

# A Guide to Demand Forecasting within the Grocery Industry

AUSTRALASIA

## ECR Australasia — Working Together for Total Customer Satisfaction

Efficient Consumer Response or ECR is a business concept aimed at delivering superior business results in a competitive environment by reducing costs at all stages throughout the supply chain to achieve efficiency and streamlining of processes. ECR is also aimed at delivering improved range, price, service and convenience to satisfy the needs of the consumer.

ECR Australasia reflects a renewed commitment to take costs out of the grocery supply chain and better satisfy consumer demands through the adoption of world's best practice. In an increasingly global food and grocery industry and retail environment subject to rapid change, the future for Australian and New Zealand suppliers, retailers and wholesalers depends on increased efficiencies, reduced costs and added value for consumers. Influences such as global sourcing, new retail formats and channels, international retailers, competing products and services, technological innovation and the spread of e-commerce, have all contributed to the pressure for change.

ECR Australasia is an initiative of manufacturers and retailers with the Australian and New Zealand food and grocery industry and its national associations, Australian Food and Grocery Council, Australian Supermarket Institute, New Zealand Grocery Marketers' Association, Inc and New Zealand Retail and Wholesale Merchants Association. Launched in November 1999 and directed by a Board of nine industry chief executives, ECR Australasia seeks to build on earlier collaborative work in the industry in Australia and New Zealand, particularly by the Grocery Industry Supply Chain Committee, and to access the outcomes of ECR related activities in more than 40 countries and globally through the Global Commerce Initiative. As elsewhere, the ambitious work program set by ECR Australasia is undertaken by project teams drawn from manufacturers and retailers with valuable support from consultants committed to the food and grocery industry.

The potential benefits for trading partners are substantial. In a landmark 1999 study for the Australian grocery industry, PricewaterhouseCoopers identified possible cost savings in excess of \$A1 billion and inventory savings of \$A750 million.

The ECR Australasia Board recognised that demand forecasting is an area of substantial savings to trading partners and benefits to consumers by reducing costs and out-of-stocks. The quality of demand forecasting determines the degree to which product supply can be synchronised with consumer demand. Successful demand forecasting thus underpins the successful implementation of ECR.

*A Guide To Demand Forecasting Within The Grocery Industry* is intended as an operational guide on demand forecasting which is applicable across a variety of trading environments and provides an improvement path for companies with varying levels of forecasting capability. It demonstrates the concepts in the Australasian context through case studies.

## Acknowledgements

The development and production of an industry guide to demand forecasting within the six months timeframe set by the ECR Australasia Board reflects the enthusiastic involvement of the Project Team, the membership of which is drawn from suppliers, retailers and wholesalers in Australia and the input of ECR participating companies in New Zealand. The time and work freely given by these individuals have ensured that the guide will have practical application within the operations of trading partners throughout the Australasian food and grocery industry.

The timely completion of the guide is also due in large part to the valuable contributions by the consultants from PricewaterhouseCoopers, which has a long standing commitment to, and reputation for, progressing improvements in the food and grocery industry.

ECR Australasia thanks the following for their contribution:

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ECR Australasia also thanks Franklins Ltd, Procter & Gamble Australia Pty Ltd and Sanitarium Health Food Company for participating in the case studies which demonstrate the operational relevance of the guide.

## About this guide

If the grocery industry is to achieve the estimated \$1 billion operating cost savings and \$750 million inventory reductions that were identified in the 1999 ECR Tracking Study, then action is required to improve supply chain management. In particular, planning and scheduling practices need to be integrated in order to effectively manage the various functional areas throughout the supply chain. Selling, distribution, production and purchasing activities should all be driven by accurate and consistent demand signals.

The quality of the demand signals determines the degree that product supply and consumer demand can be synchronised. The greater the synchronisation, the greater the service and the lower the operating cost. Therefore, effective supply chain management starts with accurate demand forecasting and communication.

The Tracking Study identified several opportunities for demand forecasting improvement:

- there are few instances where trading partners are sharing information to improve forecasting performance
- few study participants are developing forecasting capabilities based on an objective, quantified understanding of the different demand drivers
- many study participants are only forecasting monthly rather than weekly requirements making supply chain synchronisation difficult
- forecasts are often prepared by marketing and/or sales but are not communicated to operations (eg, warehousing, manufacturing), who then develop forecasts of their own
- forecast performance is not measured routinely and, where measured, error rates are typically substantial.

In this guide we present a framework that sets out the fundamental and advanced concepts of forecasting processes, organisational requirements and supporting systems for both customers and suppliers. We argue that the greatest accuracy, and therefore benefit, can be attained through collaboration between customers and suppliers and the integration of demand and replenishment planning.

The key recommendations to the industry that are set out in this guide are:

- analyse the nature of demand and economic importance of products to determine appropriate forecasting processes
- share demand data between trading partners and develop forecasts collaboratively
- suspend practices that obscure consumer demand signals
- improve the integrity of data and ensure that data standards are compatible between trading partners
- invest in the processes, people and technology that enable collaborative forecasting practices.

The objective of this guide is to provide a useful reference point for grocery companies, regardless of their size or sophistication, to begin to improve demand forecasting.



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**1**

**Why should you use this guide?**



In today's environment,  
collaboration between  
trading partners is proving  
to be necessary to best  
service end consumers

## Introduction

Underpinning the successful implementation of ECR is a common belief that forecasting demand is one of the most important business activities. However, in today's grocery trading environment where competition is becoming global, new products are being introduced at an accelerating pace and e-business is transforming the nature of buying and selling relationships, many companies are finding it increasingly difficult to forecast the demand for their products.

At the same time, competition continues to be tough creating the need to focus grocery supply chain activities on the end consumer. This, in turn, is driving a need for more collaboration between trading partners. The companies that do this the best will be the companies that build the greatest consumer loyalty through high customer service at the lowest cost.

## What is demand forecasting?

Simply put, demand forecasting is the process of predicting the timing and amount of future requirements for goods and/or services.

## Why forecast demand?

A proportion of the ECR  
savings can be attributed  
to improvements in  
demand forecasting

The 1999 Grocery Industry Supply Chain Committee (GISCC) tracking study identified potential operating cost reductions of \$1024 million and potential inventory reductions of \$753 million available to the Australian grocery industry as a result of the application of ECR concepts and enabling technologies. Demand forecasting is an integral part of, or important input to, several of the ECR concepts and it is therefore reasonable to attribute a proportion of the potential ECR savings to improvements in demand forecasting.

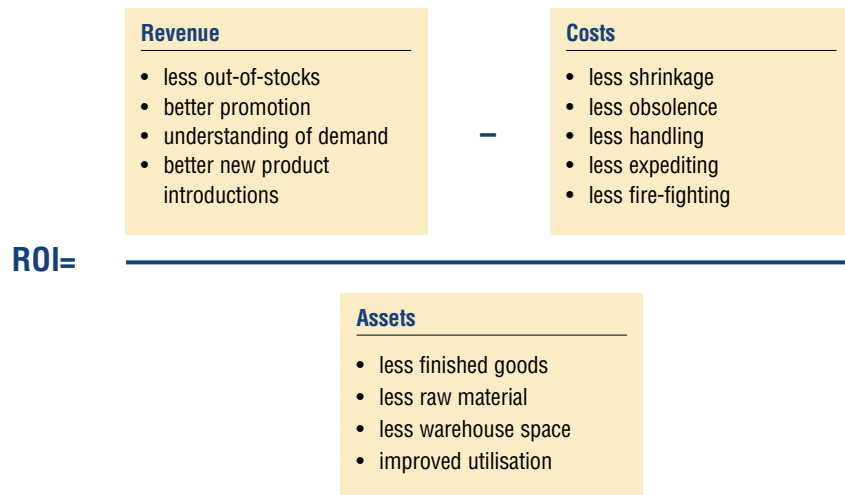
There are basically three reasons grocery companies forecast demand:

- 1 to prepare budgets for financial management purposes
- 2 to guide demand generation activities such as promotions and advertising
- 3 to plan future supply chain replenishment requirements.

While we acknowledge that demand forecasting is done for financial budgeting and sales and marketing planning, the focus of this guide is demand forecasting for supply chain management.

Most grocery items are sold from stock. Obviously, if a product is not in stock when and where the customer requires it, sales may be lost. Yet, the activities necessary to ensure that the product is in stock must usually be completed before demand is known. Therefore, forecasts are required to help determine how much stock is required and where it should be deployed. It becomes the catalyst for distribution, production and the procurement of materials.

The potential benefits of accurate demand forecasting are summarised below in Figure 1.1.



**Figure 1.1:** Improved demand forecasting improves return on investment (ROI)

A recent study estimated that out-of-stock occurrences represent 6.5% of all retail sales. For the retailer, only 53% of the sales are recouped from alternative purchases, so this means that 3.1% of sales are lost. Of the 6.5% only 23% is recouped by alternative purchases from the same supplier, meaning that up to 5% of sales may be lost for the supplier<sup>1</sup>. There are thus compelling potential gains for both suppliers and retailers from better demand forecasting.

## Some challenges in forecasting demand

Grocery trading practices can distort the consumer demand signals upstream in the supply chain because different factors influence buying behaviour

There are two categories of demand within a supply chain:

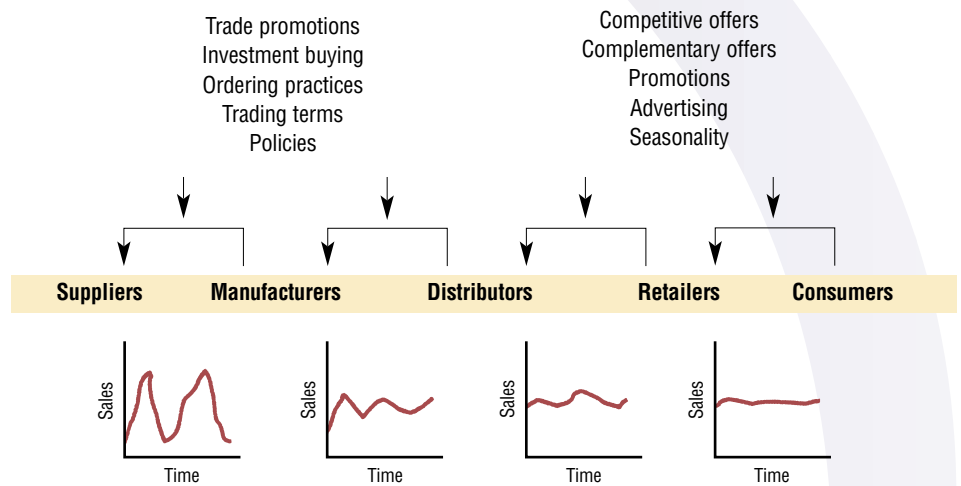
- **consumer demand** is created by the end users of the grocery products
- **customer demand** is created by trading partners who purchase the product for resale or conversion into other products.

For retailers, customer demand may equate to consumer demand, but for suppliers there can be important differences.

Trading practices can distort the consumer demand signals upstream in the supply chain because different factors influence buying behaviour at each stage of the supply chain (see Figure 1.2).

<sup>1</sup> Retailer Operating Data, Prism Partner Store Audits, Coca Cola Retail Council Independent Study, 1996

## Demand drivers



**Figure 1.2:** Trade drivers can distort consumer demand

It is an ideal of ECR that activity within a supply chain should be focused on consumer demand. The ability of trading partners to use consumer-level information to drive replenishment planning depends on the level of collaboration and the nature of the supporting technology that they can put into place.

Although examples of true, consumer-focused, collaborative forecasting and replenishment have been cited in the United States (eg, Nabisco and Wegmans<sup>2</sup>), collaborative relationships in the Australian grocery industry are generally less mature — ranging from arms-length trading where no consumer-related demand data is shared, to sharing of aggregated point of sale data, to collaborative management of inventory in retailer distribution centres.

Where consumer data is not being used to drive replenishment in the supply chain, demand signals such as retail purchase orders, which suppliers use as proxy variables for consumer demand, should not unnecessarily distort the end consumer demand.

**Nabisco** entered into a CPFR relationship with **Wegmans** supermarkets covering 22 items in the snack foods category. Sales increased by 13% (relative to an 8% decline for other retailers in the market). Service levels to stores increased from 93% to 97% and days of inventory declined 18% (by 2.5 days). These results were achieved without any increases in headcount or major investments in IT. Plans are in place to extend the CPFR relationship to cover other product categories.

<sup>2</sup> VICS CPFR Roadmap: Case studies

## Overcoming practices that obscure demand

There are various ways of ensuring that supply chain activities are more closely synchronised with consumer demand

Steps should be taken to more closely synchronise supply chain activities with consumer demand, including:

### **Sharing consumer data with trading partners on a timely basis.**

The potential for misunderstanding demand signals in an environment where there is no visibility of consumer demand is well known. One simple way to improve the visibility of consumer demand is to communicate consumer sales data to supply chain participants as soon as possible after the sales have taken place. Scan sales data is available from retailers or service providers such as ACNielsen which can be valuable for marketing and sales planning, but is less useful for supply chain planning since it may not be “real time”. The power of data sharing increases if the data is more timely, less aggregated and includes historical sales, inventory position and forecasts. To make the sharing of the data worthwhile, upstream supply chain participants need to invest in the business processes and systems which enable them to use this data to improve their supply chain planning processes.

### **Reducing and then agreeing “investment buys” well in advance.**

When downstream trading partners (eg, retailers) intentionally purchase more than their forecast requirements in order to take advantage of temporary low prices, the increase in trade demand can easily be misinterpreted as an increase in consumer demand by upstream participants (eg, manufacturers) causing them to increase supply of product or services that are not needed by consumers. Investment buying also tends to increase capacity requirements in warehouses, transportation and production facilities by creating artificial peaks of trade demand and this reduces the productivity of the supply chain.

### **Communicating retailer-funded promotions.**

When retailers initiate self-funded promotions without communicating these to affected suppliers, the unexpected impact on demand can trigger a need for costly expediting activities by suppliers.

### **Reducing and then agreeing “supplier pushes” well in advance.**

Short-term budget-based sales incentives may motivate sales staff to push stock into the trade, irrespective of whether consumer sales increase. This has the effect of decreasing sales at the beginning of the next period and distorting demand signals upstream to the supplier's supplier.

### **Adjusting payment terms to coincide with transactions.**

When payment terms are specified relative to statement dates rather than transaction dates, there may be incentives to place large orders early in the statement period rather than placing orders when goods are actually required. This practice is driven by the belief that some cash flow benefit can be obtained. Often the cost of extra storage is not taken into account. This behaviour drives the need for excess handling and storage capacities to accommodate the early delivery of goods at the commencement of statement periods.



**Reducing lot sizes.**

Practices that encourage inappropriate lot sizing can also distort consumer demand. For example, if suppliers offer incentives for ordering full truck-load shipments in areas with low demand, this may make the customer demand “lumpier” than the consumer demand.

The potential benefit from reducing or eliminating such disruptive practices can be estimated by modeling the current impact of these practices on cost, service and inventory position. We recognise that there are several steps that can be taken to eliminate these practices or at least reduce their impact in today’s trading environment with the introduction of new technologies. However, it is beyond the scope of this guide to discuss these in further detail.

The remainder of this guide is intended to provide a framework that can aid Australian grocery retailers, distributors and manufacturers, regardless of their size or sophistication, to begin to improve their demand forecasting performance given the current trading practices.



# 2

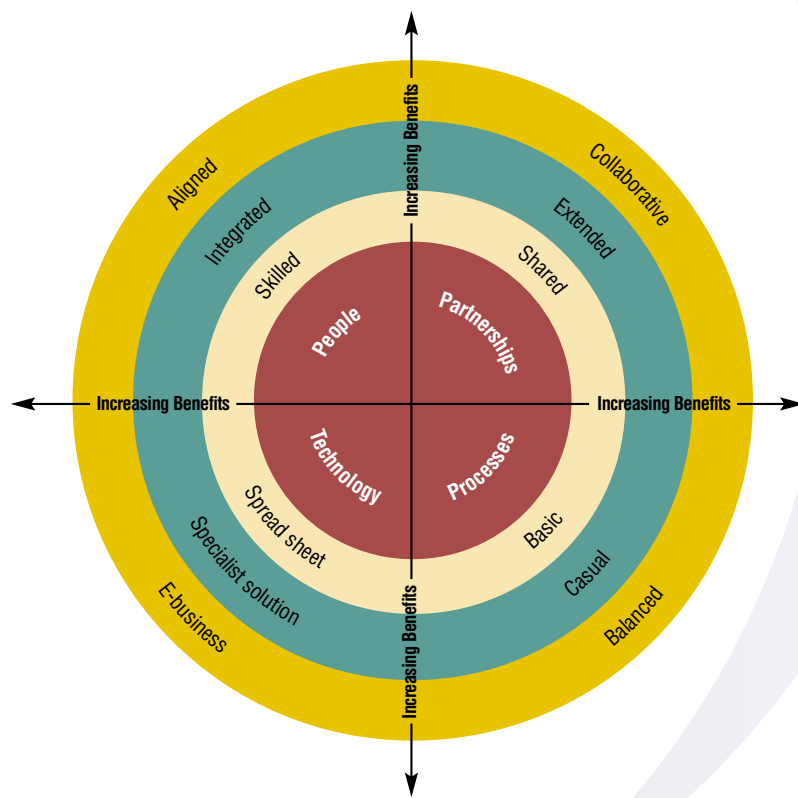
## A framework for demand forecasting

The best forecasting operations are continually improving capabilities in not one, but all of the following areas: business process, organisational skill, information technology and trading partner relationships

## Improving demand forecasting

When setting out to improve demand forecasting performance, grocery companies should adopt a holistic approach. PricewaterhouseCoopers research has shown that the best forecasting operations continually improve their capabilities in business process, organisational skill, information technology and trading partner relationships<sup>3</sup>. Changing one of these aspects alone is unlikely to bring the desired benefits.

These areas can be thought of as the “levers of change” and are expected to improve forecast performance as practices move through the continuum indicated in Figure 2.1.



**Figure 2.1:** Improving demand forecasting performance

It is possible to progress along one dimension faster than others; for example, it is possible to achieve a high level of external collaboration with trading partners without implementing causal forecasting techniques. However, there are likely to be diminishing returns to enhancing one area of capability at the expense of the others. Detailed consideration of each area is covered in chapters 3, 4, 5 and 6 in turn.

<sup>3</sup> The State of Operational Forecasting: A Benchmark Survey, Price Waterhouse 1996

## Forecasting maturity

Companies should build their own fundamental forecasting capabilities and adopt advanced practices to improve their potential to collaborate

Excellence in forecasting requires increasing levels of collaboration between trading partners. However, companies should build their own fundamental forecasting capabilities and adopt advanced practices to improve their ability to collaborate.

While customers or suppliers may reap some benefits from improving forecasting capabilities while working alone, all participating companies in the production of this guide agree collaboration will present the greatest benefits for both trading partners. Obviously, the path to improved demand forecasting may be different as indicated in Figure 2.2, but all paths ultimately converge on collaboration in order to maximise benefit.

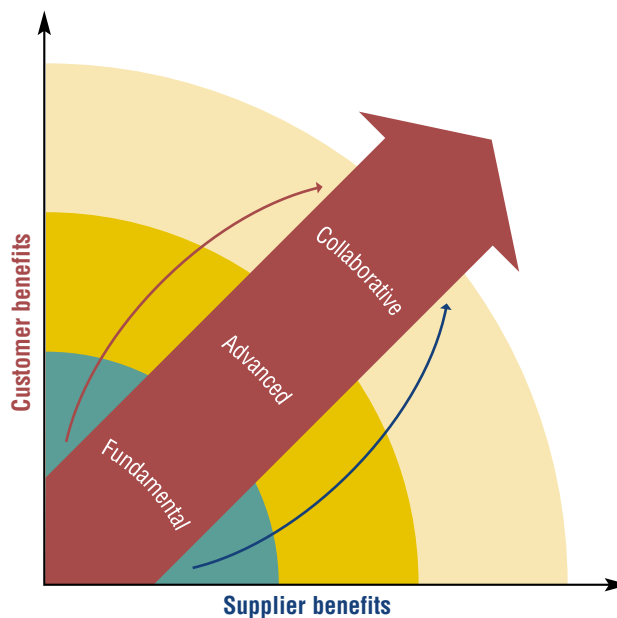


Figure 2.2: A forecasting maturity framework

There are three basic levels of maturity:

- **Fundamental** — the forecasting fundamentals are characterised by the application of basic forecasting practices such as simple statistical forecasts prepared on spreadsheet applications.
- **Advanced** — the advanced practices are characterised by the use of advanced forecasting practices such as causal forecasting and internally integrated processes such as sales and operations planning, but stops short of external collaboration with trading partners.
- **Collaborative** — the collaborative practices are characterised by suppliers and retailers developing forecasts jointly based on a full understanding of the factors which influence demand.

A more detailed description of this framework is presented in Appendix C.



A combination of the economic value and demand volatility of the product provides a basis for designing the demand forecasting process for that product

It is generally recommended that companies develop and improve their internal forecasting practices before planning to effectively collaborate with their trading partners. Given that trust and reciprocal benefit is required in any collaborative relationship, clear commitment, capability, compatibility and control should be established on both sides of the trading relationship. This is discussed in more detail later in Chapter 6.

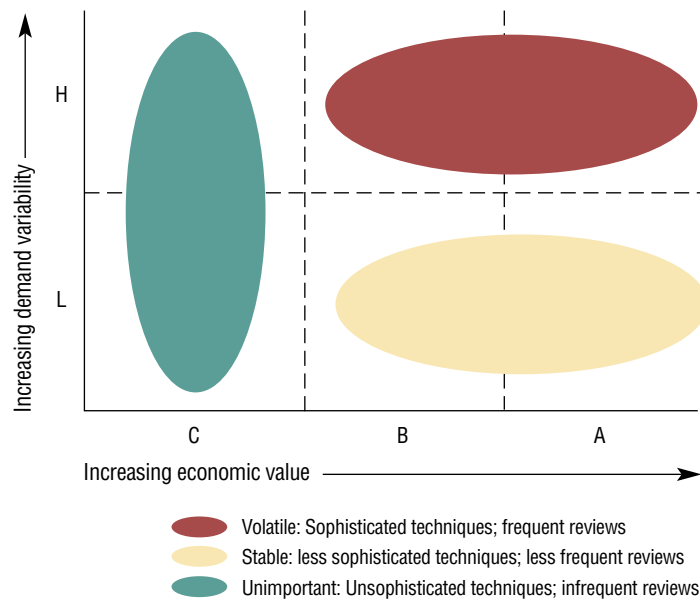
It should be noted that one forecasting process is not equally effective for all products, and all products do not warrant equal management time and focus. The degree of forecast sophistication and collaborative effort which is appropriate for a particular product is dependent on the nature of the demand and the importance of the product. Therefore, companies should segment products and determine where they will achieve the greatest returns for their management time and focus before designing demand forecasting processes.

## Product segmentation

The most appropriate demand forecasting approach depends on the economic importance of a product and the nature of its demand. Products with high economic value may warrant more intensive management than low value products. Products with volatile demand patterns may require more analysis, more sophisticated forecasting techniques or more frequent review, while products with stable demand patterns may require less sophisticated forecasting techniques and less frequent review.

Considering both the economic value and demand volatility of the product provides a basis for designing the demand forecasting process for that product. For example, the forecasting process for a highly promoted, high volume item may involve the application of causal forecasting techniques and significant levels of collaborative input, while a low volume, stable product may be forecast using simple algorithms and managed to wide exception thresholds.

Figure 2.3 presents a matrix that classifies products based on their economic importance and the nature of their demand. To be suitable for collaborative planning the product should have economic importance to both the supplier and the retailer and the promotional drivers should be subject to influence by both parties.



**Figure 2.3:** Segment products to determine the appropriate forecast approach

## Local case studies

The case studies illustrate advanced and collaborative forecasting practices within Australasia

We have included two case studies of Australasian forecasting practices in this guide to illustrate the differing levels of forecasting sophistication and collaboration.

The first case study is an illustration of advanced forecasting practices. Sanitarium Health Foods Company was able to improve the accuracy of its forecasts by strengthening its sales and operations planning process and implementing an APS system which enabled the application of causal forecasting techniques. Careful attention was given to developing appropriate key performance indicators and to linking them to incentives for the sales force.

The case study also demonstrates how the concept of product segmentation has been successfully applied. Sanitarium uses causal techniques to forecast high value, volatile products and prioritises KPIs and exception management activities based on the economic importance of the product concerned.

The second case study illustrates collaboration between two trading partners. By collaborating to forecast demand and manage replenishment to the retail distribution centre (DC), Procter & Gamble and Franklins were able to sustain a reduction in inventory levels in Franklins' DC of up to 50% while improving stock availability in the DC by up to 10%. These benefits were achieved without major investments in new technology. Both parties attribute the success of the initiative to open and honest communication and good project management.





# 3

## Improving the forecasting process

## Improving the forecasting process

Developing an integrated demand forecasting and communication process requires a consideration of:

- supply chain management activities and time horizons
- demand and demand drivers
- demand forecasting units (DFUs)
- forecasting methods
- business and decision rules
- performance measures.

## Supply chain management

The two primary outputs of a demand forecasting process are forecasts of demand and estimates of forecast error. Efforts to improve the forecasting process should begin with an evaluation of how the outputs of the process are used in the wider context of supply chain management (See Figures 3.1 and 3.2).

Effective and accurate forecasting is a critical element in integrated supply chain management

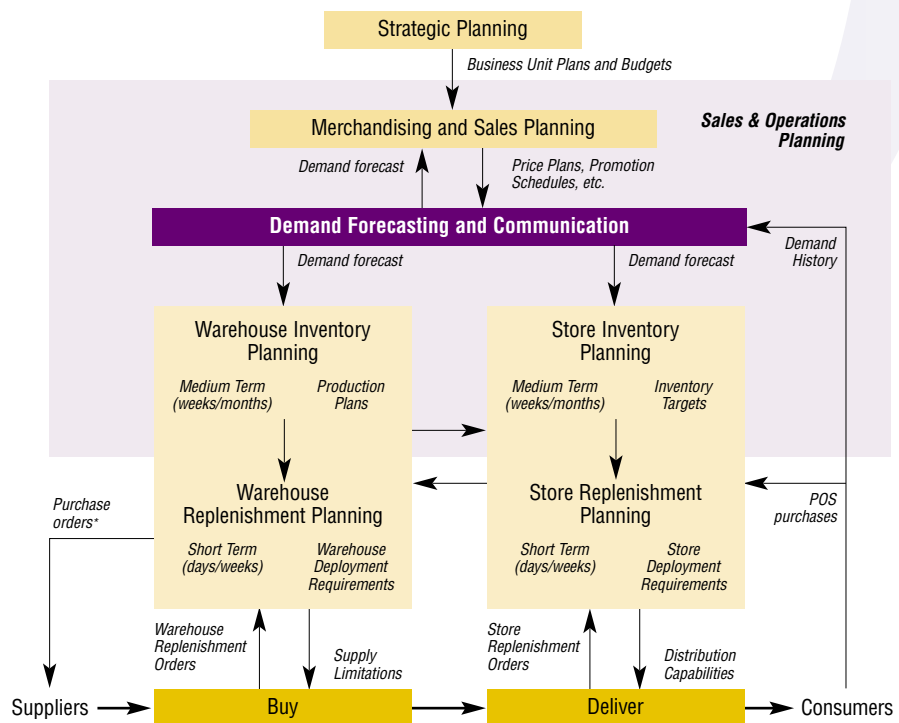
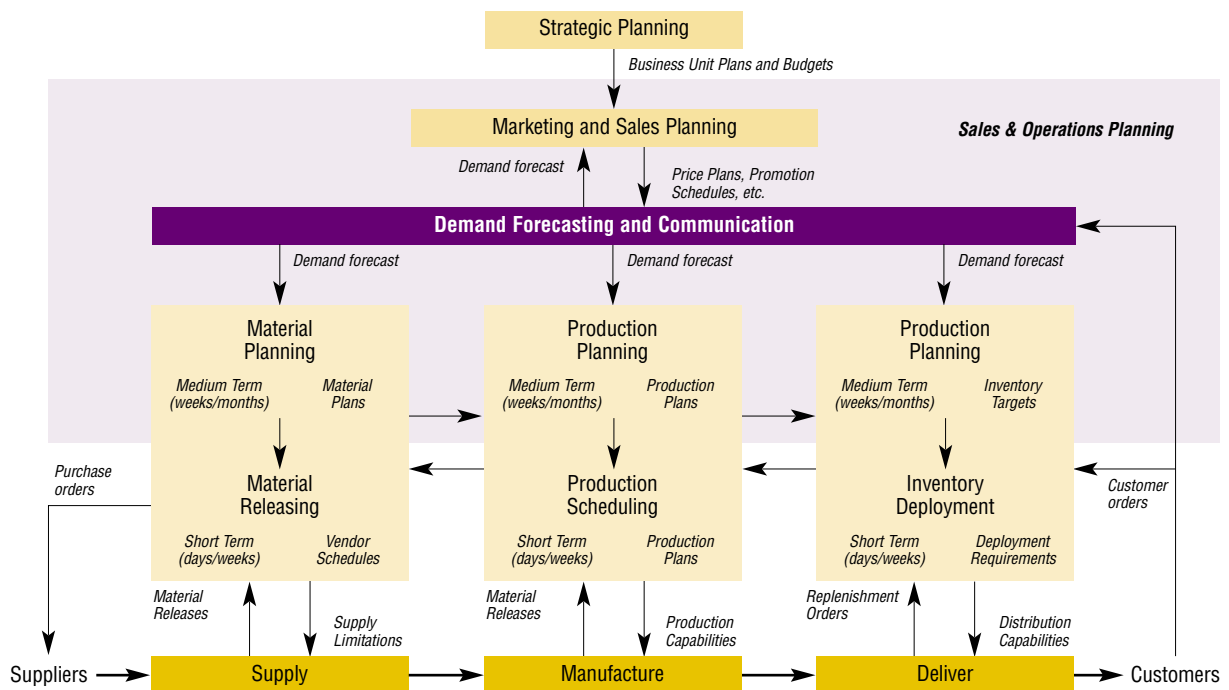


Figure 3.1: A supply chain management model for retailers / wholesalers



**Figure 3.2:** A supply chain management model for manufacturers

As shown in both supply chain management models, demand forecasts provide important input into both tactical and operational:

- marketing, sales and merchandise planning
- store inventory planning
- warehouse inventory planning
- production planning
- materials planning activities.

Demand forecasting is also a central part of sales and operations planning (S&OP) processes. S&OP activities are a series of formal meetings between the finance marketing, sales and operations functions to reach consensus on medium-term operating plans so that all business activities can be coordinated.

Depending upon the nature of the individual business and the requirements of the processes noted above, forecasting time horizons could be days, weeks, months, quarters or even years. For the greatest relevance, forecasting time horizons should match the requirements for the process using the forecast.

In a collaborative planning relationship the demand planning processes and replenishment planning processes for suppliers and customers would overlap.

Having a single well integrated forecast is central to the **SC Johnson Australia's** approach to business planning. Through a robust sales and operations planning process all functional groups are focussed on achieving a common objective. SC Johnson has already realised substantial benefits from an integrated business planning system in the form of reduced inventory, improved manufacturing efficiency, and improved customer service.

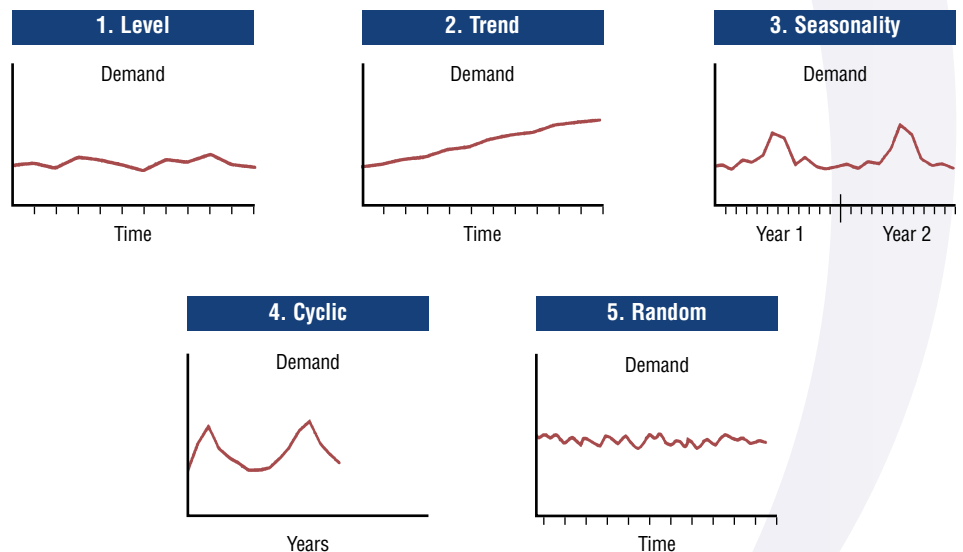
*J. Golding, S&OP Manager,  
SC Johnson Australia*

## Demand and demand drivers

To improve the accuracy of demand forecasts, demand and demand drivers need to be clearly understood

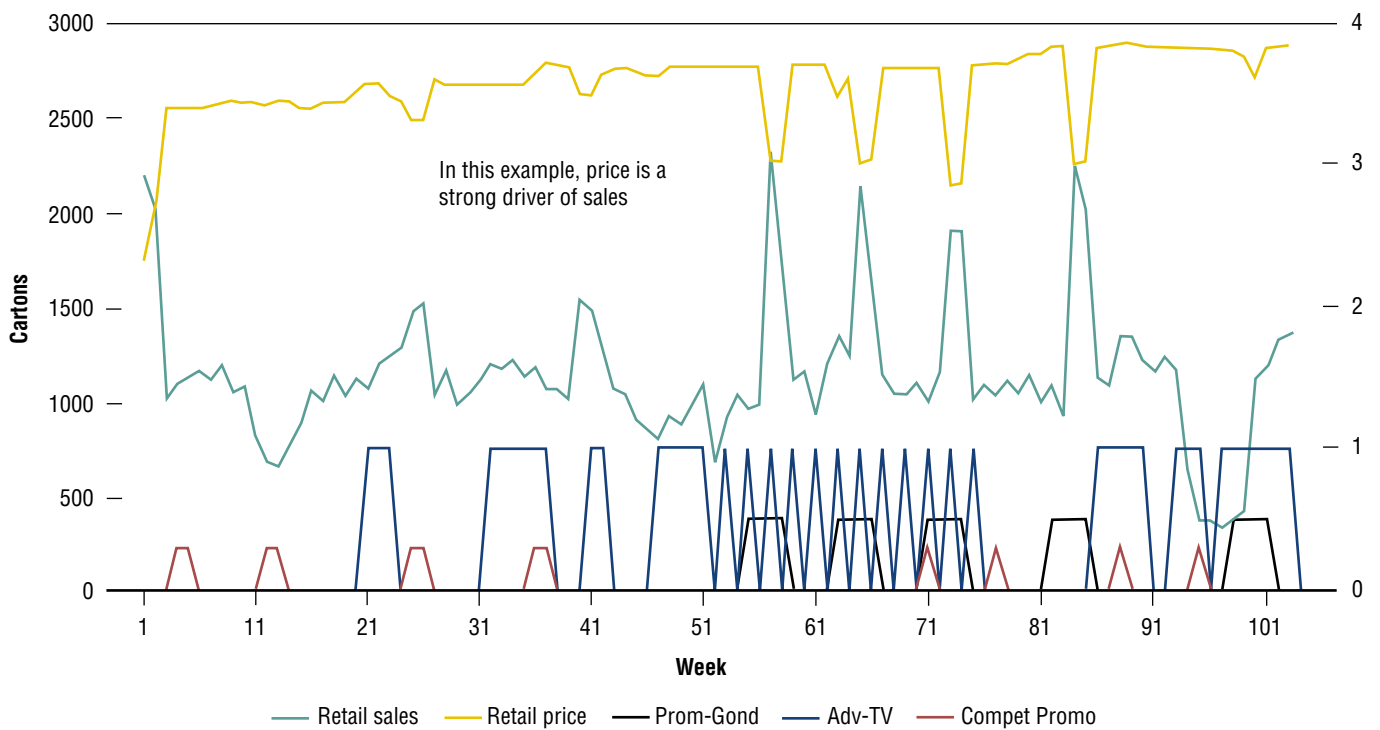
A thorough understanding of demand enables the most appropriate forecasting techniques to be selected and determines what additional data should be added to the forecast on an ongoing basis. It also provides a basis for identifying non-repeating events in historical demand data so that forecast models can be appropriately adjusted.

Historical demand data usually contains one or more of the components of demand illustrated in Figure 3.4. Which of these relationships exist can be determined by graphing historical demand data and applying seasonal decomposition techniques. These relationships can be projected into future periods using time series techniques.



**Figure 3.4:** Components of demand

The demand for many products may be actively managed through marketing variables like promotions, advertising and discounting. Where markets are sensitive to these variables, they can become the dominant drivers of demand and may obscure the time series components (see Figure 3.5). For these products, forecast quality can often be improved by including historical data about marketing variables in forecast models. The strength of relationships between marketing variables and historical demand can be assessed by applying multiple regression techniques.



**Figure 3.5:** Illustrative demand drivers

An understanding of the importance of demand drivers determines which data should be collected on an ongoing basis to support the forecast cycle. For example, a proper analysis of potential promotional drivers may reveal which types of promotions strongly affect forecasts and which are peripheral, thus allowing the collection of promotional data to be focused on relevant promotional types.

Marketing variables that can be influenced by an organisation and its trading partners are only part of the overall demand environment. External factors such as competitor actions, the level of consumer confidence, public holidays and changes in regulation can all influence demand. It is important that a forecasting process include steps to identify non-repeating events and changes in repetitive external forecast factors (eg, the entrance of a major new competitor into the market) that affect demand so that forecast models and forecasts can be adjusted appropriately.

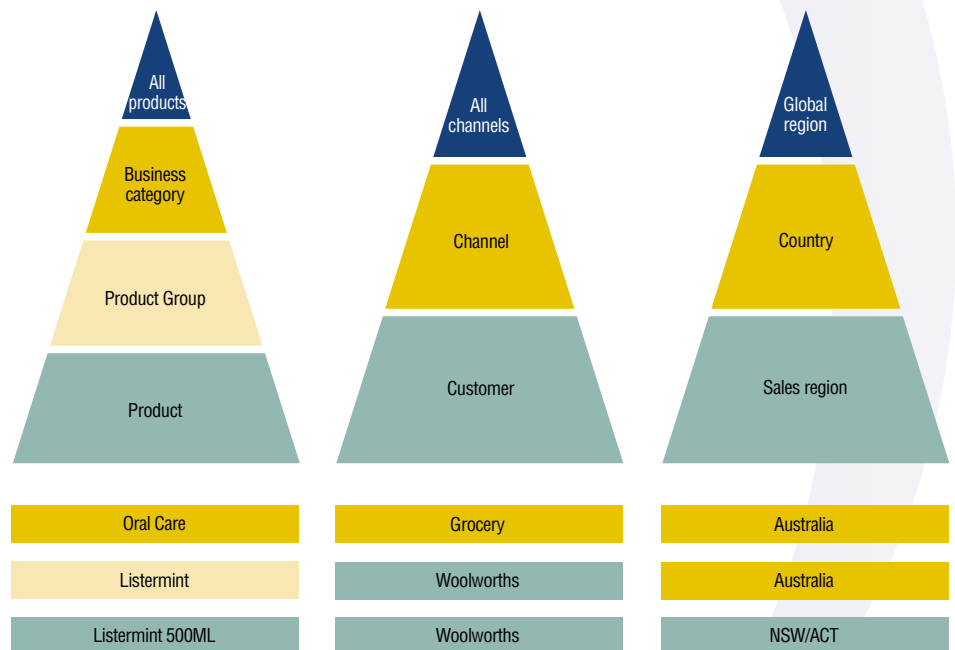


The data that is forecasted will depend upon the nature of the supply chain and management requirements

## Demand forecasting units (DFUs)

The data that are actually being forecasted are usually called demand forecasting units (DFUs) and can include a combination of product, customer and location elements.

Forecasting hierarchies can be structured around these elements as is illustrated in Figure 3.6. The depth and content of the DFU hierarchy will vary depending on the nature of the supply chain and management requirements.



**Figure 3.6:** Illustrative DFU hierarchy

The correct level at which to model is determined based on the replenishment process and the nature of the data available at each level. For example, Warner Lambert may produce statistical forecasts of demand for a product across an entire channel in a country and add market intelligence on a customer by customer basis within a sales region, as illustrated in Figure 3.6.

Forecasting accuracy normally increases at higher levels of aggregation (ie, the forecast produced for sales across all customers in a whole region will normally be more accurate than the forecast produced for a particular customer and store). In cases where lower level forecasts are required but historical demand data is sporadic and unsuitable for modeling, it is often useful to create an additional forecast at a higher level of aggregation and reconcile the forecasts produced at both levels.

It should be noted, reporting requirements are not the same as forecasting requirements. For example, Warner Lambert can report the forecast for all Oral Care products sold in the Grocery channel in Australia by aggregating detailed DFUs — there is no need to build a separate forecast model at this level.

## Forecasting methods

The appropriate forecasting method should be selected after considering the nature of demand, forecast horizon and data available

Forecasting methods are either qualitative or quantitative.

Qualitative methods are based on expert judgement. Quantitative methods are either time series methods, which project patterns from past series of data, or causal methods, which project relationships between variables. The choice of the appropriate method depends on the nature of the demand, the forecast horizon, and the data available as indicated in the table below.

	Time Series	Causal	Judgemental
Nature of demand	Good for products that: <ul style="list-style-type: none"> <li>• are seasonal</li> </ul> Poor for products that: <ul style="list-style-type: none"> <li>• have long lead times</li> <li>• are promotion driven</li> <li>• are competitor influenced</li> </ul> Fair for products that: <ul style="list-style-type: none"> <li>• new products</li> <li>• have low or sporadic sales</li> </ul>	Good for products that: <ul style="list-style-type: none"> <li>• are seasonal</li> <li>• have long lead times</li> <li>• are promotion driven</li> <li>• are competitor influenced</li> </ul> Fair for products that: <ul style="list-style-type: none"> <li>• have low or sporadic sales</li> <li>• are new products</li> </ul>	Good for products that: <ul style="list-style-type: none"> <li>• are inherently seasonal</li> <li>• are competitor influenced</li> <li>• are new products</li> </ul> Fair for products that: <ul style="list-style-type: none"> <li>• have long lead times</li> <li>• are promotion driven</li> <li>• have low or sporadic sales</li> </ul>
Forecast horizon	Good for short-term horizons Poor for long-term horizons	Good for long and short-term provided causal variables can be accurately forecasted	Fair in both short and long-term provided expert opinion is obtained
Data	Some techniques require up to 3 years of history	Generally better than time series in dealing with short data histories	Often used when data histories are short or "dirty"

Specific quantitative algorithms should be selected to achieve a balance between the simplicity of the model and how well it fits historical demand (as measured by statistical measures such as R squared). The best forecasting processes usually combine time series, causal and judgmental methods where appropriate.

System and skill requirements vary depending on the forecasting method being used as indicated in the following table.

Method	Systems	Skills
Time Series	Inexpensive and easy to systematise	Less statistical skills
Causal	More expensive and more difficult to systematise	More statistical skills
Judgemental	Inexpensive and more difficult to systematise	Expert product and market knowledge

Developing the right organisational capability and enabling systems are discussed later in more detail in chapters 4 and 5.

Well designed forecasting processes are based on clearly defined business and decision rules

## Business and decision rules

The process defines how demand forecasts are produced and communicated. Business rules set the criteria for each process step including the sequence of the steps and the frequency with which they must occur, how work should be prioritised within each step and who is responsible for completing the step. Decision rules are the policies or guidelines that assist participants in the process in effectively making the key decisions that are required through the course of executing the process.

Business rules should be considered across all time horizons. For example, business rules around process maintenance may dictate activities to be completed quarterly, while business rules around sales and operations planning may require activities to be completed monthly.

Decision rules should be considered for all key repeated decisions. For example, decisions regarding the appropriate forecasting method may require an analysis of demand volatility and economic value to be completed as noted earlier in this guide. The specific definition of demand volatility and economic value will vary depending on criteria set by the customer or supplier.

Specifying a set of key performance indicators (KPIs) to monitor demand forecasting helps to ensure that the process will improve over time

## Performance measures

Forecasts are produced in order to coordinate operations, so measures addressing cost (eg, cost per unit manufactured, cost per unit shipped) revenue (eg, stock availability, deliveries in full on time) and asset productivity (eg, inventory turns, vehicle utilisation) should be included in a KPI system.

Measures that address the objectives of the forecasting and replenishment processes should be supplemented by measures that address the performance of the forecasting process itself. These include forecast accuracy and process adherence KPIs.

The choice of the appropriate forecast accuracy KPIs depends on several factors.

- **The supply lead times associated with forecast decisions** — the decisions which operational forecasts support depend on cumulative lead times. Best practice is to measure performance of the forecast lag that matches the critical lead time decisions.
- **The desired level of detail** — forecast accuracy should be reported at the level of detail that actually drives the supply chain decision that is being evaluated. For example, if the impact of forecast accuracy on safety stock levels is being evaluated, then forecast accuracy should be measured at the distribution centre level. To report the forecast accuracy at a national level would give a misleading picture of the risks to be covered by safety stock in the DCs.
- **The purpose of the forecast error measure** — different forecast accuracy measures are appropriate for different purposes. For example, a mean squared error measurement may be appropriate for setting safety stocks, but not for reporting accuracy to management.

- **Simplicity and understandability** — forecast accuracy measures that are reported to management should be simple to calculate and understand. Two measures for reporting operational forecast accuracy are recommended. First, the **weighted absolute percentage error** should be calculated because it gives an indication of the period-by-period volatility of the forecast. Secondly, the **cumulative accuracy** of the forecast over the evaluation period should be reported because it gives an indicator of the cumulative performance over the entire time period being evaluated. (See Appendix D for a discussion of how these measures should be calculated.)

KPI measures should be mutually agreed between collaborating departments and companies. We discuss this further in the remaining chapters.





# 4

## Developing the organisational capability

Since forecasting processes require collaboration across functions and organisations, all roles and responsibilities must be clear and agreed

## Roles and responsibilities

The roles and responsibilities for every step in the business process design should be clear and agreed. Since forecasting processes require collaboration across functions and organisations it is necessary to distinguish the level of responsibility of each participant for each step in the process.

There should be a single point of accountability for each process step. Where a process step spans organisational boundaries primary responsibility can be assigned to one role in each organisation. "Primary responsibility" includes ensuring that the step occurs, that the required people participate and that the outputs meet quality standards. The roles responsible for executing the process should also be formally identified. Those participants who are required to provide input into the process but do not directly execute tasks should be assigned consultative roles. For example, if adding market intelligence to the forecast requires consultation with sales account managers that fact should be documented and agreed in a roles and responsibilities matrix (an example is given in Figure 4.1).

Processes	Responsibilities				
	Demand manager	Demand forecaster	Sales manager	Retail buyer	etc
<b>Monthly</b>					
<b>Weekly</b>					
Update data					
Generate forecast					
Add additional information					
Review the forecast with trading partners		P		P	
Review the forecast with sales and marketing		P	X		
Adjust causal factors (eg, promotional plans) if required		X	P		
Make direct judgement adjustments if required			P		
Agree the forecast (forecast review meeting)	P	C	C	P	
Use the forecast					
Evaluate performance					
<b>Legend</b> P= primary responsibility X= executes the work C= must be consulted					

Figure 4.1: Roles and responsibilities should be clear

The typical roles that are necessary in a demand forecasting process include:

- **Demand Manager** — responsible for managing the forecasting function and ensuring that the forecasting process meets business objectives
- **Demand Forecaster (or Analyst)** — responsible for analysing demand, preparing forecasting techniques, generating forecasts and coordinating the inputs from other participants
- **Marketing (or Category) Manager** — responsible for ensuring that marketing related market intelligence is incorporated into the forecast
- **Sales (or Account) Manager** — responsible for ensuring that sales related market intelligence is incorporated into the forecast
- **Operations (or Supply Chain) Manager or “Rebuyer”** — responsible for accepting the forecast and using it to drive operations activities (eg, distribution, production and procurement)
- **IT support** — responsible for ensuring that the technical steps in the process are executed without error and that the infrastructure supporting the forecasting process operates as required
- **Customer Service Representative (ie, order entry)** — responsible for ensuring that order details fairly reflect customer demand

These roles may have different names in different organisations. In collaborative forecasting processes the roles may be duplicated on the supplier and customer side. For example, retail category managers may do similar tasks as the supplier’s marketing and sales managers.

## Structure

The demand planning team should have sufficient status and authority to work across functional areas

The importance of the forecasting process usually warrants the establishment of a dedicated team and the appointment of one or more demand forecasters. Roles should be combined into jobs after considering workload, skill levels and budget objectives. Job descriptions should provide a basis for formally assigning tasks to individuals.

It is more important that the demand planning team have sufficient status and authority to operate across functions other than the particular function to which they report. Typically, organisations that choose to structure the demand planning team as part of the sales or marketing function, do so to maximise the market knowledge of the forecaster. Organisations that choose to have the demand planning team report to the operations function, do so to maximise the integration of the forecast into supply chain planning activities. In either scenario, the demand forecasting staff must have an understanding of both demand and supply management activities and requirements. They are the integrating link between demand and supply management.

To ensure that the demand planning team does have sufficient status and authority, the demand manager often leads the sales and operations planning cycle and has the same status as the leaders of the production, procurement and sales functions.



Demand forecasters should have a combination of analytical and communications skills and thorough market knowledge

Forecasting KPIs should be included in the formal performance evaluation of staff who participate in the forecasting process

**Carter Holt Harvey Tissue** sets targets for “on time in full” (OTIF) and forecast accuracy at the macro business planning stage. From the total business scorecard, team and individual scorecards are developed incorporating the key measures each team can influence. The balanced scorecard for members of the Demand Planning Team include forecast accuracy as a primary measure and for the National Sales Managers, it is a secondary measure.

The KPIs are weighted to remuneration packages to reflect the priority of the measure.

## Skills

Demand forecasters should possess a combination of analytical and communications skills. Ideally they should have an understanding of statistical techniques gained through tertiary education, but do not necessarily have to be experts in statistics (ie, a PhD in statistics is not a prerequisite for operational forecasting). A strong marketing orientation or knowledge of their market is required, preferably through prior experience. The ability to seek out and integrate input from participants in a variety of departments, as well as to participate in collaborative processes across organisations, is critical.

Training and development plans should be put into place to enable demand forecasters to develop the necessary skill sets. It is also important that the sales and marketing personnel who input market intelligence into the forecast and the operations personnel who use the forecast understand the forecasting process. Training for new starters in these areas should therefore cover the demand forecasting process.

## Incentives

Forecasting measures should be included in the formal performance evaluation criteria of personnel who participate in the forecasting process. For example, forecast accuracy should be a performance measure for marketing managers, sales managers and demand forecasters.

To reduce the risk of dysfunctional behaviour, good performance management systems include a balanced set of performance measures. The weighting given to forecasting KPIs should depend on the level of influence the particular role has over forecast performance. Target levels of forecast accuracy should differ based on the inherent volatility of the demand for the product. It is also important to weight the measures to match the economic importance of the forecast.

How performance measurements should be linked to reward is a matter to be considered by each company individually. An example of the successful use of incentives within a company is given in the Sanitarium case study where forecast performance measures are part of the formal evaluation criteria for account managers (see Appendix A). An example of the successful use of incentives between companies in external collaborative relationships is given in the case study where Procter & Gamble and Franklins have linked discount levels to compliance with forecasting and replenishment policies (see Appendix B).



**5**

**Acquiring the right information  
technology**

Information technology  
plays a key role in  
enabling demand  
forecasting processes

## The role of information technology

By providing support for demand forecasting and demand communication activities, information technology plays a key role in enabling demand forecasting processes.

Operational forecasting often requires the application of complex mathematical techniques across a large number of products. Information technology is ideal for automating these tasks and enabling a level of sophistication that would not be available with manual means. Examples, ranging in functionality from simple statistical methods to advanced causal methods include:

- spreadsheets
- general statistical packages
- specialist forecasting packages
- enterprise resource planning packages (ERP)
- advanced planning and scheduling packages (APS).

In Appendix E, we discuss the different technology choices in more detail and provide an illustrative list of vendors.

Demand communication technology enables the forecast to be integrated into the processes and systems which use the forecast and enables multiple parties to collaborate in the production of the forecast. Examples include:

- paper
- phone
- fax
- local area network (LAN)
- intranet
- wide area network (WAN) and value-added networks (VAN)
- internet.

The technology choices within each of these areas are outside the scope of this guide.

## Data integrity

Apart from processing and communicating data, the maintenance and quality of data are issues for a demand forecasting system. Demand forecasting processes draw data from a number of information systems and processes. The potential inputs and their sources include:

- **historical demand (sales and/or orders)** — from sales and order transaction processing systems, customer databases and trading partners systems (point of sale data)

Forecasting processes  
are vulnerable to the  
“garbage-in-garbage-out”  
principle

- **historical demand drivers (price, promotions, etc)** — from marketing and sales databases, value-added service providers and customer databases
- **forecasts of future demand drivers** — from value-added service providers, government statistical bodies, industry bodies and marketing
- **market intelligence** — from value-added service providers and the marketing and sales functions.

Forecasting processes are vulnerable to the “garbage-in-garbage-out” principle — if the input data is unreliable then the forecasts are likely to be unreliable too. It is therefore important to consider the reliability of each potential data stream.

## Historical demand

A common issue associated with historical demand data is whether sales or order information should be used. Both orders and sales can differ from true customer demand in certain circumstances.

Unless customer requests are captured in the ordering system before inventory availability is checked, orders may not reflect the full demand picture for items that have low stock levels or are out-of-stock. Some products may have been purchased because a preferred item was not in stock. This problem of unrecorded demand and imperfect knowledge of preferences is worse in a retail environment where orders are not used, such as a retail store. Orders may also represent an unreliable demand picture if customers do not accept backorders when an item is out-of-stock — orders may be placed repeatedly on consecutive days thus overstating the demand for the out-of-stock item.

Shipments also do not represent true demand when an item is out-of-stock. Sales of substitute items may be artificially increased during these periods. Because of these factors, the preferred definition of historical demand will differ from company to company.

Cancelled orders or sales invoices may be difficult to interpret after the fact if appropriate cancellation codes are not captured in the transaction system. For example, an order cancelled because an item is out-of-stock should still be treated as demand, while an order cancelled because of input error should not.

All of these factors may create a need to ‘cleanse’ historical data (ie, adjust it so that it more closely reflects a true picture of historical demand). This is most often done when setting up the forecasting process and on an ongoing exception-driven basis when forecast models are generated.

## Historical demand drivers

Historical promotional data may not have been subject to the same level of data integrity controls that are applicable to financial information such as historical sales. These issues will need to be addressed if the data is to be useful for forecasting.

The management of data is an often overlooked element in business. Data integrity is a key business issue. We may have the best forecasting systems with full trading partner collaboration, but if the numbers being used by the systems are garbage, the end result will also be garbage.

*Daniel Kochanowicz*

*National ECR Development Manager*

*Woolworths Supermarkets*

## Forecast of future demand drivers

Even though there may appear to be relationships between demand and variables such as promotional activity, knowledge of the relationship is only useful for forecasting if the data is consistently available in line with required timeframes in an accessible format.

## Market intelligence

The completeness of market intelligence is difficult to ensure. Sales and marketing personnel should be encouraged, through an incentive scheme, to contribute knowledge to the forecast; for example, by including forecast performance KPIs in their performance appraisal criteria.

## Data standards

Data integrity can be  
compromised by  
incompatible  
data standards

Data integrity can be compromised by incompatible data standards. For example, collaborative forecasting requires a number of data issues to be jointly addressed by the supplier and customer:

- product codes should comply to EAN standards
- category structures should be consistent
- time periods should be consistently defined (eg, weeks should begin and end on consistent days)
- units of measure should be consistent.

## Evaluating technology options

A systematic approach to  
evaluating technology  
options is suggested

The range of technology options confronting the manager can be confusing. The top ten questions to consider are:

1. What are your business requirements?
  - best practice is to consider business requirements before making technology choices
  - consider the nature of the desired business processes
  - consider which technology best suits your organisation.
2. Having regard to the benefits, what investment can be justified?
  - consider the total cost of investment, including the costs of acquiring software and hardware, ongoing licence fees and support
  - consider implementation consulting support
  - consider benefits over the same period.

3. Is the proposed solution consistent with the IT strategy?
  - ensure that the solution runs on the technology platforms supported by your IT function.
4. Is suitable packaged software available?
  - the cost of developing sophisticated demand forecasting functionality may make this option unattractive to many companies
  - configurable packaged applications are available that address most of the needs of a typical grocery company.
5. Does the package provide strong exception management facilities?
  - forecasting systems typically need to manipulate large volumes of data. To maximise the benefits of automation it should be possible to automatically direct user attention to exceptional conditions.
6. Does the package provide the flexibility for future growth?
  - does the package provide enough functionality to enable your business processes to continue to improve over time?
  - does the vendor have the vision to continue to improve the package?
7. How easily can the package be integrated to your existing systems and to the systems of your trading partners?
  - determine how frequently data needs to be updated
  - can data be updated via batch processes and interactively?
  - check references; inquire where the system has been successfully integrated.
8. Is the package easy to learn and use?
  - ask the vendor to demonstrate the solution.
9. Does the vendor offer responsive support?
  - is local support available
  - check references.
10. Is the vendor financially viable?
  - does the vendor have the financial strength to continue to develop the product at least as long as the period over which you intend using the forecasting package?





**6**

**Building collaborative partnerships**



There are a number of variants of collaborative relationships, all with the same objective

## Collaboration

The ultimate objective of building collaborative partnerships is to collaboratively produce one forecast of consumer demand and then to drive all supply chain activities from that forecast.

There are a number of opportunities for customers and suppliers to collaborate in forecasting. The nature of the collaboration varies according to the focus of the demand forecast, the data shared and who generates orders.

Focus of forecast	Data shared	Who generates order?
Consumer sales	POS purchases, store inventory, promotional plans	Supplier or Retailer
Warehouse withdrawals	Shipments, inventory, promotional plans	Supplier or Retailer
Retail orders	Syndicated POS purchases	Retailer

In a fully collaborative process, the supplier and retailer jointly prepare a business plan for the category and products. They then jointly forecast consumer demand in line with the business plan. The future retail orders on the supplier are calculated using the agreed consumer demand forecast, agreed planning rules (governing inventory policy, replenishment frequency and service levels) and total retailer inventory position. Either the supplier or the retailer may generate the retail orders, but this is a formality since retail orders match the frozen period in the projected order schedule.

Collaborative processes do not necessarily have to focus on consumer demand at retail stores. The supplier and retailer may collaborate to extend the focus of the forecast from retail orders to retailer warehouse withdrawals and use this as a basis for calculating future retail orders. If the supplier initiates the generation of the retail orders, this relationship is known as vendor managed inventory.

At its simplest, collaboration may involve a sharing of consumer-related data and supply chain data (such as inventory position) between retailers and suppliers with minimal joint forecasting or planning activities.

## The benefits of collaboration

Collaborative forecasting involves suppliers and customers joining forces to better understand, stimulate and fulfil consumer demand.

A greater understanding of consumer demand is the result of the combination of the market research that suppliers invest in their products and the closeness of retailers to consumer demand and consumer trends. An improved ability to stimulate demand comes from coordinated promotional programs and a better understanding of what actually drives consumer behaviour. Collaborative efforts to fulfil demand are enhanced by the shared forward visibility of anticipated requirements and earlier communication of exceptions.

Collaborative forecasting enables inventory buffers and operating costs to be reduced while improving customer service

These common sense advantages enable inventory buffers and operating costs to be reduced while also improving customer service. The net effect is a “win-win” outcome where both parties benefit from a leaner, more responsive supply chain. The Procter & Gamble and Franklins case study illustrates the benefits that are actually being achieved from a collaborative relationship in Australia.

## How collaboration can affect business processes

Collaborative forecasting extends the forecasting business process beyond the walls of the organisation and thus requires changes in each step of the process

Collaborative forecasting extends the forecasting business process beyond the walls of the organisation. Planning moves from a market to a customer-specific focus. As a result, some changes are required in the demand forecasting process.

The objectives of both collaborating parties should be documented in a front-end agreement which should cover the business benefits to be achieved, the metrics for determining the performance of the process, roles and responsibilities and exception criteria. The products which will be subject to collaboration should also be clearly identified.

Consumer sales forecasts should be generated based on an objective quantified understanding of consumer demand. The approach for selecting forecasting methods should be agreed by both parties. Both parties should drive their supply chain activities from one forecast of consumer demand.

Customer POS purchases and supplier market research should be shared to facilitate a deeper understanding of consumer demand. Promotional lift profiles should be calculated and a joint event plan should be developed.

Historical consumer demand and real time inventory should be shared to ensure that service objectives can be met and the parties remain responsive to consumer demand.

Both customer and supplier should maintain accurate demand driver information, such as the joint event plan. It is also important that a joint business plan for the category be developed early to link the marketing and sales planning processes at the supplier with the merchandise and promotional planning processes at the customer.

A formal process should be agreed for signing off the forecast. Customer orders should then be calculated from the consumer demand forecast using agreed planning rules and retail inventory data. The output is a time-phased, “netted” order forecast. There should be an agreed “frozen period” during which forecast customer orders are automatically converted to actual orders.

Forecast performance measures should be included as a performance indicator for retailer staff as well as supplier staff. Process adherence measures are also important given that both parties may have different processing deadlines.

A complete mind shift is required away from adversarial relationships towards cooperative relationships

## How collaboration can affect organisations

Perhaps the greatest impact of collaborative forecasting is the change required to corporate culture. A complete mind shift is required away from adversarial “win-lose” relationships towards cooperative “win-win” relationships. Both parties need a complete commitment to focusing on the long-term benefits of developing a lean, responsive supply chain and to resisting the temptation to take disruptive action based on short-term considerations.

Strong executive sponsorship is required on both sides. A high degree of integrity is required of team members, since both trading partners may be exposed to confidential or sensitive information.

Roles and responsibilities need to be agreed for each of the business process steps. Ideally there should be no duplication of work. For example, there should be no need for both sides to build and maintain forecast models when they can collaboratively use the same models.

Collaborative relationships encourage a process-oriented rather than functionally-oriented organisational structure.

Implementing collaborative forecasting processes does not usually require extensive investments in new information technology

## How collaboration can affect technology

Existing information technology capabilities in forecasting and replenishment planning can usually be adapted to accommodate collaborative processes. Companies do, however, need to invest in the capability to communicate data using agreed industry standards and public networks such as the Internet.

Data protocols need to be carefully considered and agreed by both parties, including issues such as product codes, category structures, cut-off periods for calendars and common definitions of start and stop periods for weeks. Scheduled IT operations such as batch procedures and period-end processing also need to be carefully aligned, and business continuity programs need to cover both parties' sites.

Some of the business process steps may best be performed by the party with the best information technology available. For example, if the retailer has an advanced forecasting system that can produce forecasts based on causal data, the parties may agree that the retailer will produce the forecast. However, it will still be necessary to communicate the forecast to the supplier so that additional information can be added and agreement can be reached.

## The principles of successful collaboration

There are four principles of collaboration:

- compatibility
- commitment
- capability
- control

Successful collaborative relationships are formed between parties that have mastered the principles of collaboration, the 4Cs, which are set out below and described in Figure 6.1.

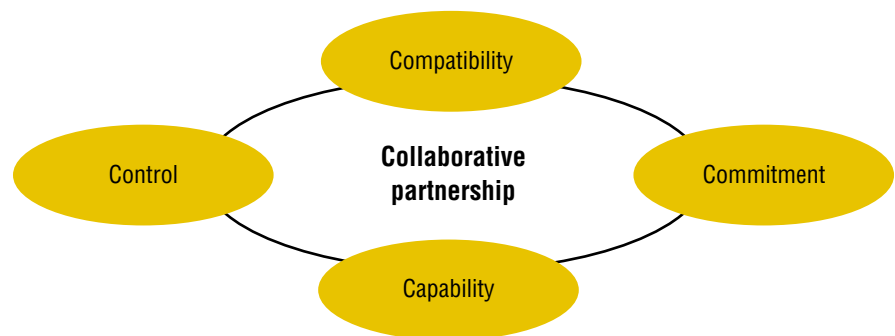


Figure 6.1: The 4Cs of collaboration

**Compatibility** — trading partners should have similar goals and desires and be mutually important to the relationship. Compatibility is enhanced if corporate cultures can be aligned, integrated business processes can be developed and common data standards are adopted.

**Commitment** — trading partners must want to collaborate for the common good, with clear sponsorship at the most senior levels within each organisation. It may be necessary to stop practices that distort demand and conflict with collaboration objectives. For example, the practices of pushing product into the trade in order to meet short-term budget requirements and unplanned investment buying may no longer be acceptable.

**Capability** — trading partners must be capable of sharing information and the information must be usable and accurate. Many collaborative initiatives have started out with a pilot site or selection of products so that each party can develop their capabilities at minimum risk.

**Control** — trading partners must have agreed the mechanism and policies for collaboration, including the thresholds for identifying exceptions, and how the information will be used. Each partner should commit to creating an environment of trust in which competitively sensitive information can be shared in confidence. Performance metrics should be agreed early and frequently reviewed.

## Initiating collaborative relationships

Organisations can take the first steps towards building collaborative partnerships by encouraging open relationships and sharing data such as promotional plans and advertising schedules with trading partners. More ambitious advances may require a more formal approach to change. How to initiate and manage this process is the subject of the next chapter.





# 7

## Getting started

To determine your objectives, consider your current position relative to your desired position within the framework for demand forecasting

## How to get started

Improving forecast performance requires a planned approach to change. The stages of the initiative should include:

- Determine your objectives
- Plan the change
- Organise for the change
- Manage the change.

## Determine your objectives

Determining your objectives involves answering the following questions:

- What is the nature of demand?
- How well is the forecasting process currently performing?
- How well should it be performing?
- How can it be improved?

The framework for demand forecasting outlined in chapter 2 should provide a basis for determining your improvement targets. For example, a company with a skilled demand forecasting team and sound S&OP process may decide to pursue advanced planning and scheduling tools and collaborative relationships with customers as a means for improving forecast performance. A full maturity matrix that is useful for goal setting is included in Appendix C.

A business case for change should be developed by estimating the impact on ROI if forecasting performance can be improved.

Objectives should be documented in a project charter. The charter should include:

- **the supply chain vision** — how supply chain participants should collaborate to stimulate and fulfil consumer demand
- **the scope of the project** — how this project will contribute towards realising the supply chain vision and the people and systems that will be affected (in the supplier and customer organisations)
- **the objectives of the project** — why the project is necessary and how its success will be measured (eg, target levels may be set for metrics such as forecast accuracy, inventory turns and stock availability); how benefits will be shared between partnering organisations

- **the approach** — what the project activities will be and the key milestones that will be used to monitor progress
- **the roles and responsibilities** — who will be responsible for sponsoring the project; the resources that will be committed to the project and their responsibilities; how the issues such as confidentiality of information will be addressed.

## Plan the change

Work backwards from  
the deliverables and  
milestones to identify  
the required tasks

Planning the change involves identifying:

- the deliverables
- the milestones for monitoring project progress
- risks and strategies for minimising them
- the tasks necessary to produce the deliverables
- the resources necessary to produce the deliverables
- responsibilities
- a feasible schedule.

It can be useful to group the tasks to be performed according to a work structure. For example, the stages of implementing improvements to demand forecasting processes may include:

- **Mobilisation** — including the determination of the vision and business case for the improvement
- **Design** — including the definition of the business requirements, the design of the new ways of working and the selection of appropriate enabling information systems
- **Prototype** — including the identification of appropriate forecast modelling techniques, the configuration of software and the testing of selected business scenarios
- **Pilot** — including the testing of the repetitive demand forecasting cycle and the ultimate acceptance by users
- **Roll-out** — including the final implementation of forecasts in the live environment
- **Mastery** — including the reinforcement of the new ways of working and the ongoing tracking of benefits realisation.



It is important that the project be properly sponsored and that a suitably senior member of management play an active role in resolving critical issues

## Organise for the change

Organising for the change requires developing a project structure, forming a project team and developing a communication plan and process to ensure that affected parties who are not members of the core team are kept up to date.

The project structure may include a steering committee, project managers, key advisors and project team members.

It is important that the project be properly sponsored and that a suitably senior member of management play an active role in the steering committee, which will be called on to resolve critical issues escalated by the project manager and to approve the progress of the project from phase to phase. In collaborative forecasting projects both the supplier and customer should provide senior representatives to the steering committee.

Sub-project teams are usually set up to enable team members to focus on process, application and technical tasks. Depending on how the project stages are scheduled there may be some overlap between the sub-teams; for example, the same team member may be responsible for process design and application configuration.

Key advisors can provide part-time assistance to the project, advising on matters such as demand driver analysis and change management.

## Manage the change

The last step is to manage the change with formal project management techniques monitoring, in particular, benefits realisation and implementation issues.



**Appendix A**  
**Case study: Sanitarium Health**  
**Foods Company**

## Background

Sanitarium is a well known health food company based in Australia and New Zealand. It produces approximately 450 SKUs in Australia and in excess of that in New Zealand. DFUs amount to over 6000. Within that range there are products with both stable and volatile demand, fast and slow-moving products, and heavily promoted products as well as those that are seldom promoted.

A couple of years ago forecasts on major SKUs were based on manual estimates made by account managers while forecasts on all other SKUs were based purely on extrapolations of historical sales, without separating baseline from event demand.

Order fill rates were unsatisfactory. Sanitarium's customers commented in the GISCC study that Sanitarium needed to enter into e-commerce in order to progress with them, and that it needed to demonstrate a capacity to respond to spikes in demand. Sanitarium knew that demand forecasting was the best place to start in taking a proactive approach to addressing these opportunities.

The new demand forecasting processes and system have resulted in major improvements in forecast accuracy — some products have moved from levels of around 50% to up to 99%.

## What has Sanitarium done to improve forecast accuracy?

### Process

Sanitarium has adapted and improved its demand forecasting process.

- **Stakeholders are committed** to the success of the process. Stakeholders include General Managers of both Sales and Operations. They are fully committed to the forecast and believe Sales should own it.
- **A demand driver analysis was performed** on a selection of products to identify the key drivers of demand for use in the forecasting algorithms. A number of drivers were considered for each SKU/account including seasonal pattern, standard trade price, retail price, bonus offer, advertising, special events, case-offs and in-store promotions. A subset of key drivers was identified and forecasts are now generated based on causal quantitative models.
- **Forecasts are done at the appropriate level** ie, by SKU by account. This is the way Supply Chain request it. It also makes the forecast for each DFU more accurate as the driver information may be different for each store or region.
- **Roles and responsibilities are clear** and KPIs which support the process are regularly monitored. Forecast accuracy is reported at monthly S&OP meetings in the form of forecast error and MAPE. Important process KPIs include ensuring data is entered on time, that the Promotion Management System (PMS) is up to date and that the forecast is produced on time.

- **Process cycle time is short** so tasks can be completed within the week and forecasts can be generated on a weekly basis.

## Systems

Sanitarium has implemented an Advanced Planning and Scheduling (APS) system which has helped to reduce the time it takes to collate data in order to analyse demand drivers by about 80%.

The system stores and can make use of 3 years worth of data from:

- the ERP system
- the Promotion Management System (PMS)
- point of sale data (ACNielsen)

The speed and visibility the system provides has enabled Sanitarium to analyse relevant data and incorporate it into forecasts on a weekly basis. Improvements have been made in analysing and incorporating the following:

- **promotional effectiveness** can be analysed easily and quickly by comparing data in the PMS, which can be broken down into type of promotion, case deal and retail price to actual sales from ACNielsen or internal sales figures. Promotional effectiveness can then be improved by adjusting future promotions accordingly.
- **consumer response to advertising** can be analysed and incorporated into future forecasts. Information is taken from advertising plans, past performance on similar campaigns and business plans. It is analysed and used to produce the next forecast, with impressive results.
- **the effect of non-repeating events** can be managed. Drops in sales can be related back to events such as media scares. A 'fill' can then be put in the data which means the past data still shows what actually happened, but the forecast is unaffected by the non-repeating event.
- **seasonal impacts** can be incorporated. Currently a percentage increase or decrease based on past performance and the experience of the Demand Manager can be incorporated into the forecast to reflect seasonality. The system does, however, have the facility to add seasonal 'flags' which will further improve the accuracy of the forecast in the season being predicted. Work is currently being done to take advantage of this facility.
- **consumer acceptance of new products/rebirths** is extremely difficult to predict. The system has made the process significantly quicker and easier, enabling Sanitarium to produce more accurate forecasts throughout the first and most difficult stages of the product's life cycle. Sales to forecast are monitored every week on new products and the forecast improved accordingly, taking into account up-to-date market intelligence.

## What are the critical success factors for forecast accuracy?

Internal collaboration and the ability to manipulate a forecast which is based on accurate data seem to be the key. Sharing information between Sales, Marketing and Demand Planning and allowing input from each of them has resulted in extremely high forecast accuracy.

This can be illustrated by comparing the forecast accuracy results for products with a high level of collaboration to those on which less focus is placed. For example, one of the best-selling products has had a forecast accuracy of up to 99% even though it has a volatile demand. For this product the Demand Manager has placed significant emphasis on collating input and collaborating with the Account and Marketing Managers. Information on promotions of this product is gathered and is clearly visible on the system. On the other hand, low-volume products where less collaboration and manipulation take place are associated with significantly lower forecast accuracy figures.

## How has Sanitarium tackled the problem of investment buying?

The process is not without its difficulties. In common with so many others in the industry, Sanitarium still has the problem of dealing with investment buying by trade customers. Steps to address this include a move towards retail scan-based promotions and the advanced negotiation of delivery profiles with retailers. This also helps to reduce the pressure on production to fulfil the 'spikes' in demand and reduces the extra inventory in the retailer warehouses. Sanitarium's Account Managers are not encouraged to push product into the trade because they are measured on forecast accuracy for their accounts.

## Conclusion

The increases in forecast accuracy have come about because of improvements in the process, the implementation of enabling technology and the attention paid to organisational issues. The forecasting process was adapted and improved, and KPIs and roles were aligned to support the process and ensure adherence to it. APS technology was implemented to drastically speed up the process, make it easier and improve visibility. The system's ability to allow manipulation of the forecast means the Demand Manager can easily and accurately incorporate important causal information and market intelligence on a product gained through collaboration with Sales and Marketing.

Sanitarium's demand forecasting solution enables reliable forecasts to be sent to production. This is an important factor in improving customer service through reducing out-of-stocks and reducing the amount of capital tied up in inventory. It has also helped to place Sanitarium on the road towards e-business by automating data transfer and beginning to ensure that order fulfilment processes will be ready to handle new sources of demand, for example over the Web.



**Appendix B**  
**Case study: Procter & Gamble**  
**and Franklins**

## Background

Procter & Gamble (P&G), a multinational fast-moving consumer goods manufacturer, entered into a co-managed inventory (CMI) relationship with Franklins, a major player in the retail sector in Australia. The benefits achieved by both parties were significant.

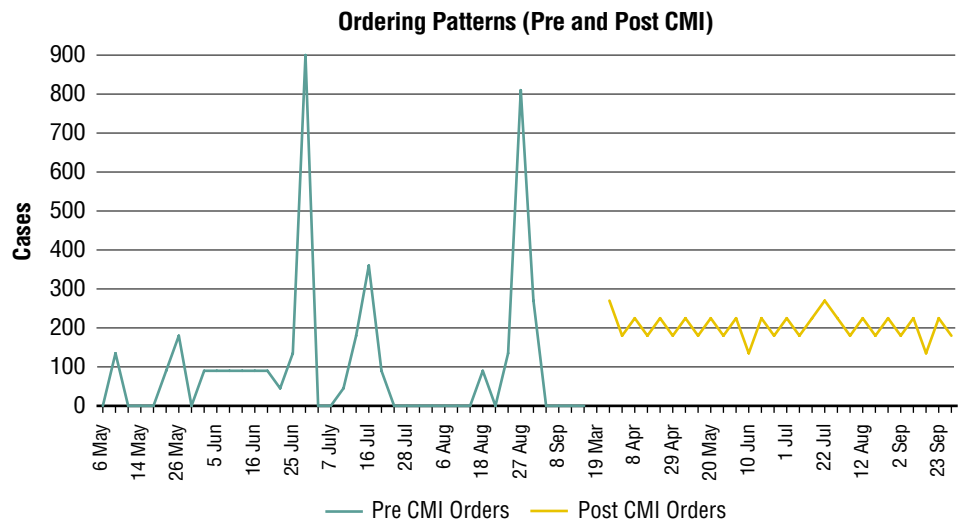
Analysis of Franklins' inventory and ordering patterns in 1997 revealed an opportunity to reduce inventory, improve cash flow and improve distribution centre (DC) service levels to stores. In September 1997, one of Franklins' DCs was holding 20 days of P&G inventory. The CMI pilot was started at this DC.

The CMI project began in March 1998 and used P&G software that optimises replenishment orders to maximise stock availability, while minimising inventory levels.

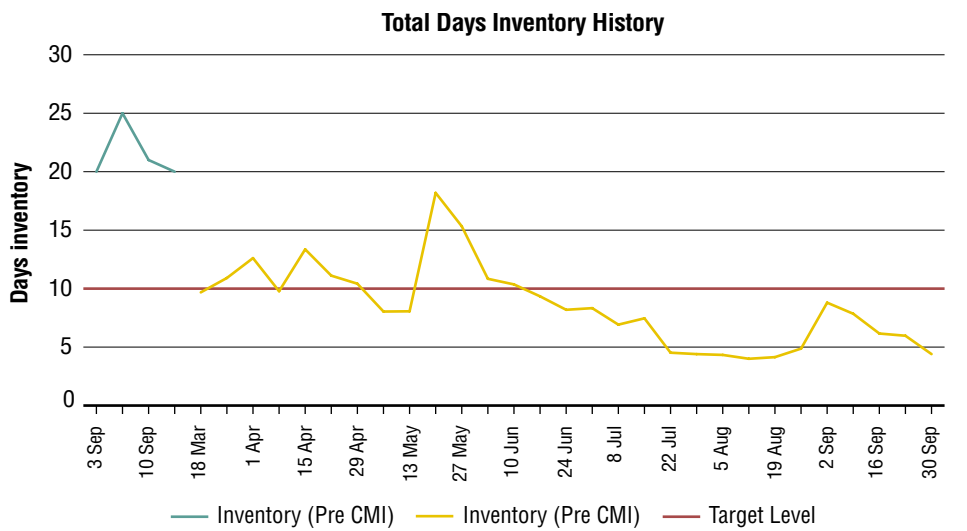
## What benefits were realised?

	Procter & Gamble	Franklins
<b>Cost</b>	Smoother more predictable demand, leading to more accurate production forecasting (record 99% forecast accuracy in May) and lower inventory levels. Reduced distribution costs, better transport utilisation and a significant reduction in investment buying.	Reduced inventory levels (from 20 down to 10 days). No order generation by Franklins' replenisher since start of CMI. More predictable and consistent flow of stock into DC.
<b>Quality</b>	100% order volume discount compliance, via order sizing capability of KARS software. Inventory and off-take data transmitted electronically to P&G.	Fresher stock on shelf. Improved stock availability from 93% to 98% at DC level (improved replenishment service level to stores). Reduced out-of-stocks at DC.
<b>Time</b>	More consistent demand reduces need for overtime at DC to deal with spikes in order processing workload.	No time lost on order generation. More consistent order size reduces need for overtime in receiving at the DC.
<b>Sales</b>	Increased sales due to increase in customer service level.	Increased sales due to increase in service level to stores, through reduced OOS at DC.

## Ordering patterns have been significantly smoothed

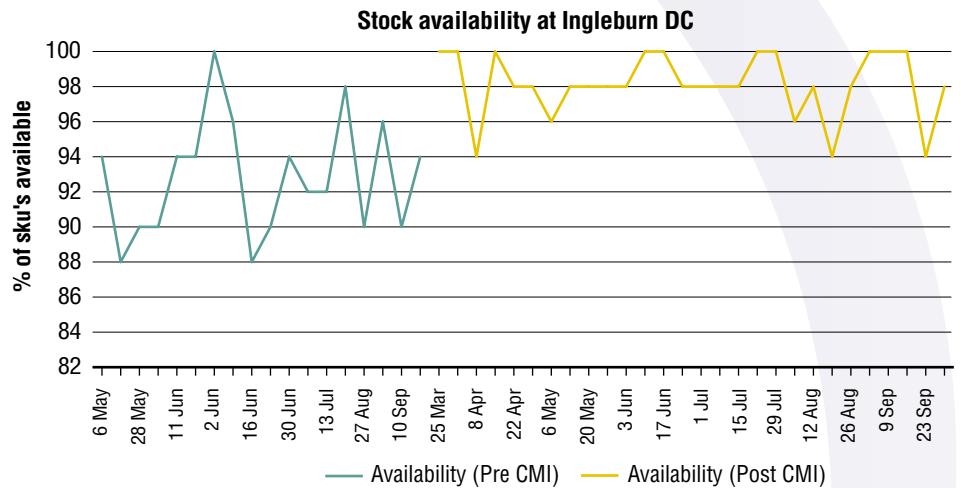


## Inventory levels have been more than halved





Stock availability was sometimes as low as 88% before CMI. It is now consistently around 98%



## Why was the CMI project successful?

P&G and Franklins believe that attention to the following critical factors contributed to the success of the CMI project:

- **Full backing was in place** from high level sponsors at both P&G and Franklins. The project was an important initiative in the overall ECR program of both companies.
- **A formal project establishment document** set out each party's objectives and a common definition of the project's scope. Performance measurement criteria were agreed and signed off by both companies up front. Review periods of 3 months, 6 months and 1 year were agreed and adhered to.
- **The project was aligned to a joint business plan** established between Franklins and P&G. An environment of trust was established and data was openly shared.
- **Sound project management principles** were applied. A common project methodology was agreed up front and closely followed throughout the project. A critical path schedule, with specified deadlines, was agreed and followed throughout. The project team was defined up front with specific roles and responsibilities allocated.
- **Processes were designed** before the information systems were designed. Process schedules were aligned and continuity was ensured by arranging back-ups for each team member in advance.

- **A common EDI capability** using the Internet was agreed and established. It was simple and fast to set up without the large cost associated with using a value-added network (VAN). Interfaces to legacy systems were viable and software was compatible.
- **The system is user friendly and requires little maintenance.** Simple standard operating procedures and an operating manual were drawn up and are in use making training easier to execute. Maintaining data integrity is not difficult.

## How were issues addressed?

Throughout the project a number of issues needed to be addressed:

### Promotion management

Accurately forecasting promotions is typically a difficult task. This was approached by analysing each promotion and building up a database containing scan sales and store issues for each type of promotion. This system allows the estimated impact of a promotion to be entered to the forecast in advance.

### Extracting relevant customer data

The CMI software required data on inventory levels and warehouse off-take. Franklins had this data available in aggregate, but it was difficult to separate and access the data solely relating to P&G products. This was initially addressed by manual intervention and later Franklins succeeded in automating the process.

### Internet speed and security

Initially there was a significant time lag in sending the data over the Internet due to the location of different gateways. This was an issue as the timely receiving of data was critical to the process. Information security was also a concern of both companies. Both issues were addressed when Franklins set up a separate secure mailbox for P&G which enabled P&G to access the data as soon as it was sent.

### Investment buying

The project raised the awareness of the importance of efficient promotional buying through quantifying the effects of investment buying. Both companies recognise the opportunity to further reduce this activity by addressing the performance measures of the retail buyers.

## How does this relate to ECR?

CMI requires a significant shift in mindset for the retailer. Although orders are calculated in accordance with a mutually agreed forecast, it involves passing over a certain amount of control over the ordering and replenishment process to the supplier. Franklins accepted this and approached it in a forward thinking manner. As a result they have reaped the benefits and are leading the adoption of CMI in Australia.

CMI has resulted in an excellent open and trustworthy relationship between Franklins and P&G. The project is in line with both companies' ECR strategies and there is open sharing of data and a resulting sharing of cost savings.

Smoothing out replenishment volumes on a weekly basis has allowed Franklins to consistently achieve order volume discounts. P&G based the discount on the principle of sharing supply chain savings that arise as a result of collaborative ECR initiatives.

## Conclusion

P&G and Franklins' experience has proved to them that doing CMI is not that difficult. The major hurdle is the required change in mindset for the retailer in allowing the supplier to have more control over ordering and replenishment. The system issues are relatively easy to overcome. The data that is required (ie, inventory and off-take) is normally obtainable from most retailers' existing systems.

The most critical success factors were that:

1. both parties were willing to participate and share critical information
2. sound project management principles were adopted and monitored throughout the project.

The CMI initiative has led to an open and trustworthy relationship (in keeping with ECR principles) between the two companies which has led to major business benefits: ie, reducing inventory yet increasing product availability and allowing the sharing of savings in cost.



## **Appendix C**

### **Forecast maturity framework**

<b>Lever</b>	<b>Area / step</b>	<b>Fundamental</b>	<b>Advanced</b>	<b>Collaborative</b>
Process	Supply chain management activities and time horizons	Forecasts are loosely integrated into marketing and sales planning as well as operational planning processes.	Forecasts are tightly integrated into marketing and sales planning as well as operational planning processes. High levels of consensus are obtained in the forecast review meeting as part of the Sales and Operations planning cycle. All departments work to the agreed forecast.	Both suppliers and customers are able to integrate collaboratively produced forecasts into their marketing and Sales and Operational planning processes.
Process	Supply chain management activities and time horizons	Forecast error is not formally utilised for inventory planning.	Forecast error is used for inventory planning and production planning.	Forecast error is used for production planning and inventory planning at both supplier and customer.
Process	Supply chain management activities and time horizons	The forecast process is not seen as a means of obtaining a better understanding of demand dynamics by marketing.	The forecasting and marketing processes are well aligned. Marketing can respond on a timely basis when forecast results differ from target levels. The forecasting process engenders a higher level of understanding of demand dynamics and this understanding is leveraged in marketing planning processes.	Marketing and category plans at both the supplier and customer; benefit from a quantitative understanding of demand drivers gained during the demand forecasting process.
Process	Demand and demand drivers	Trends in demand history are graphically and statistically reviewed.	Trends in demand history are graphically and statistically reviewed. Multiple regression analysis of the relationships between historical demand and historical marketing variables provides the basis for determining what marketing variables can usefully be incorporated into the forecast.	A common, quantitatively based, understanding about demand drivers provides the basis for sound demand communication practices between trading partners.
Process	Demand and demand drivers	Demand history is the only data on which forecasts are based.	Causal information is updated together with demand history.	Customer produced data (point of sale or warehouse withdrawals) is updated to the forecasting system together with demand history and causal data.
Process	Demand and demand drivers	Additional information is entered into the forecast as overrides. It is not possible to ascertain the reason for the adjustments. It is difficult to make adjustments at multiple levels in the forecast hierarchy.	Reason specific adjustments can be captured to the forecast. It is easy to make adjustments to multiple levels of the forecast hierarchy and reconcile the levels flexibly.	Both suppliers and customers add additional information to the forecast. The process encourages the building of consensus through the adjustment process.
Process	Demand forecasting units	Forecasts are produced at one level of aggregation. Forecasting at multiple levels in the forecasting hierarchy is difficult.	Forecasts are produced at multiple levels of aggregation as appropriate to drive sales and marketing decisions. Flexible forecasting hierarchies can be set up and forecasts produced at each level can be reconciled using top down or bottom up logic.	Forecasts are produced at multiple levels of aggregation as appropriate to drive sales and marketing, inventory, production and materials planning decisions at customers and suppliers. Flexible forecasting hierarchies can be set up and forecasts produced at each level can be reconciled using top down or bottom up logic.

<b>Lever</b>	<b>Area / step</b>	<b>Fundamental</b>	<b>Advanced</b>	<b>Collaborative</b>
Process	Forecasting methods	Forecasting methods include simple time series techniques such as moving averages or exponential smoothing.	Forecasting methods include the application of more complex time series algorithms and causal techniques.	Forecasting methods include the application of more complex time series algorithms and causal techniques.
Process	Forecasting methods	Forecasts regeneration requires a large amount of manual intervention.	Forecast regeneration is automated and users interact with the forecasts and models based on a prioritised, exception driven process.	Through an automated process, customer and suppliers generate one forecast or compare independently produced forecasts and resolve differences that fall outside of pre-agreed exception thresholds.
Process	Business and decision rules	The forecast process is uniform across all products.	The forecast process is differentiated based on the economic value of the product and demand volatility.	The forecast process is differentiated based on the economic value of the product to both the and supplier customer and the demand volatility.
Process	Business and decision rules	The process is exception driven.	The process is exception driven based on tailorable exception thresholds that are set after considering the economic importance of the product and nature of its demand.	The process is exception driven based on tailorable exception thresholds that are mutually agreed between customers and suppliers.
Process	Performance measures	Forecast accuracy KPIs are regularly monitored and appropriate action is taken to resolve exceptions.	Forecast accuracy KPIs are regularly monitored and appropriate action is taken to resolve exceptions. Forecast accuracy KPIs: are reported for the lag that matches critical lead time decisions; can be reported at varying levels of detail; include measures of cumulative accuracy and absolute period by period deviation (eg WAPE).	Forecast accuracy KPIs form part of a balanced set of KPIs that are formally agreed to by both supplier and customer and are monitored in accordance with the collaborative agreement.
People	Roles	The organisation has appointed a demand forecaster. The demand planning function has not however been given the status or authority to work effectively across functions within the company.	The organisation has appointed a demand forecaster. Finance, sales, marketing and logistics participate in the forecasting process.	Finance, sales, marketing and logistics representatives from both supplier and customer organisations participate in the process.
People	Responsibilities	The responsibilities of the demand planner have been formally documented. The responsibilities of other departments have not been formally documented and agreed.	The responsibilities of all cross functional participants in the demand planning process have been formally identified and agreed.	The responsibilities of cross functional participants at suppliers and customers for mutually agreeing a forecast have been formally identified and agreed. Backups have been identified for key ensure personnel to business continuity.

<b>Lever</b>	<b>Area / step</b>	<b>Fundamental</b>	<b>Advanced</b>	<b>Collaborative</b>
People	Structure	Forecasting is seen as a functional specialisation.	Forecasting is seen as a cross functional process.	Forecasting is seen as a cross-organisational process.
People	Skills	The demand planning team does not include participants with deep skills in product/market knowledge, marketing research, statistics, finance, logistics and information systems. Demand forecasters have skills in only one of these knowledge areas. Training or recruitment plans to build the necessary skills have not been implemented.	The demand planning team includes participants with deep skills in product/market knowledge, marketing research, statistics, finance, logistics and information systems. The demand forecasters have skills that cross more than one of these areas of knowledge. Training and recruitment plans are implemented to resolve skill gaps that are identified.	The collaborative demand planning team includes participants with advanced skills from both the supplier and customer side.
People	Incentives	Target levels have been set for KPIs. KPIs are reported and monitored but have not been formally included in the evaluation criteria for particular staff members.	Target levels for forecasting KPIs have been set and are formally included in the performance evaluation criteria of the participants in the demand planning process.	Target levels for forecasting KPIs have been set and are formally included in the performance evaluation criteria of the participants in the demand planning process, on both the customer and supplier side.
Technology	Tools	Forecasts are produced using spreadsheets.	Forecasts are produced using specialist forecasting applications.	Forecasts are produced using specialist forecasting applications that are tightly integrated into supply chain management systems of suppliers and customers.
Technology	Automation	A large amount of manual interaction is required in order to produce the statistical forecast.	The manual interaction that is required in order to produce the forecast is confined to the resolution of exception messages which are automatically generated and prioritised by the forecasting application.	The manual interaction that is required in order to produce the forecast is confined to the resolution of exception messages which are automatically generated and prioritised by the forecasting application. Exception messages are automatically communicated to the persons responsible for resolving them, whether they be suppliers or customers.
Technology	Granularity	Market intelligence can only be added by overriding the forecast.	Market intelligence can be added by entering specific marketing events and causal factors as well as forecast overrides. These adjustments can be separately tracked from period to period.	Market intelligence can be added by entering specific marketing events and causal factors as well as forecast overrides. Supplier and customer adjustments can be added and tracked separately.
Technology	Integration	Forecasts are not well integrated into supply chain planning and transaction systems. The forecast is updated to the supply chain systems manually or via a batch process.	Forecasts are well integrated into supply chain planning and transaction systems. The forecast is automatically integrated with the supply planning systems.	Forecasts are well integrated into supply chain planning and transaction systems of both the supplier and the customer. Both parties have open protocols to enable sharing of data.
Technology	Communication	Forecasts are communicated using paper reports.	Forecasts are communicated electronically.	Forecasts are communicated electronically. Both supplier and customer can access and manage the forecast in real time.

<b>Lever</b>	<b>Area / step</b>	<b>Fundamental</b>	<b>Advanced</b>	<b>Collaborative</b>
Technology	Data integrity	Control procedures are in place to ensure the reliability and consistency of historical demand data.	Control procedures are in place to ensure the reliability and consistency of historical demand and causal data. Order entry procedures capture customer demand accurately.	Supplier and customer data standards are compatible including use of standard codes, common period definitions and common cut-off procedures.
Technology	Continuity	Business continuity procedures are in place.	Business continuity procedures are in place and are regularly updated and tested.	Business continuity procedures are in place and are regularly updated and tested and cover supplier and customer systems and the way that they interact.
Technology	Ease of use	User instructions are up to date.	User instructions are up to date.	User instructions are up to date.
Partnerships	Commitment	There is little executive support for adopting collaborative trade relationships.	There is strong executive support for adopting collaborative trade relationships.	There is strong executive support for progressing collaborative trade relationships in both the supplier and customer organisations.
Partnerships	Capability	There is little awareness of collaborative processes.	There is widespread understanding of the details and are being rolled out.	Pilot collaborative forecasting initiatives are in place and benefits of collaborative forecasting processes.
Partnerships	Compatibility	Industry coding standards (such as EAN) are not fully implemented.	Industry coding standards (such as EAN) are fully implemented.	Industry coding standards (such as EAN) are fully implemented. Category structures are major aligned with trading partners.
Partnerships	Control	NA	NA	Data security issues are addressed. An environment of trust has been established. Service level agreements are in place and exception reporting mechanisms function effectively.
Partnerships	Replenishment	Sales are initiated by the customer.	Sales are initiated by supplier, or if sales are initiated by the customer then the supplier has full visibility into the reasons for the order.	Sales are initiated by supplier based on converting the frozen period of a jointly prepared replenishment plan.
Partnerships	Focus	Retail orders.	Retail warehouse withdrawals.	Consumer demand.
Partnerships	Data sharing	Ad hoc sharing of POS and inventory data.	Regular sharing of warehouse withdrawals, inventory and promotional plans.	Regular sharing of POS data, inventory and promotional plans.







## **Appendix D**

### **Forecasting KPIs**

## Illustrative forecast KPI calculations

In this guide we suggest that different forecast performance measures may be appropriate for different purposes. However, there may be value in adopting a common definition of KPIs for reporting forecast accuracy to management or benchmarking performance against peers.

Note that different organisations may choose different data as the basis for calculating forecast KPIs. For example, an organisation with long raw material lead times that forecasts monthly may choose to measure the performance of the forecast made 3 months in advance; another organisation which has short lead times and forecasts weekly may choose to measure the performance of the forecast made 1 week in advance. These differences would need to be adjusted to compare the performance of the two organisations.

Period	Forecast	Actual	Error	Absolute error	Accuracy index	Absolute percent error	
	F	A	F-A	[F-A]	F/A	[F-A]/A	
P1	100	95	5	5	105%	5%	
P2	100	106	-6	6	94%	6%	
P3	100	50	50	50	200%	100%	
P4	100	149	-49	49	67%	33%	
P5	100	100	0	0	100%	0%	
	$\sum F$	$\sum A$	$\sum(F-A)$	$\sum[F-A]$	$\sum(F/A)$	$\sum(F-A)/A$	
sum	500	500	0	110	567%	144%	
avg	100	100	0	22	113%	29%	→ MAPE
					$\sum F/\sum A$	$\sum F-A /\sum A$	
after aggregation					100%	22%	
Measures of forecast accuracy and error					↓	↓	
					Cumulative accuracy	WAPE	

As a means of illustrating the recommended forecast KPI calculations consider the following table:

All measures of forecast error or accuracy are based on relationships between actual and forecast demand in a given forecasting period.

If there is a requirement to report on what percent of the actuals were forecast in a particular period, an accuracy index with the actuals in the denominator is useful. If the question was 'what portion of the forecast actually materialised in a particular period', it would be more appropriate to put the forecast in the denominator.

As soon as measures of forecast accuracy are required at higher levels of aggregation (eg, across a number of periods or across a number of products), the measurement of forecast error becomes more complex because there is a danger of masking problems in the lower level forecast by averaging out compensating errors. Therefore, it is recommended that absolute forecast errors be used as a basis for the aggregate forecast accuracy measure.

Period	Forecast	Actual	Error	Absolute error	Accuracy index	Absolute percent error
	F	A	F-A	[F-A]	F/A	[F-A]/A
P1	100	0	100	100	#DIV/0!	#DIV/0!
P2	100	106	-6	6	94%	6%
P3	100	50	50	50	200%	100%
P4	100	149	-49	49	67%	33%
P5	100	100	0	0	100%	0%
	$\Sigma F$	$\Sigma A$	$\Sigma(F-A)$	$\Sigma[F-A]$	$\Sigma(F/A)$	$\Sigma( F-A /A)$
sum	500	405	95	205	#DIV/0!	#DIV/0!
avg	100	81	19	41	#DIV/0!	#DIV/0!
					$\Sigma F/\Sigma A$	$\Sigma F-A /\Sigma A$
after aggregation					123%	51%
↓ WAPE						
Period	Forecast	Actual	Error	Absolute error	Accuracy index	Absolute percent error
	F	A	F-A	[F-A]	F/A	[F-A]/A
P1	100	1	99	99	10000%	9900%
P2	1	100	-99	99	1%	99%
P3	100	50	50	50	200%	100%
P4	100	149	-49	49	67%	33%
P5	100	100	0	0	100%	0%
	$\Sigma F$	$\Sigma A$	$\Sigma(F-A)$	$\Sigma[F-A]$	$\Sigma(F/A)$	$\Sigma( F-A /A)$
sum	401	400	1	297	10368%	10132%
avg	80.2	80	0.2	59.4	2074%	2026%
					$\Sigma F/\Sigma A$	$\Sigma F-A /\Sigma A$
after aggregation					100%	74%
WAPE versus MAPE						

MAPE cannot be calculated if there are zero actual values for any period

MAPE penalises over-forecasting more than under-forecasting

To answer questions like 'what was forecast accuracy for this product over all the forecast periods' or 'what was forecast accuracy for this product across all regions' a measure such as mean absolute percentage error (MAPE) or weighted absolute percentage error (WAPE) is required. WAPE is recommended because it can still be calculated when there are zero values for actual demand in a period and it is less prone to overstate errors when actual values are small.

Despite the unwieldy acronym, WAPE is simple to calculate: ie, sum the absolute forecast errors over the periods being aggregated and divide by the sum of the actuals over the same periods. Alternatively, the average absolute error divided by the average of actual demand will give the same result.

When comparing the quality of a number of forecasts be wary of aggregating forecasts that are expressed in different units of measure. To overcome this problem, convert the actual and forecast observations to a meaningful unit of measure such as dollars or kilograms before aggregation and then calculate the WAPE as shown above.

WAPE is an error measure. Therefore it should be communicated as 'weekly forecast error over all the periods averaged 74%'. It can also be used to express a measure of forecast accuracy, eg, 'weekly forecast accuracy over the periods averaged 26%'.

Any measure of forecast error that aggregates absolute errors may be difficult to reconcile to knowledge of actual or forecast demand over the period. It is therefore considered to be good practice to report the cumulative forecast accuracy over the period too.

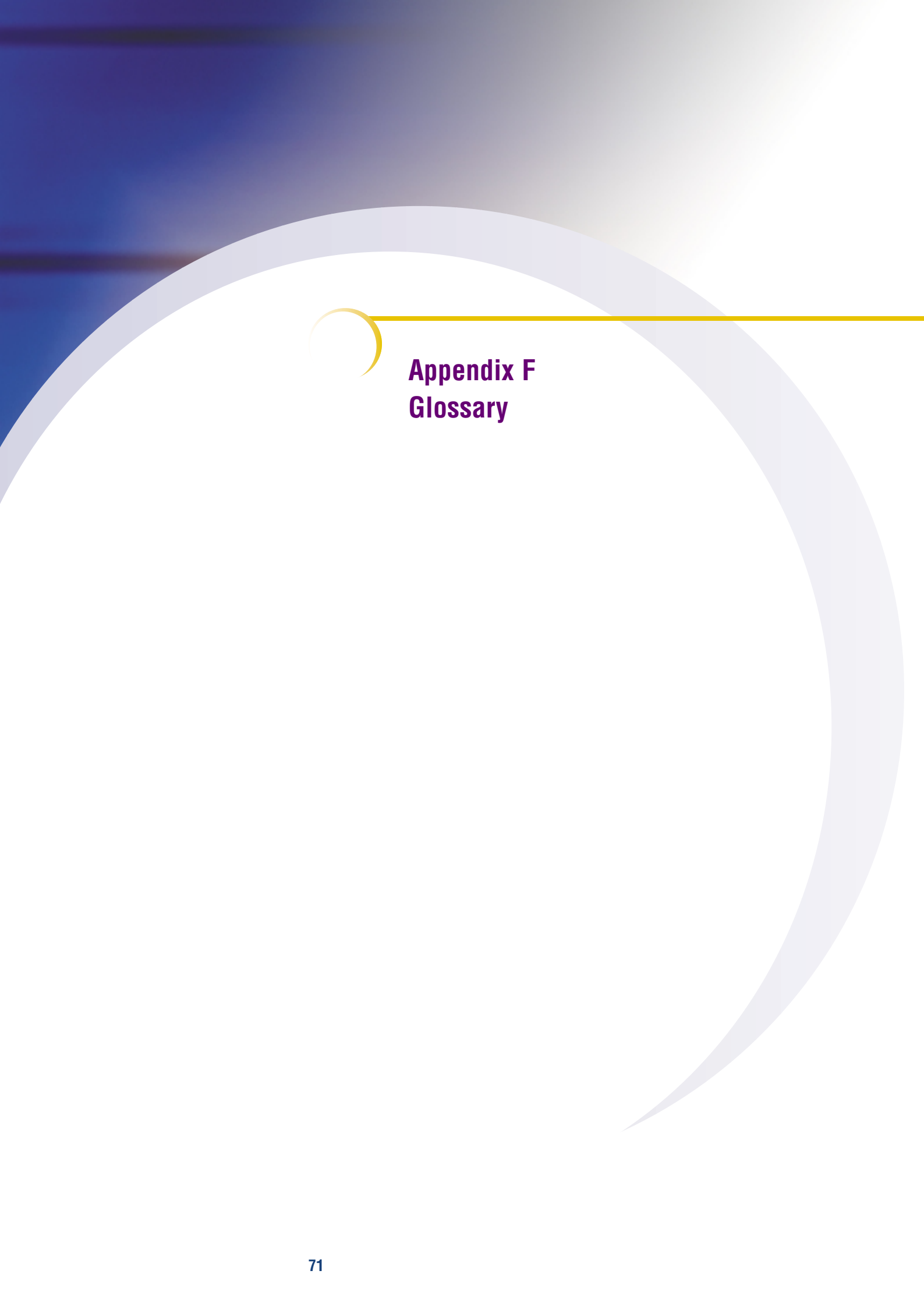
The goals of participants in the demand forecasting process should be to drive forecast error measures closer to zero and forecast accuracy measures closer to one hundred percent. However, it is unrealistic to believe that the consumer demand for many products can ever be perfectly forecasted. Management focus should therefore be more on continual improvement over time than the absolute level of accuracy achieved.



**Appendix E**  
**Technology choices**

Many business applications include demand forecasting functionality. The evaluation of any package should be made in the context of the business requirements particular to each company.

Technology	Example	Comments
Spreadsheet	<ul style="list-style-type: none"> <li>• Lotus 123</li> <li>• MS Excel</li> </ul>	<p>Spreadsheets contain basic functionality that enable the application of simple forecasting techniques such as the calculation of moving averages. Many have add-in modules that enable more sophisticated options, eg, regression analyses can be performed in MS Excel.</p> <p><b>Advantages</b> Spreadsheets are inexpensive and many users are familiar with how to use them.</p> <p><b>Disadvantages</b> Data integrity is difficult to ensure when the volume of data being handled is large and/or the spreadsheet model becomes complex. Tight integration to other information systems is often not possible which increases the manual effort in maintaining the spreadsheet models.</p>
General statistics packages	<ul style="list-style-type: none"> <li>• Minitab</li> <li>• SAS</li> <li>• SPSS</li> </ul>	<p>General statistics packages usually provide some forecasting facilities and may be most useful to companies requiring statistical, graphical, and data analysis.</p> <p><b>Advantages</b> Best-in-class statistics packages are available for both mainframes and microcomputers; they offer programming facilities allowing the customer the option of implementing forecasting methods not already provided as standard.</p> <p><b>Disadvantages</b> The central focus of these packages is not on forecasting — as a result the level of the forecasting functionality may be more limited than for forecasting specific packages. Not integrated with supply planning systems.</p>
Specialist forecasting packages	<ul style="list-style-type: none"> <li>• Autobox</li> <li>• Eviews</li> <li>• Forecast Pro</li> <li>• SCA</li> </ul>	<p>Small computer packages, specialising in forecasting, which are designed for organisations with specific forecasting needs.</p> <p><b>Advantages</b> Contain a variety of forecasting tools to assist the expert demand forecaster.</p> <p><b>Disadvantages</b> Contain a more limited range of facilities than the general statistics package. Most packages are only available on the windows platform. Not integrated with supply planning systems.</p>
Enterprise resource planning (ERP) packages	<ul style="list-style-type: none"> <li>• Baan</li> <li>• JD Edwards</li> <li>• Oracle</li> <li>• Peoplesoft</li> <li>• SAP</li> </ul>	<p>ERP systems aim to provide an integrated environment for all of an organisation's core information systems. Some ERP modules may include forecasting functionality.</p> <p><b>Advantages</b> Tight integration of the forecasts into a common information system platform.</p> <p><b>Disadvantages</b> The central focus of ERP may not be on forecasting functionality. Specialist packages and APS packages may provide more flexibility to the demand forecaster (Note that many ERP vendors also market APS technology).</p>
Advanced planning and scheduling packages (APS)	<ul style="list-style-type: none"> <li>• i2</li> <li>• Manugistics</li> <li>• MerciaLincs</li> <li>• SAP APO</li> </ul>	<p>APS systems aim to provide a decision-support environment to perform optimised supply chain planning. Many vendors have modules that have specifically been developed for operational demand forecasting.</p> <p><b>Advantages</b> May provide functionality specifically geared towards operational demand forecasting. Can handle large volumes of data and usually provide a simulation environment. Usually integrated with supply planning systems.</p> <p><b>Disadvantages</b> More costly than specialist forecasting packages.</p>
Note that several of the technologies have overlapping functionality		



**Appendix F**  
**Glossary**



## Term

## Explanation

CPFR	Collaborative planning, forecasting and replenishment.
APS	Advanced planning and scheduling system. A decision-support system that develops forecasts and optimises supply plans.
Causal techniques	Techniques for developing forecasts based on the relationship between two or more variables other than time; for example, a technique which projects future sales levels based on anticipated retail prices.
CMI	Co-managed inventory. A process whereby a supplier manages the replenishment of inventory to a customer warehouse or store based on mutually agreed rules.
Coefficient of variation	A measure of the dispersion of a data series. The ratio of the standard deviation to the mean, expressed as a percentage.
DC	Distribution centre.
Demand driver	A factor that influences the demand for a product. Examples include price and promotional activity.
DFU	Demand forecasting unit.
DIFOT	Delivery in full on time.
DRP	Distribution resource planning.
ECR	Efficient consumer response.
Frozen period	The short-term portion of a replenishment schedule that will only be changed to reflect changes in the demand or inventory position in exceptional circumstances.
Lag	A difference in time between an observation and a previous observation. For example, an evaluation of a weekly forecast produced one week in advance is an evaluation of Lag 1.
MAPE	Mean absolute percentage error. The average of all absolute percentage errors in a data set.
Multiple regression	A statistical technique for projecting future values of one forecast variable based on projected values of more than one other explanatory variable.
OOS	Out-of-stock.
OTD	On-time delivery.
OTIF	On-time in full (see DIFOT).

Reconciliation	The process of adjusting one level of a forecasting hierarchy so that the sum of the forecasts at that level equals the sum of the forecasts at another level. If top-down reconciliation is used, the lower level forecasts are adjusted. If bottom-up reconciliation is used, the top level forecasts are adjusted.
ROI	Return on investment.
R Squared	The proportion of variation in a data set that can be explained by the explanatory variables in a quantitative model.
Seasonal decomposition	A statistical technique that decomposes a time series into level, trend, seasonal and random components. These sub-patterns can then be analysed separately.
SKU	An item at a location. For example one product that is stored in two warehouses represents two SKUs.
Super-session	The phasing-in of new products and phasing-out of predecessor product.
Time series	A set of data grouped into contiguous, evenly spaced time periods; for example, historical orders grouped into weekly buckets.
WAPE	Weighted absolute percentage error. The sum of all absolute errors in a data set expressed as a percentage of the mean of the data set.
VMI	Vendor managed inventory.



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