, 2005):

$$\% \text{ utilisation} = \frac{\text{average output rate}}{\text{maximum capacity}} \times 100 \quad (1)$$

3. Potential Planning Alternatives

There are various planning options for organisations to choose from in order to utilise its plant capacity optimally while at the same time meet the demands of its customers. The two popular alternatives are: (a) chase demand strategy, and (b) level workforce strategy.

A chase demand strategy is used when an organisation adjusts its production rate to meet the fluctuating customer demand. It is chosen when a company produces made-to-order products that are one off or any product which is deemed highly perishable or prone to obsolescence. Disadvantages with this strategy is that capacity needs are constantly changing, resulting in either under- or over-capacity. Over-capacity results in operating costs being too high, while under-capacity often results in lost customers and strained resources (Stevenson, 2012). This strategy may involve costs of hiring and training new employees, costs of firing (for example: unemployment insurance, severance pay), and productivity losses from low morale and loyalty of employees.

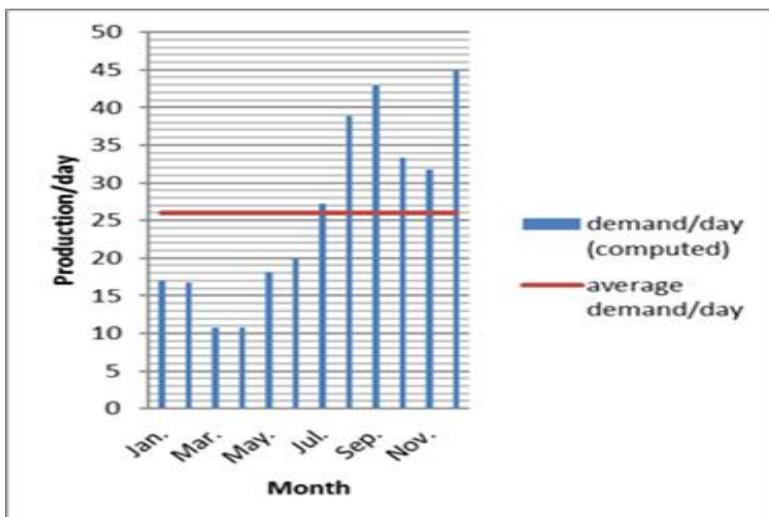
The level workforce strategy (Figure 1) sets production output to meet the average demand over a set period (Reid & Saunders, 2003). The firm can maintain a steady output that builds inventory during periods of low demand that can be used during periods of high demand, thereby avoiding dramatic and costly changes in production and staffing (Martinich, 1997).

Table 1: Summary of data

Month	Expected Demand	Production Days	Demand/Day (Computed)	Average Demand Per Day
Jan.	375	22	17	26
Feb.	300	18	17	26
Mar.	225	21	11	26
Apr.	225	21	11	26
May.	400	22	18	26
Jun.	400	20	20	26
Jul.	600	22	27	26
Aug.	700	18	39	26
Sep.	900	21	43	26
Oct.	700	21	33	26
Nov.	700	22	32	26
Dec.	900	20	45	26

Taking into account the pros and cons of above two strategies, many organisations seek to adjust their aggregate planning by introducing a hybrid aggregate plan that introduces a number of options such as: scheduling overtime or back-ordering to smooth out the fluctuating demand (Reid & Saunders, 2003).

Figure 1: Level aggregate plan (Heizer & Render, 2011)



Vonderembse and White (2004) have stated that an organisation can adopt either a proactive or a reactive strategy when developing its aggregate plan to meet uncertain demand. They suggest the following strategies under two categories: (i) Proactive: producing goods that are seasonally complementary; offering discounts to increase demand during low periods; increasing advertising and promotions when demand is low. (ii) Reactive: varying the workforce through firing or hiring; scheduling of overtime or additional shifts, or reducing work hours; scheduling holidays or complete plant shutdowns; build-up of inventory; subcontract work out at peak periods; and build-up order backlogs.

Similarly, other researchers (Reid & Saunders, 2002; Schroeder, 1993) maintain that customers can choose between demand based options which are similar to the proactive strategy and capacity based options which are similar to the reactive strategy. Depending on the industry, some options do not represent a viable alternative, for example, companies that produce perishable or customised type products cannot build up inventory, while companies that require skilled and trained staff are not able to easily vary their workforce (Reid & Saunders, 2002).

3.1 Various Alternative Strategies and Related Issues

According to the GM of XYZ, the company has explored various reactive and proactive strategies in an attempt to even out its demand and has implemented workforce scheduling through the use of 4 day weeks during the lean season and 6 days weeks during peak season (but paying for 5 days per week only for both the seasons). However, this does not fully solve the long-term issues. GM states that many unique issues apply to the company that do not make many of the proactive or reactive strategies feasible for effective aggregate planning. Some of the issues are: the lack of availability of locally trained workforce, 3 month time needed to train them, highly customised products manufactured with warranty implications, and majority of sales coming from a few large corporations which are not influenced by discount sales promotions. Various alternatives are listed in Table 1, but GM feels that *marked alternatives are infeasible for various reasons. While the company has used limited subcontracting which does impact on profitability but it does nothing to fully utilise the company's manufacturing capacity in the lean season.

The remaining option is to identify and produce seasonally complementary products using the same facility and workforce. Seasonally complementary products have counter-cyclic demand patterns, so that the peak demand periods for one product are the low demand periods

for another product. For example, lawn mowers and snow blowers are two products which can be made by using the same facility. However, for XYZ Company, the temperature controlled food display cabinets are not the seasonal products in the traditional sense. It is the ordering pattern of their corporate buyers which make the demand and production fall in the second half of the year.

Table 2: Alternative strategies and related issues

Alternative planning strategy	Related issues
Production of seasonally complementary products.	Considered and discounted on the basis of lack of clearly identified complementary products.
Offering discounts to buyers during low demand periods to increase demands.	*Discounts do not influence corporate buyers.
Increase advertising and sales promotions.	*Again ads would not influence corporate buyers to purchase early.
Varying workforce through hiring and firing.	*Trained workforce not available and not considered a long term solution. 3 month training required, and training investment is lost when temporary staff are allowed to go.
Scheduling of overtime etc.	Used and found effective but does not solve full problem.
Build-up of inventory.	*Product is customised and prone to obsolescence.
Subcontract work out.	Product is highly customised with significant warranty implications. Used to gain some success previously, however, a no. of subcontractors used before have gone out of business following the recession.
Build-up order backlogs.	*Are unable to influence corporate buyers to order early.

3.2 Exploring More Alternatives

In periods of economic recession, managers are forced to make a number of decisions

to deal with the decline in activities. However, Hubbard and O'Brien (2010) suggest that organisation must also plan to deal with the growth that will follow the recession. Typically during recession investments on capital goods (e.g., new factories, additional machinery and equipment) decline, staff laid off, and production rates fall. Conversely, even during recession, some businesses will continue to prosper and push ahead in anticipation of the end of the recession and the lack of activities of their competitors (Hubbard & O'Brien, 2010). Taking a clue from the above research report, a potential solution for XYZ is to maximise the utilisation of its capacity and to maintain a stable workforce is to undertake subcontracted jobs from other manufacturers who do not wish to commit to capital investment.

3.3 Outsourcing and Offshoring Strategies

Outsourcing is the use of production facilities of other firms to meet the production target as opposed to using the existing in-house facilities (Ehie, 2001). Chung's (2007) defines outsourcing as 'purchasing immediate goods or contracting business activities that were previously performed within firms to outside providers'. It is also commonly known as the 'make or buy decision' and is typically divided between material and non-material outsourcing. Chung makes distinction between outsourcing and offshoring. The primary purpose of offshoring is to move 'processes to low cost regions' while control may or may not be relinquished whereas with outsourcing, control is always handed over to the third party. Rubin (2007) adds that outsourcing has evolved from both a low cost labour saving measure and generic parts manufacturing to a strategy of producing high end finished components.

Outsourcing gains: Outsourcing firms are able to provide a range of cost saving techniques by taking advantage of economies of scale, access to a skilled workforce, smooth out unpredictable workflow patterns, core competence, and the learning curve, while the client benefits from high quality and just-in-time delivery (Rubin, 2007). Ehie (2001) looked at how outsourcing enables a firm convert a range of fixed costs into variable costs, to gain access to the invention and innovation attributes of suppliers, plus faster new product development by focusing key resources on the firm's core competencies. However, there is no gain without some risks as outlined in the next section.

Outsourcing risks: The main strategic risk in outsourcing is the potential for losing key skills or expertise that may be required in the future (Leavy, 2004; Jiang et al., 2007). According

to Ehie (2001), outsourcing often did not live up to client's expectations because of two main reasons: (a) putting emphasis only on cost cutting, and (b) many contracts were viewed as combative rather than cooperative. Ehie and Vanarase (2007) found that many outsourcing contracts were undertaken solely to achieve lower costs, and therefore outsourcing failed to realise or match the clients' expectations. Barthelemy and Adsit (as cited in Vanarase, 2007) listed seven mistakes of outsourcing as: outsourcing the wrong process; choosing the wrong outsourcing partner; writing the wrong type of contract; the actual effect of outsourcing on their people; lost control of the activity; failure to take into account all costs associated; and failure to include an exit strategy into the contract.

3.3.1 Selection Criteria for Outsourcing Partners

Chung (2007) revealed that the outsourcing decision should include the effects of both production cost and transaction cost. He suggested that where production cost is to be lowered by more than the transaction cost and then outsourcing should be considered. However, cost should not be the sole basis of selection rather the decision should be determined by partner's ability to improve overall competitiveness, through provision of increased manufacturing flexibility, lowering inventory levels, and ability to respond and adapt to changes in the market environment (Ehie, 2001). Choy and Lee (2003) suggest the factors to be considered when selecting an outsourcing partner as: price, quality, and service. However, other factors that should be included are: having a similar culture, ability to share development and innovation ideas, trust and communication. Choy and Lee grouped these attributes under three generic headings: (a) Technical capability: delivery, capability and price; (b) Quality assessment: commitment, development, quality and assurance; and (c) Organisation profile: culture, financial status, achievements, etc.

3.4 Mutual Outsourcing Approach

Mutual outsourcing approach is common in the service sector. For example, in 2005, Norwegian IT Service Provider (EDB) entered into a mutual outsourcing agreement for 5 years with the Norwegian HR Services group (Bluegarden) to provide IT operating services. In return, Bluegarden would provide payroll services to EDB. However, no research is found where mutual outsourcing is used in the manufacturing sector. This concept is similar to the advantages

firms get when they become part of a clustering group to share their best practices and gain access to a more informed labour pool as promoted by Michael Porter. Figure 2 shows how the movement of outsourced work flows between XYZ Company and another Company A. During XYZ's lean period outsourced work is obtained from Company A, while during the peak period, XYZ could look to outsource its work to Company A. This will help both companies mutually in improving the percentage capacity utilisation. Once the model is established and potential issues have been sorted, there is no reason why this could not be extended with more companies as in Figure 3.

Figure 2: Mutual outsourcing between XYZ and Company A

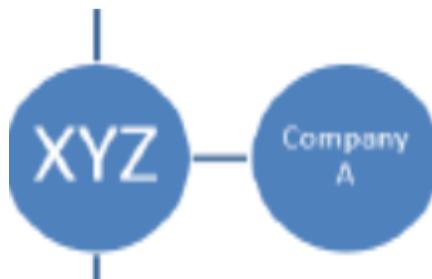
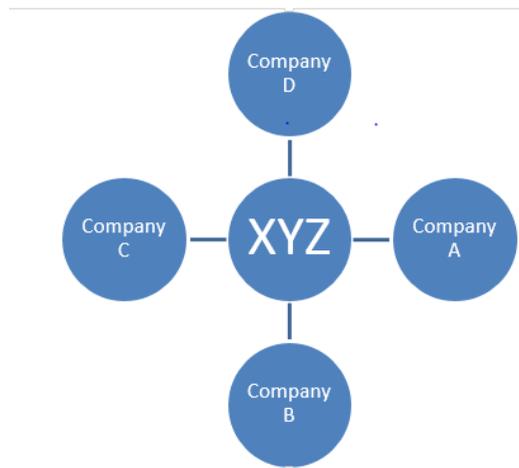


Figure 3: Mutual outsourcing between XYZ and other companies



3.5 Information sharing for mutual outsourcing

To manage the mutual outsourcing process between companies, a common website

could be developed similar to what is used in the tourism industry by travel agents for booking seats with airlines, or rooms in hotels. Using a spreadsheet as shown in Figure 4, the participating manufacturing companies could share information about their capacities which can help scheduling the various activities conveniently and transparently. This way, companies can also share their schedules of production to let others know when they can mutually outsource their jobs to utilise each other’s extra capacities.

Figure 4: A spreadsheet template for capacity related information sharing

Day \ Work Centre	Monday 1st	Tuesday 2nd	Wednesday 3rd	Thursday 4th	Friday 5th	Monday 8th	Tuesday 9th	Wednesday 10th
Metalwork	Processing	Processing	Processing	Pending	Pending	Available	Available	Available
Joinery	Available	Available	Processing	Processing	Processing	Available	Available	Available

Processing

Pending

Available

4. Conclusions and Discussions

XYZ Company is faced with the recurring seasonal demand pattern of its products for a number of years and despite investigating a range of aggregate planning techniques it is yet needed to identify one plan that could fully provide a workable long term solution. Varying the workforce through hiring and firing would provide the best solution, but this option is not feasible as a long term measure and is further complicated due to the lack of availability of skilled manpower in the Hawke’s Bay region and the high cost of training for potential new employees.

XYZ has positioned itself as a leading manufacturer of highly customised products. Leaving the customised product side of the business in favour of a standardised product has also been discounted by the company’s senior management team. Alternative solutions are further complicated by the type of customers XYZ has, which are primarily large global businesses and as such are not able to be influenced by proactive strategies such as offering discounts and provision of enticements for early or off-season ordering.

Despite all this, XYZ is able to partially smooth the workflow by reactive measures such as the use of scheduling overtime during the peak periods of demand, and reduction in work hours during lean period. However, this technique does not go far enough to solve the significant over and under capacity problem experienced by XYZ.

Of the remaining eight planning strategies identified in Table 1 to smooth demand, only two are considered to have merit for further consideration, and they are: (i) to produce a product that is seasonally complementary, and (ii) to subcontract work during the peak periods. Identification of a seasonally complementary product is partially explored by the senior management team. Since the products of XYZ Company are not seasonal products, there is not really an easily identifiable complementary product. Subcontracting at peak periods does go to some extent to solve the capacity issues; the cost of this solution would significantly impact the profitability. Recently the closure of local joinery factories (which were used as subcontractors) caused by the recession in the economy has further complicated this solution.

This leaves a choice of hybrid of the above two solutions to be considered further: outsourcing work-in during the company's lean period (Jan to June), and outsourcing work-out in the peak season. Manufacturing outsourcing is a major business strategy undertaken in global markets and initially outsourcing is seen as a strategy only to lower the operations costs. However, outsourcing has evolved primarily based on the advantages vendors can provide due to their competitive positioning through specialisation and core competence. It also helps the company to concentrate on improving their core competencies creating even greater levels of competitiveness.

XYZ has skilled employees and a range of manufacturing equipment and technology that could be more fully utilised to capacity, if a suitable outsourced product from other companies could be identified to be manufactured during the January to June period. Additionally, because XYZ is primarily looking to cover the overhead costs of maintaining full capacity of a productive workforce then it is well placed to be cost competitive in addition to taking advantage of its skilled workforce and infrastructure. The timing of XYZ looking to market itself may also be advantageous, given the uncertainty many businesses are facing regarding growth along with expansion and as such do not wish to commit to additional capital expenditure, also will likely view outsourcing as a viable alternative.

5. Recommendations

1. Mutual-outsourcing should be pursued by XYZ Company to address the company's seasonal demand pattern.
2. XYZ should prepare a brochure highlighting its capability to manufacture a range of products that are in peak demand during January to June period.
3. The company should prepare a draft statement of works addressing the issues identified in this paper to support the type of negotiations required.
4. A company representative should be assigned the job to call on prospective businesses within the North Island including Manufacturers Associations and Chambers of Commerce to identify potential partners for mutual-outsourcing.
5. Once a partner is identified to be mutually beneficial, a common website should be developed to facilitate the outsourcing process more effectively.
6. Once the above processes have been sorted, more partners could be invited and added to the group for extended mutual-outsourcing of work flows.

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