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Concepts of chain management and chain optimisation
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‘Let Pharaoh appoint commissioners over the land to take a fifth of the harvest of Egypt during the seven years of abundance. They should collect all the food of these good years that are coming and store up the grain under the authority of Pharaoh, to be kept in the cities for food.

‘This food should be held in reserve for the country, to be used during the seven years of famine that will come upon Egypt, so that the country may not be ruined by the famine.’

Genesis 41: 34–36

21.1 Introduction

Since man started to grow his own food, instead of searching and hunting for it, the sites where we consume our food are gradually taken away from the production sites. In recent decades this process has sped up enormously. Industry has almost completely taken over control of the production and distribution of our foods from local production and consumption. The food chain becomes more and more a global issue.

Within the context of this book, several techniques of modelling have been described and examples are given to elucidate the building and application of models. All these examples are somehow related to the behaviour, quality and safety of a commodity. All these models, however, have to be applied within a larger framework that includes the responses of sellers, buyers and consumers of that commodity. This introduces all consumer research and economics into the game. Commercial companies will only be interested in modelling when a clear
increase of sales and profit will be the result of this application. This framework in modern sales technology is the supply chain.

The modelling techniques used and the models described in the earlier chapters of this book primarily deal with issues directly or indirectly connected to food properties and food behaviour. The main difference of food supply chains as compared to non-food supply chains, is the time critical and ever-changing quality and properties of the perishable food during their journey from growing site to consumption site. Food commodities have to be handled, transported, distributed and eventually sold to and consumed by the consumers with as high a quality as possible for as little cost as achievable. This whole sequence of actions and the omnipresent decay of quality require proper management to achieve the high standards as set by the modern consumers and retailers. Due to the alienation of consumers with growers and retailers, the reliability of continuous supply with high and acceptable quality inevitably leads to a risk of acceptance both for the buyer as for the seller of commodities. As a consequence, chain supply management not only comprises the purely physical aspects of delivering commodities but also the reduction of risks involving sales, quality, safety and consumer acceptance.

Apart from the perishable nature of food, another property of food is psychologically very important to the consumer. Unlike other commodities bought by consumers, food is used as the raw material for building up and maintaining our bodies. When the commodity does not prove safe and reliable, consumers can no longer put it aside, as it is already built-in in our bodies. This places a very major emphasis on safety and health aspects of our food, both in the short term and in the long term.

The necessity for the food industry to set high standards for food safety and overall food quality has led to an enormous increase in the development of conceptual models for the optimisation of the throughput of products in the chain of production.\(^1\) The modelling of food processes and secondary product characteristics has to be complemented by development and implementation of conceptual models that deal with more managerial type of problems that arise when managing and optimising food supply chains. This chapter will focus on some important issues in chain optimisation and chain management, within the framework of consumer driven supply chains.

### 21.2 Key principles and methods

Chains in general and food supply chains in particular can be considered on a number of aggregation levels. For most product-oriented experts and modellers, the food chain consists of the successive actions performed to that particular batch

\(^1\) Within the area of economics and chain management, production signifies more than just the physical production. It also comprises the auxiliary infrastructure for making decisions and all the actions to support and maintain the flow of information.
of product ranging from growing, transportation, storage, and distribution over retail up to the final consumer. As such it consists, from the product's point of view, merely of the actual scenario, expressed as time-temperature combinations during its journey from the producing area to the consumption area. From an economic and marketing point of view, however, a chain is a much more complex structure of product flow, cash flow and information flow (see Fig. 21.1) that needs to be understood and described for proper management and optimisation. Several views and definitions have developed during the last decades.

### 21.2.1 Chains and networks

A chain is a network of autonomous and specifically named organisations, systematically cooperating in the production of a commodity. The cooperative relations are more than incidental and can vary from direct linear to complex network forms (van Dalen 1994).

The notion ‘chain’ has been defined in different ways (Meulenberg and Broens, 1997). Three definitions will be considered in more detail:

1. The **value chain** as defined by Porter (1980): a functional definition
2. **Vertical coordination**: A cooperative relation of two or more organisations in a production column involving the coordination of decision making towards an increased performance for a common third party (Porter 1985): an institutional definition.
3. The **network chain**: the attitude or viewpoint that enterprises participating in a production chain, have to coordinate their actions as well as possible

These three viewpoints form a conceptual development with an increasing complex and abstraction level. A visualisation of this development is shown in Fig. 21.2.

**A functional definition: value chain**

One of the oldest interpretations of food chains is provided by Porter (1980). It considers five operations, conducted within one company that collectively prepare a commodity for a specific customer: inbound or production logistics, production, outbound or distribution logistics, marketing and sales. These five operations are among others supported by the information structure within one company. A disadvantage of the description/definition of Porter is that it only concerns activities within one single company.

Whereas Porter (1980) starts off with the concept of strategy of the individual enterprise, he also combines the ‘forces’ that affect the competitive position of the enterprise within the concept of the value chain, in which the enterprise
enhances its competitive position by improving the links between the value adding processes in its value chain.

Extrapolation of Porter’s views to a multi-company effort provides an interpretation of the chain as a consecutive sequence of logistic and marketing activities in preparing a commodity or goods for delivery to a specific end-user or consumer. In this definition, ICT (Information and Communication Technology) is not an inherent part of the chain as a whole but remains a supporting activity that exists separately.

An institutional definition: decision making in vertical coordination
Vertical coordination is the central issue in the institutional approach (Porter 1985, Zuurbier et al. 1996). The enterprises participating in a chain do not act independently but are coordinated, like retailers in a franchise organisation with a centralised purchasing facility. This coordinated action is not necessarily formalised in contracts. Most of the time, due to the emphasis on cooperation, not every enterprise, acting in that chain, is a member of this coordinated action framework.

Enterprises form a kind of network of mutually cooperating enterprises. The enterprises are not only interdependent for their physical products and raw materials but also in terms of service, information interchange and cash flow as influenced by third parties in the supply chain. This transforms the supply chain into a network of actors (Fig. 21.3), whose operations are mainly related to getting high quality products and information on to the market. Within the institutional definition, the cooperation is primarily driven by the necessity for improvement.

Vertical coordination has both strategic and operational aspects. Strategic coordination comprises, e.g., coordination of product design, process design and structuring information infrastructure. Operational coordination can occur on the level of production means and information flow, parallel to flow of goods, cash and property (Mallen 1977). This explicit cooperation regarding information flow and infrastructure will inevitably lead to needs and demands for specific information. Hence, within this definition, ICT plays a central role. Not only the infrastructure of information exchange, but also the actual usage of information from this structure and its interpretation are essential common resources.

A conceptual definition: the network chain
In the first two approaches on chain structure and meaning, the viewpoint was obtained from one enterprise or from a cluster of enterprises looking at the necessary actions to get a commodity to the final user. In the conceptual definition, only one chain, ‘the’ chain exists, as an abstract entity outside the enterprise(s) involved. The enterprise(s) can cooperate voluntarily with this

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2 This multidimensional approach in information flow can nowadays also be perceived at the level of flow of goods. Not only the traditional flow from producer to consumer is being considered in this approach, but also the return flow of auxiliary material like packaging and waste material.
Chain, but the existence of the chain has to be taken into consideration in the commercial policy. Chain policy can then be considered as a policy for the whole branch to achieve the requirements of the customer by cooperation. This third definition of chains puts the main emphasis on the awareness for the need of cooperation, rather than the cooperation itself. Note that this definition of the chain comprises all issues defined by the institutional definition.

The type of cooperation between actors in a chain can reach from almost non-existing (e.g. sellers at a local market place) over contractual cooperation to a complete merger (see Fig. 21.4). In this figure a number of features of cooperation are visualised for non-cooperative actors (local markets), a network chain and a fully merged enterprise. Of course the coefficient of vertical coordination increases from local markets over network chains to the merged enterprise. The flexibility of local markets as well as for fully merged enterprises is high: they can decide on the spur of the moment to change suppliers or target other buyers. However, the cost of changing over is for local markets quite low,

Fig. 21.3 Network chain and vertical coordination, with one possible pathway highlighted in bold.
while for network chains and merged enterprises the costs are relatively high due to the massive changes throughout the organisation. The costs of transactions are, on the other hand, relatively high for local markets, since they cannot rely on mutual built-up trust, as the network chains and the merged enterprises can. Within the conceptual definition and the connected efficient consumer response (ECR) concept, the enterprises in a network chain cooperate non-contractually but on a long-term basis, due to the recognition of mutual advantage.

21.2.2 Incentives for supply chain management

The great changes in market structure, consumer behaviour and consumer needs and the massive changes in technology, especially the information technology, have been major reasons for the need of supply chain management. Retailers have gained more and more power on our food supply (supermarkets), and enterprises are merging all over the world to grow into large multinationals. Consumers act more and more as individuals in an increasing population (mass individualisation). The innovations in computer technology and information made it possible to start considering to manage the whole chain.

Supply chain management deals with total business process excellence and represents a new way of managing business within each link and the relationship with other members of the supply chain (Lambert et al. 1998). Since the 1980s, literature on supply chain management stresses the need for collaboration among successive actors, from primary producer to final consumer, to better satisfy consumer demands at lower costs (Ellram 1991, Towill 1996, Bechtel and
Jayaram 1997, Cooper et al. 1997). Stevens (1989) refers to the interdependency of activities in the supply chain: ‘if one activity fails, the chain is disrupted, creating poor performance and destabilising the workload in other areas, thereby jeopardising the effectiveness of the supply chain’. This holds true especially in food supply chains because of the shelf life constraints of food products and because of increased consumer attention for safe and environmental/animal friendly production methods (Boehlje et al. 1995). Recent events like e.g. the BSE crisis in Western Europe and the classical swine fever in the Netherlands and Germany made producers aware of the necessity of supply chain control and intensified supply chain cooperation.

The increasing distance between production site and consumption site from local production to production more distant from the consumer, inherently calls for an equal shift in reliability of information, from pure confidence of consumers in the retailer at the street corner, to more objective and measurable quality indicators. In the early days, consumers relied almost completely upon previous experience, buying at a specific retailer, building up gradually the confidence in that retailer. With the more impersonal supermarkets growing more and more important, the consumers need increasing product information regarding quality, safety, content and ultimate selling date to reach a decision whether or not to accept that particular product. But not only the final consumer is faced with this increasing need for information. For each actor in the chain, that product and history information becomes more and more important in deciding which products to buy to be certain he or she is going to be able to sell (van Trijp and Meulenberg 1996).

The increasing importance of information for the successive actors in the chain of events has a number of severe practical and managerial consequences (economics of scale and scope). Coordinated cooperation of all actors in the chain can:

- Increase the efficiency of material and information resources
- Reduce risk of safety and quality
- Decrease the production life cycle
- Decrease the cost of obtaining and retaining that information throughout the chain (transaction costs).
- Decrease the cost and number of repackaging a commodity by different actors in the chain (packaging cost and environmental benefit).
- Reduce the stock level by one actor, based on production information by the successor actor.
- Decide the optimal location in the chain for quality increasing investments.
- Increase profits.

Also strategic issues can be reasons to search for closer cooperation and sharing of information. A good example of sharing information to reduce costs and increase profits is the system applied by the world’s largest retailer Wal Mart (USA). This enterprise allows free and total access to the purchase and consumer database without restriction or prescription, as long as added value of its usage can be substantiated by increased sales results.
Motives for cooperation within the supply chain, asking for complex innovations, not only come from inside the food supply chain (e.g. commercial, organisational and technological influences), but also from outside the chain (e.g. social, legal, political and community influences).

21.3 Food supply chains

For consumers of a product of a food production and supply chain, and hence for the chain as a whole, the quality of a purchase comprises more than the pure intrinsic quality of the purchased product. When deciding to buy a certain product, the buyer finds a balance between, among others, his own preferences, the preferences of its final consumer, the assumed properties of the product, the availability of the product on the market and the costs involved. The overall picture of this balance evaluated at the moment of every purchase decision can be found in Fig. 17.3 of Chapter 17. Combining the information from that chapter, and the viewpoints behind it, with the actual motives and considerations of purchase, the issue commonly called quality, is more the acceptance of a product by the consumer/buyer (Meiselman and MacFie 1996). In this acceptance the intrinsic quality of a product is only one of the many issues affecting the consumer’s decision. Most of these issues are subjective in nature, including the risk assessment, safety factors, and product quality itself. For a useful application in the integrated supply chain, all these factors have to be recognised, described and modelled, and techniques have to be developed to measure all these factors affecting the consumer’s acceptance in an objective manner. All these factors are dealt with in previous chapters of this book.

21.3.1 Modelling the chain

The art of modelling is not yet very advanced in the realm of chain description and chain management, especially on the level of individual commodities and batches of commodities. The subject is too young and too complex to have already achieved a comprehensive mathematical description. The models concerning the chain as an integral entity are still limited to conceptual models as described in previous sections. However, increasingly models generated in other parts and disciplines, concerning product behaviour, product quality, keeping quality (or shelf-life) and safety are used in description and optimisation of parts of the integral chain. A number of these models and viewpoints are dealt with in previous chapters of this book (Chapters 5, 19 and 20). Specific conferences are being organised that cover the development in this area (Ziggers et al. 1998, Triekenens and Zuurbier 2000).

21.3.2 Acceptance versus quality

Acceptance of a product by the consumer is the ultimate goal and the ultimate test of the supply chain. Managing that chain and optimising it, signifies that one
has to make sure that the consumer in the (near) future goes on purchasing his foods from that particular chain. Within the decision of purchase, a number of issues play an important role. These issues are of very different nature and impact.

- **Product-related issues:**
  - The intrinsic quality of the product purchased, however ill defined, and the connected keeping quality. This issue brings in the whole physical pathway the product has to go through, including all aspects of actual scenarios with respect to e.g. temperature, and the actual physical handling performed to the product like, e.g. cleaning, packaging and processing.
  - Safety of the commodity e.g. microbial infection, radiation, health.

- **Market-related issues:**
  - Availability of comparable products on the local market
  - Confidence in the enterprise with respect to, e.g. quality, applied technology and information

- **Economic-related issues:**
  - Costs of purchase of the commodity
  - Price reductions
  - Sales promotions

- **Social issues within the boundaries of the social community:**
  - Is the commodity ethically acceptable, e.g., child labour?
  - Is the technology applied acceptably e.g. genetic modifications, organic production, etc.

- **Psychological issues:**
  - Does this commodity provide the buyer some social status?
  - Does this commodity fulfil consumer’s expectations? (MacFie and Thomson 1994).
  - Is the information about the product, its contents and its production and processing adequate and reliable? (advertising and labelling).

Given the ongoing mass-individualisation of the contemporary consumer, the understanding of and the compliance to all these items obtain more and more weight for commercial companies. Some effects in the decision making of a consumer are already clear and described while many effects are not clear at all and still remain very vague. All efforts and actions within a particular chain are directed towards that ultimate goal: keeping the consumer happy so he will come back. Managing and optimising a supply chain aims at maintaining the structure and functioning of the complete supply chain in such a way that the buyers/consumers do come back and keep on purchasing commodities from that chain, while still making some profit in the process. This signifies that efforts have to be directed to the many unresolved relations between decision making and supply, while maintaining the paramount properties of quality and safety. Managing a chain is finding the balance between purely economic issues (profits, transaction costs), flexibility in pathway and commodity throughput (see e.g. Fig. 21.3) and maintaining food safety and food quality.
In the realm of product behaviour and product properties, many items are already clear. Relations and effects have been described and modelled, as can be taken from many previous chapters in this book. All these models on food quality, safety and handling can be and are being used in optimising the product going through supply chains. In the realm of specific economic issues, the science of modelling in the chain and network area, is still in its infant stage. When making strategic and tactical decisions, a fair part of information on product properties and behaviour is already modelled and implemented. Structured information on economic effects and processes are, however, still quite sparsely available (see Fig. 21.5). Some progress has, however, been made (ECR or Efficient Consumer Response (see section 21.5), sales promotions (Wierenga and Soethoudt 2000). In the realm of psychological and of social issues, consumer research has come up with a number of empirical relations and rules of thumb, but has hardly achieved any fundamental breakthrough in really understanding the ongoing processes. Some examples of psychological relations and unstructured facts are, e.g., a more emotional involvement when buying food products compared to non-food products: buying of food occurs much more at the spur of a moment or affected by a particular space; food is bought on a repetitive basis; consumers walk preferentially at the outer perimeter of supermarkets and avoid more the inner space.

Combining all these effects for managing and optimising supply chains, inherently leads to very diverse levels of understanding of the effects within and throughout a supply chain.
What has been developed during the past decades is a decomposition of
supply chains into the participating actors and into the relations between those
actors: an understanding of the structure of a supply chain.

21.3.3 Technological issues
Technology of food production, processing and handling, has shown some
drastic changes over the years. All of these changes were initiated by incentives
and motives of increasing the quality of the delivered commodities combined
with an increasing profit or decreasing production costs (technology push). The
results of some technological changes were accepted by the customers without
any protest or objection, e.g. sterilisation, MAP packaging, microwave heating,
minimal processing. Other technologies studied never came to appreciable
commercial application by lack of economic results, e.g. ohmic heating, infra
red heating, large-scale maceration. However, in some cases, objections of
ethical, safety and risk hazards nature were so strong, customers did not accept
product treated with that particular technology (negative market pull). An
example of a rejected technology is, e.g., application of ionising radiation.
Recently quite some fierce discussions are ongoing on the risks and ethical
acceptability of genetically modified substances in our food products and the
occurrence and avoidance of BSE in bovine products.

As a consequence, innovations applied to our food production and supply
system, have always been and will always be subject to acceptance by the
customer/consumer. Accepting or rejecting a particular commodity is in fact the
only action possible for consumers. It is in these terms that consumer driven
innovations have to be considered (market pull).

The food supply chain is ultimately the structure where this type of
information from producer to customer and back from the customer to the
producer takes place. Managing a food supply chain means therefore more than
tactical and operational planning, but also has to include the long term strategic
views on consumer response, together with providing adequate means of
communication and information interchange between all actors in that chain.

21.4 Problems and issues of global sourcing
The main goal of enterprises whether or not as partner in a chain, is not to bring
as high quality products as possible to the final consumers, but to bring products
onto the market at as low cost and as high profit as possible, while keeping the
consumers satisfied.

One of the major trends in supply chains as a consequence of increased
technological abilities, is globalisation of resources and consumption or
internationalisation of trade. More and more a substantial portion of our daily
food no longer originates from local or national resources, but the origin spreads
out all over the world e.g. Europe and North America import more and more
kiwis from New Zealand, mangoes from the southern hemisphere, beef from
Australia and Argentina, etc. Customers in North America and Europe are more
and more used to obtaining all products the year round, without limitation of
growing season. This aspect of consumer demands also puts considerably more
emphasis on understanding and modelling product quality and the interactions
between successive enterprises in the chain.

To optimise the whole process of buying raw material and selling final
products on a global market, several aspects come into play that for itself have
no bearing on the product and the product behaviour itself. A common quality
language is absolutely necessary throughout the chain, not only to communicate
but also to define which aspects of quality and product properties should be
measured and in what way. That is why consistent theories on quality as e.g.
described in Chapter 17 and the related and emerging common language
(Shewfelt and Tijskens 2000) are so important. Also essential is a transparency
and understanding of the complete process of a product going through the chain.
A major factor in this transparency results in a mutual trust between the
successive actors in the chain. With sufficient and reliable exchange of
information between the partners in a chain, transaction cost can be decreased
considerably.

To ascertain the quality and safety of commodities and to minimise risks (of
all kinds), several difficulties arise in this so-called global sourcing. All
difficulties involved are already mentioned in previous sections of this chapter.
By the shear distance between original producer and final consumer, the
difficulties require, however, special attention and precautionary measures.

Food safety is an issue of such paramount importance, consumers in the
western world are becoming more and more aware of the risks involved in the
food production chains. Whether it is a case of BSE in the animal production
chain or a case of pesticide residues in the fruit and vegetable chains, consumers
demand that food companies and retail outlets do everything that is required to
avoid any health risks.

In the second place the paramount quality has to be guaranteed and maintained.
Solutions for this problem are sought for by technological means like modified
atmosphere packaging (MAP, see Chapter 14), transport in controlled atmosphere
containers (CA) and developing breeds of produce with long shelf-life and
temperature-time indicators (see Chapter 19). However, only part of the problem
of maintaining food safety and quality throughout the chain, can be tackled with
high tech end-of-pipe solutions. It is essential to overcome the gap between local
(third world country) production systems and western consumption. The first step
is taken by investing and developing the local infrastructure.

In order for private companies to be competitive in both local and
international markets, chains of production have to be built from scratch. Most
of the existing infrastructure is inefficient and usually not geared for change.
These changes will not be implemented within some months. Periods of
transmission may even mount up from five to ten years, depending on the
possibilities of implementation and awareness of the necessity of new concepts of supply chain management.

Farmers have to be educated to handle seed materials properly and apply suitable growing and harvesting techniques. Resources have to be made available to upgrade the primary chain in the network. These funds can only be made available if the products, coming out of the system, meet local and global quality standards, including food safety.

21.5 Practical application of supply chain management: efficient consumer response

Related to the concept of supply chain management, the concept of efficient consumer response (ECR) emerged in food supply chains, in which distributors and suppliers work closely together to offer better value to the consumer. By jointly focusing on the efficiency of the total supply system, rather than the efficiency of individual components, they reduce total system costs, inventories, and physical assets while improving the consumer’s choice of high-quality, fresh products. In accordance with supply chain management the ultimate goal of ECR is to achieve a responsive, consumer-driven system in which distributors and suppliers work together as business allies to maximise consumer satisfaction and minimise system costs. Accurate information and high-quality products flow through a paperless system between manufacturing line and check-out counter with minimum degradation or interruption both within and between trading partners (Kurt Salmon Associates 1993).

The ECR working group comprising a group of industry leaders in the United States developed five guiding principles that concisely articulate the ECR strategy (Kurt Salmon Associates 1993): providing better value, committed business leaders, accurate and timely information, ensure the right product is available at the right time and a common and consistent performance measurement and reward system. Coopers and Lybrand (Anon. 1996) translated these guiding principles into a family of 14 ECR improvement practices, categorised into three clusters concerning marketing or category management, logistics or operations improvement and information technology or enabling technologies (see Fig. 21.6).

Three different approaches exist to explain and describe cooperative relations as found in efficient consumer response, on theoretical premises (Overbooms 2000, Boehlje and Schrader 1998, Verhaegen et al. 1999, Bash and Davies 1998, Zylbersztajn et al. 1996, Thomas et al. 1995).

1. Transaction cost theory

Costs of transaction are those costs directly caused by the simple transaction of buying and selling from one partner to another. They depend among other things on incomplete information, uncertainty about the market, about the behaviour of business partners, and about the draft and check-up of contracts. Without sufficient confidence in the quality of the bought
product, every enterprise, every actor in the chain has to check the quality of the newly acquired goods, no matter what information is provided by the seller. With sufficient confidence, whether or not by contractual agreement, these costs can be reduced considerably. It then becomes a matter of mutual agreement how and when commodities have to be and will be tested for quality and content. The concept of transaction cost theory is useful for explaining and understanding the behaviour of enterprises and for improving their efficiency. Especially logistic issues of the ECR concept (operations improvement) can be understood using the principles of the transaction cost theory since the goals of logistics are always formulated in terms of efficiency.

2. Strategic management theory
Competing strategies are the subject of strategic management. Michael Porter (1985) is the most prominent author in this school. The theory starts from the traditional industrial organisation, explaining the performance and the behaviour of the enterprise (conduct). The emerging cooperation between enterprises is in this theory a strategic response to uncertainties and interdependencies. The higher the uncertainties the more intense the cooperation will be (Pfeffer and Salancik, 1978). Using strategic management, concerted relations can be treated and considered as category
management. Especially the uncertainties with respect to consumer (buying) behaviour generate an interdependency on information exchange, and increase the willingness to introduce the category management-concept.

3. Resource-based view

In the search for explaining the conduct of enterprises in the agri-business it was also proposed to use the theory of key competences (e.g. Prahalad and Hamel 1990). Key competences are the specific skills ensuring an enterprise performs better than another enterprise and ensuring a sustainable competitive performance. To build up and maintain these key competences, resources and capabilities are needed. Within the ECR concept, the pooling of complementary resources and capabilities of all partners involved can explain the added value of close cooperation between individual enterprises.

The concepts upon which the ECR approach exist, are partly fully developed, other parts still need further extension and study. The added value of ECR, however, is to be found in the cooperation of all supply chain actors as equal partners in the development, implementation and evaluation of these concepts.

21.5.1 Category management

Category management focuses on product categories for the optimisation of assortments, product introductions and promotions. Food industries and retailers jointly work on providing consumers with the right product that has the right specifications, resulting in the purchase of the products.

In literature many definitions for category management are used. The ECR category management subcommittee defines category management as (ECR Board 1995):

The process between parts in the chain, where categories are being managed as strategic business units, producing enhanced business results by focusing on delivering consumer value.

A category is defined as a distinct, manageable group of products/services that consumers perceive to be interrelated and/or substitutable in meeting consumer needs.

One of the most important goals of category management is the optimisation of the assortment as perceived by the consumer. The central issue for applying category management is the knowledge of and the information on how the consumer perceives the available brands of product in their mutual relation. Within the issues of ECR is category management focused on increasing the efficiency of logistics and on increasing the efficacy to satisfy the consumer.

For category management, a number of tools are available, one of them is the cost approach direct product profitability or DPP. Direct product profitability is basically a quantitative analysis of the assortment, based on profitability calculations. DPP is assumed to be a better indication of profitability than the gross margin (Floor 1996). Indications based on gross margin sometimes give a
completely wrong impression. For example, two different products with the
same gross margin can show in the end severely different assets to profitability.

The costs of handling and sale, associated with different products can be very
different for each product. In direct product profitability, the contribution to the
overall profit is the difference between gross margin and direct product costs.
Direct product costs (DPC) are composed of three aspects of costs: the costs
made by the distribution centres, costs of transport to and costs at the retailers.
Some of the items constituting these costs are invariable while other costs are
variable costs. Unlike the variable costs, invariable costs do not increase parallel
with the number of commodities sold.

DPP at a retailer can be represented in different ways:

\[
\begin{align*}
\text{DPP per week} & = \text{DPP}_\text{week} \\
\text{DPP per sold consumer unit} & = \text{DPP}_\text{cu} \\
\text{DPP per week per m}^3 & = \text{DPP}_\text{vol}
\end{align*}
\]

The basic relation for DPP calculations is shown in equation (21.1). This
equation expresses that the profitability increases linearly with weekly sales.

\[
\text{DPP}_\text{week} = \left( \text{Gross margin} - \text{variable costs} \right) \cdot \text{weekly sales} - \text{invariable costs}
\]

The three representations of DPP can be converted into one another and are
consequently proportional to each other:

\[
\begin{align*}
\text{DPP}_\text{cu} & = \frac{\text{DPP}_\text{week}}{\text{weekly sales}} \\
\text{DPP}_\text{vol} & = \frac{\text{DPP}_\text{cu}}{\text{shelf space}}
\end{align*}
\]

Costs of transport, costs of distribution centre operation and costs at the
retailers through the entire chain are all contained in the variable and invariable
costs. DPP can be regarded for one actor in the chain, but can in principle also be
used to estimate the DPP of the entire chain. In Table 21.1 an example of the
calculation is given.

So, the DPP of a product can be increased by, e.g., a higher rate of sales, a
more efficient use of shelf space, an increase in gross margin, a more efficient
handling routine or a different way of supplying commodities. Based on DPP
analysis, advice can be formulated on a different form or kind of packaging,
package content or repackaging.

21.5.2 How are DPPs affected

For calculating DPP values, the most sensitive and important input variable is
the weekly sales. The relation between \( \text{DPP}_\text{cu} \) and the mean weekly sales is an
orthogonal hyperbola as can be taken by combining equations (21.1) and (21.2):

\[
\text{DPP}_\text{week} = \left( \text{Gross margin} - \text{variable costs} \right) \cdot \text{weekly sales} - \text{invariable costs}
\]

\[
\text{DPP}_\text{cu} = \frac{\text{DPP}_\text{week}}{\text{weekly sales}} \\
\text{DPP}_\text{vol} = \frac{\text{DPP}_\text{cu}}{\text{shelf space}}
\]
It approaches an upper limit at ever-increasing sales, consisting of gross margins minus the variable costs. This upper limit hence represents the maximum DPP\textsubscript{cu} that can be obtained at unlimited sales. The intercept at sales = 0 represents the (negative) invariable costs of operation (see Fig. 21.7).

Within the distribution operation the degree of distribution, that is the number of retailers serviced, is of major importance, quite similar to the retailer sales in determining the costs of the distribution centre.

The parcel magnitude also has a major effect on DPP. With increasing parcel magnitude the direct product costs (DPC) and exploitation costs decrease considerably.

DPP analysis constitutes a valuable tool for category management and composition of assortment, but can also assist in the planning of retail shelves,
the optimisation of distribution and the development of price and advertising policies. As such DPP is a valuable tool for managing and optimising the entire supply chain and to support and promote the cooperation between producer and retailer and to increase overall the efficiency in that chain (Stichting Ketenmoduul, 1995).

21.6 Conclusions

Although the number of models that describe the changes of properties and quality attributes and safety in our food steadily increases, market research and economic applications of these models, and especially the development of dedicated economic models is still in its infant stage. A vast effort applying good and sound principles, based on problem decomposition and borrowing knowledge and techniques from other disciplines, has to be undertaken in the near future to achieve structured information on economic effects and processes. Also in the area of consumer research and psychological effects, large gaps in modelled knowledge still exist. All these voids in structured knowledge inherently lead to very diverse levels of understanding within and throughout a supply chain.

The necessity for the global food producing and food retailing companies to achieve high standards for food safety and overall food quality strongly directs the efforts in both the private domain as well as in the public domain.

With ‘situations’ such as the ongoing BSE crisis in Western Europe or the case of strong consumers’ ‘dislike’ of genetic modified organisms, transparency in the food chain is of utmost importance. In terms of the three schools of thought mentioned above, uncertainty has to be reduced, transaction costs have to be reduced, and new levels of trust have to be achieved.

These changes in network structures are not accomplished by mere input of financial resources from the major food companies. The capability of the (local) actors themselves have to be made available. Awareness, why certain standards on food aspects and food quality have to be implemented, has to grow gradually over time. The public domain – the knowledge infrastructure – has to play its part as well.

The translation of developed standards on food safety and food quality is a major responsibility for research in the food domain. It is important to understand the mechanisms in the sector of food processing, but it is even more important to understand how and with which stimuli an overall higher level of food safety and quality can be achieved. After all, garbage in = garbage out.

Economic theory on chains and networks is useful in trying to understand why economic actors act as they do and where the best opportunities for improvement are. It is also indicated that cooperation can lead to results that are on a higher level than those achieved on the basis of individual performance. With the increasing importance of linking the final consumers directly to the basic production itself, e.g., with the help of Internet, transparency and uniform standards are the only recipe for success.
21.7 References


VAN DALEN J.C, (1994). Geboeid door ketens (Fascinated by chains). Inaugural speech, Wageningen University, Wageningen NL.


