

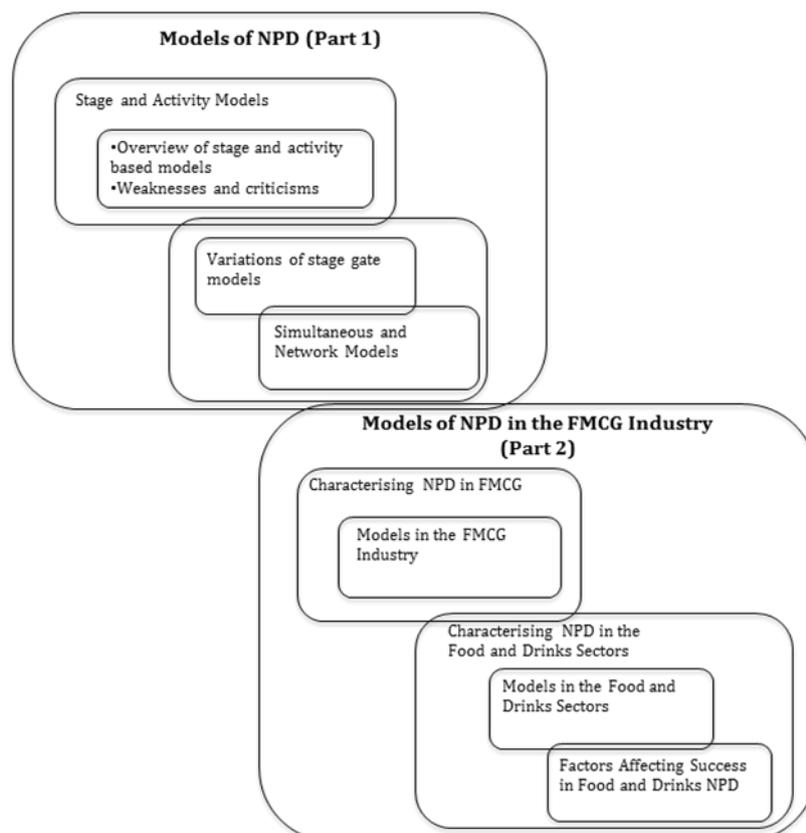
CHAPTER 3: NEW PRODUCT DEVELOPMENT LITERATURE REVIEW

3.1 Introduction

This chapter provides an overview of the existing models of NPD, and is divided into two main sections. The initial section focuses on generic models of NPD, beginning with a discussion of stage and activity based models, which includes a summary of some key and widely recognised models in the literature. Weaknesses of these types of models are then examined, followed by a discussion of alternative models.

The second part of the chapter narrows down in focus. It examines models generated from research in the FMCG industry, and subsequently, the food and drinks sectors. These are critically reviewed in the context of this study.

Figure 3.1: Structure of Chapter New Product Development Literature Review



3.2 Models of New Product Development

A variety of types of NPD models are evident within the literature. The main models identified focus on: the stages or activities in the NPD process (Section 3.2.2), the simultaneous and overlapping nature of activities (Section 3.3.1), and the external and network interactions involved in NPD (Section 3.3.1.2). Each of these types of models makes an important contribution to understanding, but also possess a number of weaknesses.

A significant proportion of the research on NPD models has focused on developments which encourage a structured approach to NPD (Kleinschmidt & Cooper, 1991; Cooper & Kleinschmidt, 1994; Cooper, 2001; Filippini *et al.*, 2004; Troy *et al.*, 2006; Cooper & Edgett, 1995a; 1995b; 2008). The benefits of this have been widely reported in the literature (Oorschot *et al.*, 2010; Cooper and Kleinschmidt, 2007; Griffin, 1997; see also Appendix 3.1). This body of the literature, addressed in the initial Sections of this chapter, consists of a number of different types of models. The emphasis is on examining the constituent phases of the process, and the configuration of activities aimed at realising new products (Urban and Hauser, 1997; Verona and Prandelli, 2006).

Many structured models and methods have been explored and developed, with the aim of improving NPD (Nijssen & Lieshout, 1995; Schelker, 1976). This includes a particularly high level of attention to models examining the process, and particular techniques or methods with which to optimise various stages. Many of these models are closely associated with stage gate thinking (Sections 3.2.3.1, 3.2.3.2), which suggests that certain criteria must be met before a project progresses to the next stage. The adoption of these types of models has been found to improve the chances of success (Cooper & Kleinschmidt, 1986; Cooper, 1993; Nijssen & Lieshout, 1995; Ettie and Elsenbach, 2006; Barczac *et al.*, 2009).

Stage, or activity, based models dominate the literature. However, weaknesses of this approach have been identified (Section 3.3): particularly on the grounds that these models fail to capture the simultaneous and overlapping nature of activities (Fuller, 1994; Brockoff, 1999), and the significance of external and network interactions (Pittaway *et al.*, 2004; Rothwell, 1983). This had resulted in the development of two further types of models (Section 3.3.2): namely, network; and

concurrent (or simultaneous) models. McCarthy (2006) also refers to these frameworks as recursive and chaotic.

3.2.2 Stage Based Models and their Evolution

The history of NPD literature is largely considered to date back to the 1950s (Conway and Steward, 2008), and the various models to have emerged can be seen to provide a historical guide of the way in which organisational processes of NPD have evolved (Tidd *et al.*, 2001). This began with the early departmental and activity stage models, commonly referred to as technology push and market pull (Utterback, 1971), which represent what Rothwell (2002) and Nobelius (2004) describe as the 'first generation' models of the process (see Appendix 3.2).

Departmental stage models have been heavily criticised, as they suggest that a functional department separately handles each activity. This is in contrast to more effective and modern approaches, requiring boundary spanning communications and coordination (Conway & Steward, 2008; Trott, 2008). The criticisms of these models led to the development of the next 'phase': activity stage models (Saren, 1984). These represented the process as consisting of a number of individual activities or stages, including idea generation, idea screening, and concept testing. Whilst these have also been criticised for representing an 'over the wall' approach, they are recognised as an improvement, as they incorporate some feedback loops (Conway and Steward, 2008).

Decision stage models have largely superseded the Department stage and activity stage models. Arguably, these represent the latest thinking on NPD, alongside network models (Section 3.3.1). The dominance of these stage based models is reflected in the wealth of literature in this area. As a result, much of this chapter focuses on detailing them.

3.2.3 The dominant models of New Product Development: An overview of key stage & activity based models

Stage based models explicitly state the individual stages of the NPD process, their order, the activities involved, and linkages between the stages (Conway and Steward, 2008): thereby aiding understanding of the process, and its management.

The practical applicability of these models, for managers and consultants, has been a key factor in their popularity and dominance.

Majority stage based models represent the process as a series of linear activities, with feedback loops between each activity or 'stage'. The key focus is in providing a series of key steps, devised to act as a guide to move ideas towards successful products (Cooper, 2008; Cooper and Kleinschmidt, 1991). New products must pass through each stage in order to be commercialised or launched. In order to proceed and progress, a number of evaluation criteria must be fulfilled at each stage, enabling it to pass through a 'stage gate'. Hence, the stages are commonly viewed as information gathering activities, followed by go/kill decision gates (Cooper, 2008). This arguably helps focus decision-making and ensures that evaluations are undertaken at critical points.

Process models provide a useful depiction of the key activities involved in NPD, effectively acting as a blueprint for organisations to follow and adapt as required (Oorschot *et al.*, 2010). Their adoption and use has been linked to improved profitability and performance (Nijssen & Lieshout, 1995). For managers, these models assist portfolio planning and risk management, aiding the allocation of resources to the right projects at the right time (Oorschot *et al.*, 2010; Cooper, 2008; Cooper *et al.*, 2001). For organisations, their adoption can be beneficial, as in many cases, managers have little confidence in their ability to effectively manage NPD (O'Marah, 2004; cited in Koudal and Coleman, 2005). Utilising these models can help avoid the omission of critical activities from the process, which is not uncommon (Cooper & Kleinschmidt, 2000).

As far back as 1976, Schelker (cited in Nijessen & Lieshout, 1995) suggested that if all the variations of models and methods were considered, over 600 could be identified. This figure has clearly increased since, as a result of the growth of NPD literature. To discuss and list them all would not be feasible within the constraints of a single chapter. The following, however, provides an overview of a number of the most commonly accepted, relevant, and recent models: revealing differences in terms of the activities or stages identified, and the number of these activities. In practice, the completeness of the process, and proficiency of the activities undertaken, are both of critical importance to success (Cooper and Kleinschmidt, 1986).

The following tables present the main stages depicted in the selected models, enabling them to be compared. Tables 3.1 and 3.2 are adapted from Eveleen's (2010) and Francis' (2008) papers respectively. Each provides a useful overview of some of the most influential NPD models, spanning the past fifty years. The tables further illustrate the heterogeneity of these models. Table 3.2 attempts to group the activities into three broad types (left column), aiding their comparison: prior to development (product independent), focused on the product's development, and post development evaluation.

Table 3.1: Process phases, stages, components or activities (Eveleens, 2010: p. 6-7)

Paper	Rogers (1962)	Cooper & Kleinschmidt (1986)	Rothe-well (1994) [3 rd Gen]	Van der Ven et al. (1999)	Noote-boom (2001)	Mulgan & Albury (2003)	Verloop (2004)	Cormican & O'Sullivan (2004)	Tidd & Bessant (2005)	Andrew & Sirkin (2006)	Hansen & Birkinshaw (2007)	Jacob s & Snijders (2008)
Research type		Recent theory & practice	Prior research	Large empirical study	Theory	Prior research & cases	Experience	Empirical & theoretical	Empirical & theoretical	Experience & empirical data	Empirical experience	Theory & empirical
Journal/ Source	Book	JPIM	International market review	Book	Book	UK Strategy unit paper	Book	Technovation	Book	Book	Harvard Business Review	Book
Industries (if applicable)	N/A	Industrial companies in Canada	Conceptual: high-tech industry focus	General survey of innovation managers	N/A	Public sector	Experience in Shell chemical s/petroleum	Healthcare, pharma, computing, telecom, & electronics	Specifics not revealed	General experience & research of BCG	Specifics not revealed	Specifics not revealed
Stages	Knowledge	Scoping	Idea generation	Initiation period	New combinations	The generation of possibilities	Idea generation & crystallisation	Analyse environment & identify opportunities	Search	Idea generation	Idea generation	Variation
	Persuasion							Generate innovation & investigate				
	Decision	Build the case	Research design & development	Developmental period	Consolidation	The trialing & prototyping of promising ideas		Plan project & select sponsor	Select	Commercialisation		(Internal) selection
									Acquire			
		Development	Prototype development				Development & demonstration	Prioritise project & select teams	Execute	Realisation	Idea conversion	Realisation
		Testing & validation	Manufacturing									
			Marketing & sales									
	Implementation	Launch	Marketing	Implementation/ termination period			Investing & preparing for launch	Implement project implementation plan	Launch			Select-ion/ survival
	Confirmation				Generalisation							
					Differentiation	Replication & scaling up			Sustain		Idea diffusion	Multiplication
					Reciprocation							
						Analysis & learning			Learning & reinnovation			Learning

Table 3.2: Overview of NPD Models (Adapted from Francis, 2008: p. 5)

PHASE	Wolf (1994)	Booz, Allen, & Hamilton (1982) ¹	Cooper (1998) ²	Griffin (1997) ¹	Wheelwright & Clark (1992) ¹	Dimancescu & Dwenger (1996)
Research type	Literature review	Book	Book	PDMA survey	Book	Book
Journal/source	Journal of Management Studies	Book	Book	JPIM	Book	Book
Industries (if applicable)	N/A	N/A- Book Based on group's extensive experience	N/A- Book Based on group's extensive experience	PDMA members, primarily manufactured goods, and larger firms. 34.8% high tech, 34.8% mixed, 30.4% low tech	N/A- Book Based on group's extensive experience	Manufacturing organisations
Product independent					Build up knowledge & capability	
Product development		Identify new product strategy				
	Idea conception	Exploration	Idea generation	Idea/concept generation	Idea generation	Idea
	Awareness					
	Matching					
	Appraisal	Screening	Preliminary assessment	Idea screening	Product definition & selection	Design
			Concept			Plan
				Business analysis		
	Persuasion					
	Adoption decision					
	Implementation	Development	Development	Development	Design & build prototypes	Engineer
	Confirmation	Testing	Testing Trial	Test & validation		
					Pilot production	Produce
	Routinisation	Commercialisation	Launch	Commercialisation	Manufacturing ramp up	Distribute
Post-development evaluation	Infusion					
						Dispose

Whilst the three phases Francis (2008) identifies provide a useful overview, and facilitate comparison, they are very broad, and arguably fail to effectively encapsulate the different types of activities. Cooper (2001) has also suggested an alternative method of grouping, identifying three types of phases always evident: recognition, idea formation and screening, and product development phases. But the

¹ Cited in Durisin *et al.* (2010) as one of the most frequently cited works in JPIM

² Identified as a key author in JPIM (see Biemans *et al.*, 2007)

heterogeneity between the various models represents a challenge when attempting to group and summarise common stages and features in the models.

The following tables (3.3, 3.4, 3.5) attempt to build on the preceding discussion: providing an overview of key NPD models. The tables group the activities in these models, based on eight generic types of activities (left column in italics). The models are selected from three areas. Table 3.3 presents models from selected mainstream and well recognised textbooks, including some of the most recognised authors in the area (Biemans *et al.*, 2007, indicated by ²), and two of the most frequently cited textbooks in the Journal of Product Innovation Management (JPIM) (Durisin *et al.*, 2010, identified by ¹). Table 3.4 then details models in the mainstream literature: again focusing on some of the most widely recognised authors (e.g. Biemans *et al.*, 2007) and influential papers (e.g. Durisin *et al.*, 2010), but also including the most recent PDMA survey and work of Robert Cooper. Finally, Table 3.5 attempts to provide a wider overview, detailing models presented in the wider design and engineering literature.

Table 3.3: Overview of selected well-recognised NPD Stage Models in Innovation, Marketing (inc. Product Management) and NPD Textbooks

Authors	Trott (2008)	Tidd, Bessant & Pavitt (2005)	Crawford & DiBeneditto (2007)¹	Baker and Hart (2007)	Booz et al. (1980)*	Cooper (2001)*¹	Clark & Fujimoto (1991)*	Kotler & Armstrong (2007)	Brassington & Pettitt (2006)
Perspective on Process	Innovation Management	Innovation Management	Product Management/ Marketing	Product Management/ Marketing	Product Management/ Marketing	NPD	NPD	Marketing	Marketing
Source	Book	Book	Book	Book	Book	Book	Book	Book	Book
Strategy/p re-requisite					New product strategy				
Idea stages	Idea generation	Search	Opportunity identification and selection		Idea generation	Discovery		Idea generation	
	Idea screening				Idea screening	<i>Idea screen</i>		Idea screening	
Concept development and testing stages		Select	Concept generation		Concept development and testing	Scoping		Concept development and testing	
	Concept testing		Concept/ project evaluation			<i>Second Screen</i>			
Strategy development		Acquire				Build business case		Marketing strategy development	
Analysis and evaluation stages	Business analysis				Business analysis	<i>Go to development</i>		Business analysis	
Development stages	Product development	Execute	Development		Product development & testing	Development		Product development & testing	
						<i>Go to testing</i>			
Testing stages	Test Marketing				Test Marketing	Testing & validation		Test Marketing	
						<i>Go to launch</i>			
Launch/commercialisation stages	Commercialisation	Launch	Launch		Launch	Launch		Launch	
						<i>Post launch review</i>			

Table 3.4: Selected Examples of well-recognised and Recent Stage Models

Authors	Cooper & Kleinschmidt (1986)¹	Wheelwright & Clark (1992)²	Cooper (1994)²	Griffin (1997)¹	Song & Montoya-Weiss (1998)²	Cooper (2008)	Barczak et al. (2009)*
Perspective on process	NPD	NPD	NPD	NPD	NPD	NPD	NPD
Research Type	Recent theory & practice	Book	N/A	PDMA members survey	Survey & literature	N/A	PDMA members survey
Source/Journal	JPIM	Book	JPIM	JPIM	JPIM	Perspective article	JPIM
Industries (if applicable)	Industrial companies in Canada	N/A- Book Based on group's extensive experience	Perspective article; authors experience. Focus on 3 rd Gen. process	Primarily manufactured goods 35% high tech, 35% mixed, 30% low tech	US High-technology industries	Perspective article, based on authors experience	36% high-tech, 26% mix, low-tech 38% (inc. 6.4% FMCG)
Strategy/pre-requisite		Build knowledge & capability			Strategic planning		
Idea stages	Initial screening	Idea generation	Idea generation	Idea/concept generation	Idea development & screening	Discovery stage	Idea Generation
			Preliminary assessment	Idea screening	Business & market opportunity analysis	<i>Idea screen</i>	Idea Screen
Concept development & testing stages		Product definition and selection	Concept			<i>Scoping</i>	
						Second screen	
Strategy development							
Analysis & evaluation stages	Preliminary market assessment			Business analysis		Build business case	Business Analysis
	Preliminary technical assessment						
	Detailed market study/ research						
	Business/financial analysis						
							<i>Go to development</i>
Development stages	Product development	Build & design prototypes	Development	Development	Technical development	Development	Development
						<i>Go to testing</i>	
Testing stages	In-house product testing		Testing	Test and validation	Product testing	Testing and validation	Test and Validation
	Consumer product tests					<i>Go to launch</i>	
	Test market/ trial sale					Launch	
	Trial production						
	Pre-commercialisation business analysis					<i>Post launch review</i>	
Launch/commercialisation stages	Production start-up	Manufacturing ramp up	Launch	Commercialisation	Product commercialisation		Commercialisation
	Market launch						
Post-launch stages							Success

[(*)Barczak et al. (2009) stages are based on those identified in the PDMA survey. It is included on the basis of the survey being widely recognised]

Table 3.5: Selected examples of key NPD Stage Models in the wider literature

Authors	Luchs & Swan (2011)	Unger & Eppinger (2010)³	Finger & Dixon (1989)	Fairlie-Clark & Muller (2003)	Osteras et al. (2006)
Perspective on Process	Design	Engineering Design	Engineering Design	Engineering	Engineering
Research type	Analysis of prior research	Model drawn from prior literature	Review of prior research	Literature review & research in manufacturing companies	Literature review
Source/Journal	JPIM	Journal of Engineering Design	Research in Engineering Design	Journal of Engineering Design	Journal of Engineering Design
Industries (if applicable)	N/A	N/A	N/A	Manufacturing companies	N/A
Strategy/pre-requisite	1) <i>Context & strategy:</i> Firm strategy, external context & inter-firm engagement.	Planning			
Idea stages	2) <i>Product Design Process:</i> Idea generation & screening		Recognition of need	Identify product opportunity	Phase 1: Pre-design
			Specification requirements		
Concept development & testing stages	Concept development & evaluation	Concept design	Concept formulation	Generate proposals	Phase 2: conceptual design
			Concept selection	Evaluate and approve proposals	Phase 3: detailed as I
Strategy development					
Analysis & evaluation stages				Identify requirements & generate PDS	
				Developed product business plan	
Development stages	Technical implementation	System level design	Embodiment of design detail	Generate product proposals	
	Manufacturing	Detailed design iterations		Evaluate and approved project proposals and business plans	
Testing stages		Integration & test		Fund and schedule project	
				Monitor projects	
Launch/commercialisation stages	Commercialisation	Release	Production, sales, maintenance	Design product	Phase 4: component development
				Specify supply processes	Phase 5: prototype development
				Develop new supply resources	
				Evaluate & approve development	
				Validate product	
				Developer support	
Post-launch stages	<i>Consequences:</i> Consumer evaluation & choice, post consumer choice, product success, firm performance.			Release products into product range	Phase 6: production
				Evaluate product launch	

³ Authors note that this may be seen as a spiral process.

Tables 3.3, 3.4 and 3.5 provide further illustration of the complex nature of the NPD process, and the activities involved. Whilst it is not the purpose of this chapter to examine each activity involved, it is worth noting that in many cases, the stages or activities identified are likely to consist of sub-activities and evaluations, each of which may be significant to success. Each stage is therefore effectively a summary of the activities occurring.

The sub-processes and activities are illustrated in Fairlie-Clarke & Muller (2003)'s model. It is generated from both interviews and a review of the literature (Wheelwright & Clarke, 1992; BS 7000; Cooper and Kleinschmidt, 1986; Song and Montoya-Weiss, 1998), and is particularly comprehensive: identifying eighteen key generic elements, or activities. The high number of elements identified is partly a reflection of authors breaking down the main stages found in other models.

It is worth briefly expanding on Osteras *et al.* (2006)'s model, which actually breaks down the main stages identified in Table 3.5 into a number of other sub-activities:

Pre-development (stage 1)

1. Front-end (phase 1) Pre-Design: Identifying customer needs, convert into product characteristics and business objectives, feasibility study, decision as to whether to proceed.
2. Design: Detail on systems and components develop.
 - Conceptual design (phase 2) Identify means of performing each function, fix structural and spatial relationships of components.
 - Detail design (phase 3): Concept is elaborated on to include layout and form, and basic tests of product undertaken (e.g. appearance, function, consumer preference).

Development and production (stage 2)

3. Development: Physical conversion of design into final product to meet customer needs.
 - Component development (phase 4) Components developed and tested.
 - Prototype development (phase 5) Components assembled and a prototype is developed.
4. Production (phase 6): Trials pre-production run, refining manufacturing and quality control, feedback methods established.

A final model that warrants brief expansion is that of Luchs and Swan (2011), which differs from many presented in the tables above as it is focused on product design. Their conceptual model draws together prior research articles in the design field.

They break down the main stages in the model (Table 3.5), providing greater detail (Table 3.6). The identification of packaging design as an example topic is unique amongst the models reviewed - although no detail on its management is provided.

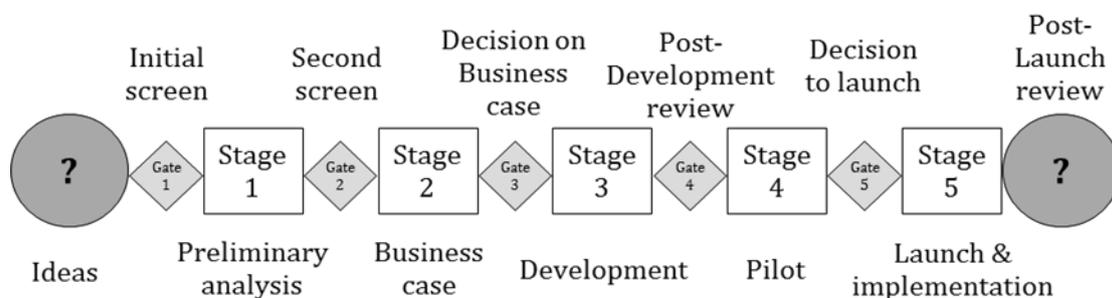
Table 3.6: Examples of topics addressed within each category of product design conceptual model (Adapted from, Luchs and Swan, 2011: p. 331)

General Category	Topic Category	Example topics
Context and strategy	External context	Customer needs Socio-cultural context Competitors Environment
	Firm strategy, objectives, and capabilities	Dynamic capabilities Team performance
	Inter-firm engagement	Role of suppliers Product complexity and supply chain
Product Design Process	Idea generation and screening	Creativity/ideation techniques Concept design techniques
	Concept development and evaluation	Attribute based models (e.g. conjoint) Integrating customer needs and firm capabilities Subjective product characteristics
	Technical implementation	Efficiency & cost Platforms/modular architecture Design for manufacturability, design for environment
	Manufacturing and commercialisation	Product design-manufacturing integration Package design
Consequences	Consumer evaluation & choice	Product form Product function Form-function interdependency
	Post consumer choice	Product use Product disposal Sustainability
	Product success	Dominant design Success rates Sales Market share Brand development
	Firm performance	Sales Market share Brand development

3.2.3.1 Stage-Gate Models

A discussion of stage and activity models would not be complete without specific mention of Robert Cooper's research into 'stage gate' models (Figure 3.2). His research in this area (Cooper and Kleinschmidt, 1993; Cooper *et al.*, 2002) warrants attention, as it has arguably popularised the stage based approach. The model is in many respects similar to the others detailed in this section. However, each main activity stage is followed by an evaluation phase, before the project proceeds. The identification of these evaluation activities represents a more detailed breakdown, arguably inherent in other models.

Figure 3.2: Stage Gate Model of NPD (Cooper *et al.*, 2002, Cooper, Edgett and Kleinschmidt, 2002: p. 5).



The stage gate approach is widely employed in organizations. Its use has been studied in a number of industries: including the chemical (Shaw *et al.*, 2001), automotive and aerospace (Ettie and Elsenhach, 2007; Baback and Holmes, 1999), hardware and software (Oorschot, *et al.*, 2010; Ettie, and Elsenback, 2006) industries, as well as smaller organisations (Skalak, Kemser, and Ter-Minassian, 1997). Furthermore, their use is reported to be widespread within the food industry (Moskowitz *et al.*, 2009).

The model divides effort into distinct time-sequenced stages, separated by management decision gates. Multi-functional teams must successfully complete a prescribed set of related cross-functional tasks in each stage prior to obtaining management approval to proceed. The framework of the stage-gate process includes work-flow and decision-flow paths, and defines the supporting systems and practices necessary to ensure smooth operation.

3.2.3.2 Variations on the Stage Gate model

A number of versions of the stage gate model have been developed and observed (Cooper, 1994 and Hauser, Tellis and Griffin, 2005). Each has a different emphasis, and to some extent overcome particular deficiencies and weaknesses of the stage based approach (addressed in Section 3.4).

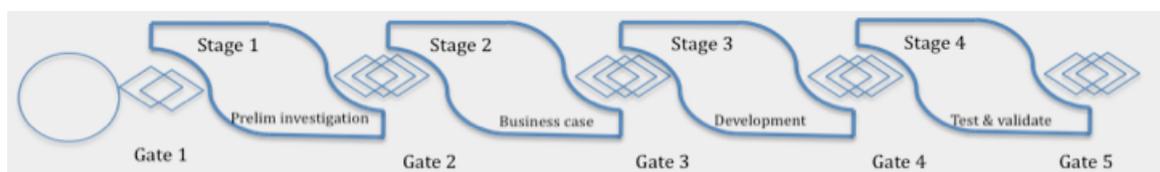
Cooper (1994) refers to these newer variants as ‘third generation’ process models. He suggests that the third generation model should incorporate a number of additions, which revolve around improving the process to (based on what he refers to as the ‘four F’s’):

1. Be *fluid* and adaptable, with overlapping stages where required (which may also be difficult to define).
2. Feature *fuzzy gates*: meaning that ‘go’ decisions do not have to be absolute, but can be conditional.
3. Provide sharp *focus* for resources and management of a portfolio of projects, allowing for decisions that account for the organisation’s projects and portfolio (thus decision making is more complex and advanced).
4. Be *Flexible*, in that each stage of the process and criteria should not be considered mandatory, but depends on the project, situation, and level of risk (thus tailored).

These new types of model emphasise efficiency, in speed and allocation of resources. However, they can make the process more complicated to manage, particularly as there is some freedom and reliance on discretion, thus also providing more autonomy to the NPD team.

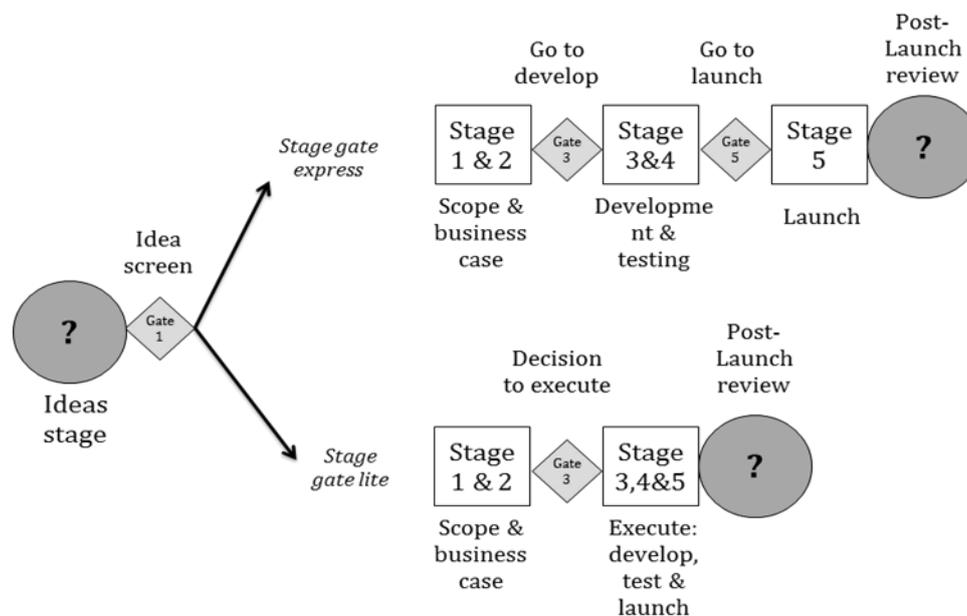
The first variation of stage gate (Figure 3.3) highlights that some organisations have implemented what has been termed ‘fuzzy gates’, allowing some conditional ‘go’ decisions to be made, and hence, what is effectively an overlapping of stages (see Cooper, 1994).

Figure 3.3: Third generation model, adapted from Cooper, 1994 (p. 5).



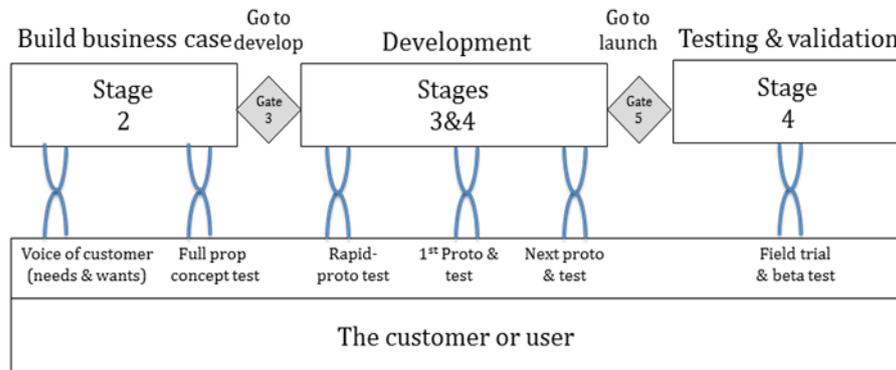
The second major adaption follows Cooper's discussion that organisations have developed variations on the stage gate model (Figure 3.4), based on requirements to make it adaptable and flexible, and scaling it to fit different types of project (Cooper, 1994; 2008; Ettie and Elsenbach, 2007). Two variations are presented: stage gate 'xpress' and 'lite'. The 'xpress' model is intended to be used on moderate risk projects (such as line extension modifications and improvements), whilst 'lite' should be used for minor changes (based on salesforce and marketing requests): thereby rendering the process risk adjustable and scalable. A significant number of organisations have now adopted this approach: skipping stages, overlapping gates, and making conditional decisions (Barczak *et al.*, 2009).

Figure 3.4: Xpress and lite variations of stage gate (Adapted from Cooper, 2008: p.223)



Finally, Cooper (2008) has presented a variation, entitled the 'spiral' development, which incorporates the continual inflow of information, particularly from customers (Figure 3.5). This allows for fluid information to come into the organisation, and continual changes to the product and its design to be made throughout this objective spiral process. It also allows for continual testing and feedback. The spiral model accounts for inputs into the process to a greater degree than the traditional stage gate model, although it largely focuses on consumer inputs.

Figure 3.5: Spiral variation of stage-gate (adapted from Cooper, 2008: p.225)



3.2.3.3 Summary of the literature on Stage and Activity Models of NPD

The preceding discussions have provided an overview of stage and activity based models: revealing that their primary emphasis is on a number of discrete activities, required in order to produce a successful product, which involves a continual ‘gate’ based screening process (Cooper *et al.*, 2002). This could be effectively viewed as a development funnel (Trott, 2008)

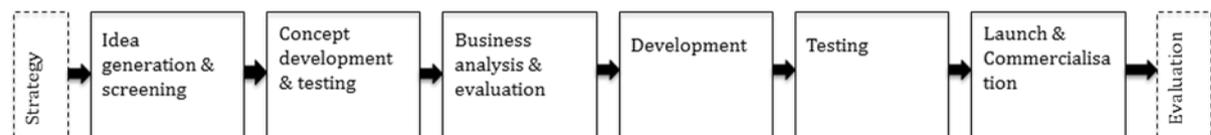
Whilst differences are evident across various models studied, in terms of the activities identified, each theoretical field presents a framework that is broadly similar. An analysis and comparison of these models revealed six broad product development stages. These are identified in the far left column of each table, and drawn together in Figure 3.6. The heterogeneity between the models represents a significant challenge; however, these activities were relatively consistently identified across the majority of models:

1. Idea stages
2. Concept development and testing stages
3. Analysis and evaluation stages
4. Development stages
5. Testing stages
6. Launch and commercialisation stages

In addition, a preceding strategy stage was identified (evident in some models), and an evaluation stage follows on from the process itself. That said, as Cooper’s

research particularly highlights, the process is scalable, and activities can therefore be omitted.

Figure 3.6: Summary of key stages and activities in the NPD process identifiable across a variety of articles analysed in the above tables.



The review of the generic stage and activity based NPD and innovation models revealed a final finding worthy of note. Packaging did not appear within any of these studies, with the single exception of Luchs and Swan (2011), who identify it as a possible topic at one stage of design. This omission is partly explained by packaging not being applicable within some industries. However, in at least some respects, it is surprising: considering the importance of the FMCG industry, and given that around 75% of finished goods require some kind of packaging (Hanlon, 1984).

3.3 Criticisms of Stage Based Models of New Product Development

Stage and activity based models are key to understanding of the NPD process. However, weaknesses of these models have been identified. Balconi (2010) and Dosi *et al.* (2005) have termed this onslaught of criticism as ‘linear model bashing’. Criticisms of stage models have largely focused on two weaknesses: the degree to which they accurately represent the process, and their weaknesses in practice.

It is argued that stage models do not effectively reflect reality. The organisation and sequence of activities within the processes is likely to depend and vary based on the product being developed, as well as the relationship of that project with the firm’s overall activities (Cooper, 1988; Snelson, 1988; Baker & Hart, 2007). Hence, there is no single definitive process (Jewson, 1991).

Building on this, Kotler & Armstrong (1991) describe how some stages may be simultaneous and overlap, or concurrent (Fuller, 1994 and Brockoff, 1999). In 1994, Rosenberg suggested that “*everyone knows the linear model is dead*” (p. 139). Yet

many of the preceding models do little to address the weaknesses of this linear presentation. Indeed, they have a tendency to oversimplify this complex and interactive process. A number of studies have examined the overlapping nature of activities (e.g. Ahmadi and Wang, 1999; Ford and Sterman, 2003a, 2003b; Lin *et al.*, 2008), and the issue of 'rework', which causes a cycle effect in the NPD process (Cooper, 1993). This is not reflected in most models.

The second criticism focuses on the limitations of these models when applied in practice. Trott (2008) provides a brief overview of some of these key limitations:

- The procedure is sequential and therefore will be slow;
- Decisions are focused on the next gate rather than the end of the chain;
- Deviating activities can be stopped or frozen too early. The high levels of uncertainty that accompany breakthrough concepts makes the procedure a model of lost opportunities (explored further by Oorschot *et al.*, 2010);
- Stage gate is a black box with respect to the actual network processes at the innovation shop floor.

Van Der Ven (1988) and Cooper (1994) provide further detail on the potential negative impacts of a stage-based approach: highlighting that the focus of these models is on management control, and the progression of a project through this pre-set process. This has a number of potential negative impacts (Adapted from Van Der Ven, 1988: p 112 and Cooper, 1994: p7-8):

- Slowing the progression of projects, as each must wait at a gate until the entire set of required tasks has been completed, preventing overlapping activities.
- Reducing the smoothness of progression, through waiting at each stage.
- Encouraging and focusing on individual stages, leading to lack of a holistic overview and high-level evaluation criteria.
- Overlapping stages is all but impossible.
- The system does not lead to project prioritisation and focus, thus not aiding sufficiently in the allocation of resources.
- Some new product processes are spelt out in far too much detail, such as a manual of guidance to staff that is too bureaucratic and hard to understand.
- The process itself can become too bureaucratic.

Stage gate models, despite their wide acceptance, clearly have their limitations.

These criticisms have, at least in part, led to the development of Cooper's adaptations of stage gate (Sections 3.2, 3.3). However, other types of models have

also emerged in the literature: overcoming some shortcomings of stage models, and acknowledging that the project must progress through a series of stages, but with overlaps, feedback loops, and resulting behaviours that resist reductionism and linear analysis (McCarthy *et al*, 2006).

3.3.1 Simultaneous and network models

A key criticism of the activity stage models is of their emphasis on the stages of the process, in some respects failing to highlight how the process itself truly works in practice. As evidence of these deficiencies, both Cooper (2008) and Urban & Hauser (1993) discuss how each stage is cross-functional in its nature, and some activities may occur in parallel, yet the models fail to depict this. Similarly, critical external linkages, information, and inputs are not fully captured. Factors such as changes in the external environment may also affect the degree to which NPD occurs in this linear manner.

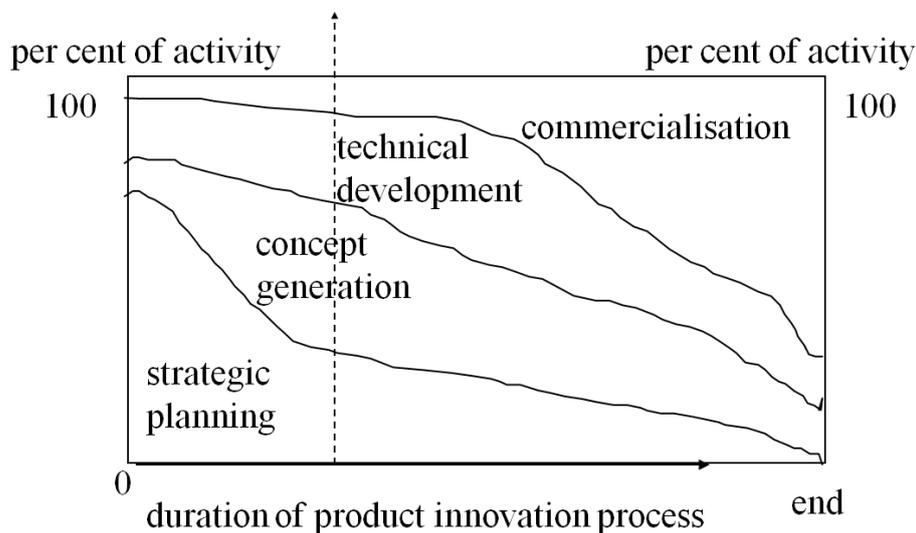
The linear presentation of stage models has resulted in criticism of their accuracy, particularly as the process is actually likely to involve a more dynamic and adaptive approach, rather than a simple linear process. These shortcomings have resulted in discussion of research into a practise 'gap' (Eder, 1998; Frost, 1999). There is also a call for new frameworks that link information and decision making across the organisation, respond to market and technology changes, and open up new innovation opportunities (Nelson, 2004). Models providing two alternative perspectives on NPD can be identified in the literature: activity stage and network models.

3.3.1.1 Activity Stage & Simultaneous Models

A number of models reflecting the simultaneous and overlapping nature of NPD activities have evolved within the literature. These models broadly fall into one of two types. The first emphasises the concurrent nature of stages, whilst the second breaks the product down into a number of modules and relates these to activities required to develop them (in a matrix structure). Each provides greater account for the significance of cross-functional processes and integration (Griffin, 1997; Pinto and Pinto, 1990; Davis, 1993), when contrasted with stage based models.

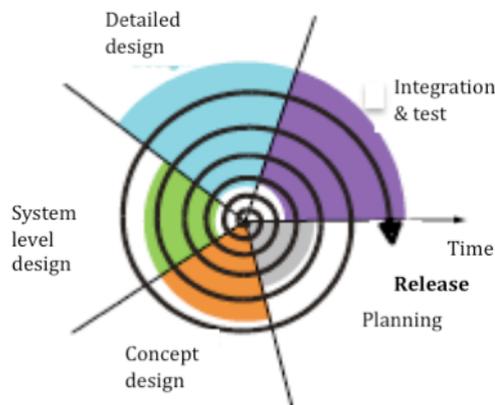
Crawford (1997)'s activity stage model of NPD (Figure 3.7) falls into the first category - depicting the process as comprising of multiple overlapping and interactive stages (Hart and Baker, 1994; Saren, 1994; Souder and Moenaert, 1992), a key characteristic of NPD (Biazzo, 2009). Crawford's model identifies four activities, similar to those in other models. Its emphasis, however, is on representing them as occurring concurrently, but with differing degrees of importance as the project progresses. This view overcomes the linear weaknesses of traditional stage based representations. Fuller (1994) illustrates the importance of this perspective, suggesting that the number of steps modelled, their order, and name, do not matter. What matters is an understanding that these activities overlap and are simultaneous.

Figure 3.7: Activity Stage Model of NPD (Crawford, 1997, reproduced from Trott, 2008: p. 400)



This interactive and concurrent thinking is also reflected in Under and Eppinger (2009)'s (Figure 3.8), and MacGregor *et al* (2006) 's models. Each adopts a different approach, representing the activities as part of a spiral (a view supported by Dahan & Hauser, 2001), and accounting for projects moving between each activity at any time, in an overall spiralling process, until the end is reached. Where applied, these approaches involve less formal reviews and more iterations (Unger and Eppinger, 2010).

Figure 3.8: Unger and Eppinger's (2009) Spiral Model (reproduced from Unger and Eppinger 2010: p. 692)



The key benefit of simultaneous and spiral models is their reflection of the important information exchanges between departments (Gupta *et al.* 1986; Souder and Moenaert, 1992), and the cross-functional nature of the process (Trott, 2008; Brown and Eisenhardt, 1995). The latter is key to enhancing success, due to the information requirements in NPD (Millson *et al.*, 1992). These models have, however, largely been studied in higher technology industries (Biazzo, 2009): including the automotive (Graves, 1987), computer hardware and software (Unger and Eppinger, 2009; Unger and Eppinger, 2010) industries.

The second type of model represents NPD as a matrix of activities (Lin *et al.*, 2008; Ahmadi and Wang, 1994; Gebala and Eppinger, 1991; Steward, 1981). Figure 3.9 is an example of one such model, the Design Structure Matrix. It reveals relationships among technical parameters. Its structure is based upon specified tasks required (represented in A-D on the horizontal axis), in order to build each component of the product or output required (detailed along the vertical axis).

Figure 3.9: Example Design Structure Matrix (Smith and Eppinger, 1997: p1106)

Figure 1 Example Design Structure Matrix

	A	B1	B2	B3	B4	C	D
System Design	A	X					
Component 1	B1	X	X	X	X		
Component 2	B2	X	X	X	X	X	
Component 3	B3	X	X	X			
Component 4	B4	X	X	X	X		
Prototype	C		X	X	X	X	
Testing	D					X	X

Matrix models arguably provide a meaningful view of the concurrent nature of NPD, and reflect the increasingly modular nature of NPD (Section 4.6). However, they do not fully account for the overlapping activities (Lin *et al.*, 2008).

3.3.1.2 Network Models

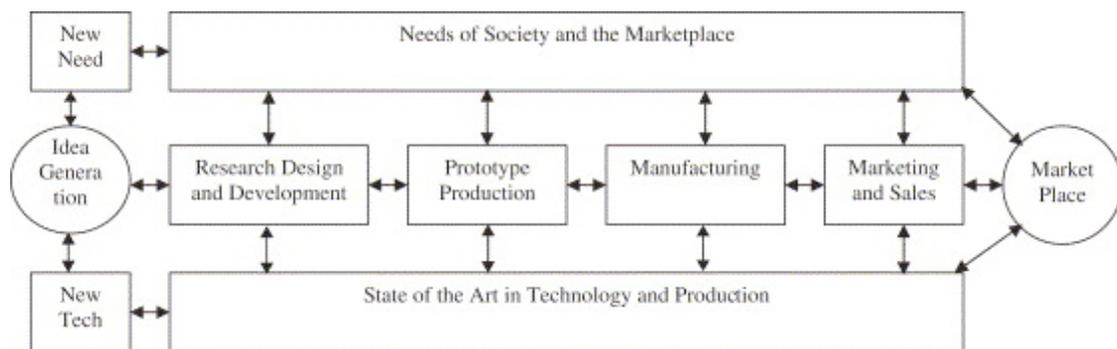
Network models further develop understanding of NPD, focusing to a greater extent on inputs and network interactions. The significance of these interactions is reflected in the growing body of literature on networks, open innovation (Pittaway *et al.* 2004; Chesborough, 2003), and lead user involvement (Von Hippel, 2005). An early example adopting this perspective was Rothwell (1983)'s interactive or coupling model (3.10). Whilst following a stage based approach, the model reflects the non-linear nature of NPD (represented in the arrows) and identifies external interacting linkages.

This model was proposed as a response to a need to cut costs of NPD, as well as understanding success criteria, and methods of reducing failure. Rothwell and Zegveld (1985) describe it as follows (p. 65):

....a logically sequential, though not necessarily continuous process, that can be divided into a series of functional distinct but interacting and interdependent stages. The overall pattern of the innovation process can be thought of as a complex net of communications paths, both intra-organisational and extra-organisational, linking together the various in-house

functions and linking the firm to the broader scientific and technological community and to the marketplace. In other words the process of innovation represents the confluence of technological capabilities and market needs within the framework of the innovating firm.

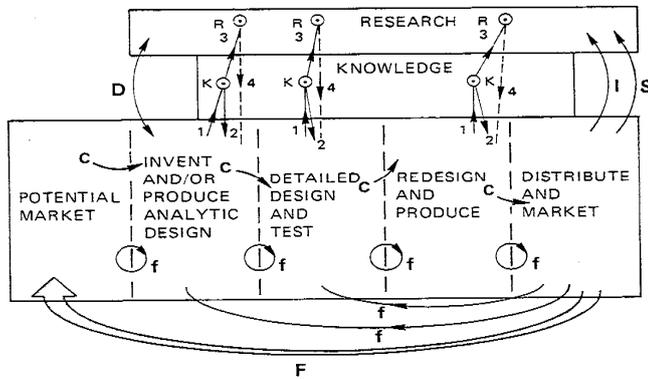
Figure 3.10: The interactive or coupling model of innovation (adapted from Rothwell, 1983; as cited in Rothwell, 1994 and reproduced from Conway and Steward, 2008: p. 68).



A second, similar, framework is the chain link model (Kline, 1985). This attempts to model different paths to innovation, feedback loops, and the importance of external science and research inputs into the process (Figure 3.11). However, these types of model have been criticised in terms of their ‘spaghetti’ representation of the process, and degree to which they are useful as an analytical framework (Kelly and Kranzberg, 1975; Godin, 2004).

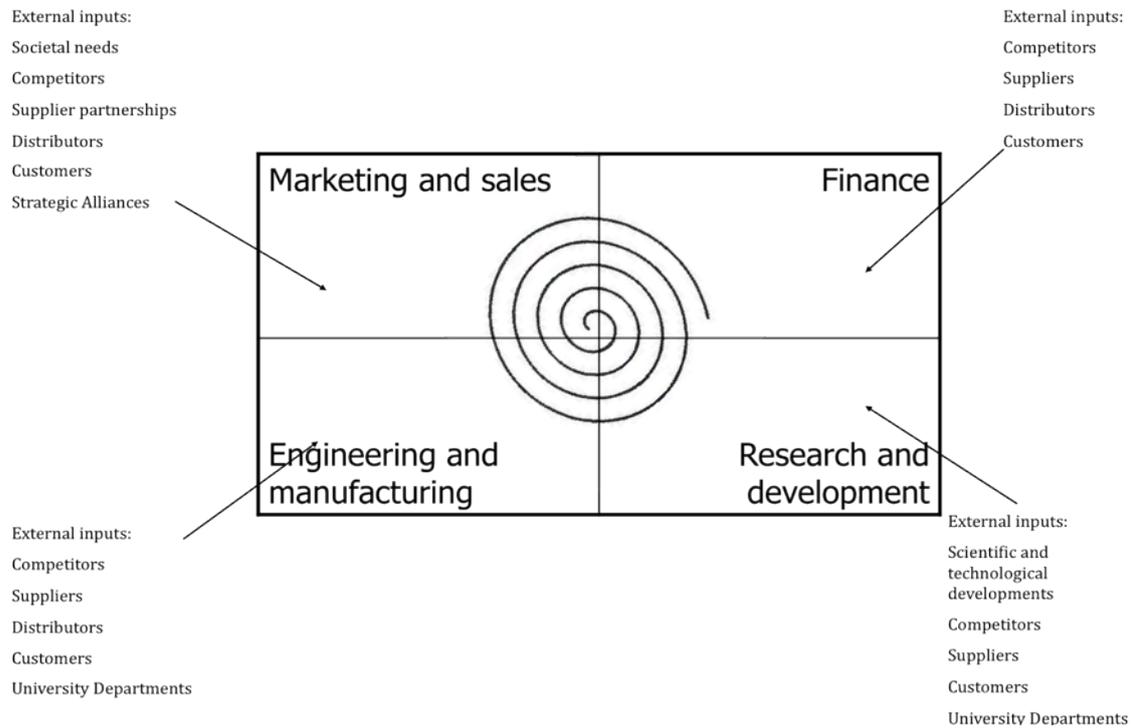
Figure 3.11: Chain link model of innovation (Kline, 1985, reproduced from Klein and Rosenberg, 1986: p. 290), showing flow paths of information and cooperation.

Symbols: C= Central chain of innovation, f= Feedback loops; F= Important feedback.



The above models could be described as an attempt to account for the network inputs through a traditional stage based approach. Figure 3.12, however, represents a different approach, and is focused on the key inputs and knowledge accumulation aspects of NPD, and its external linkages. These linkages, and the information gathered through them, are critical to the network perspective. Arguably, the model provides some indication of the importance of cross-functional teams.

Figure 3.12: A network model of innovation (adapted from Trott, 2008: p. 411)



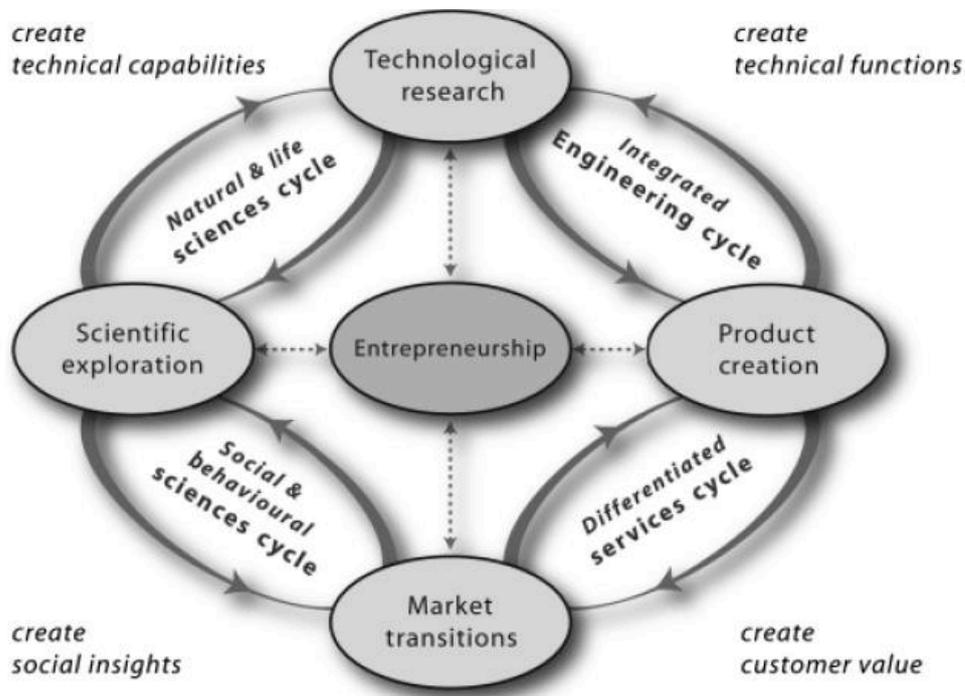
Building on the external perspective, one of the most recent frameworks from the innovation literature is that of the 'Cyclical Innovation Model' (Figure 3.13). The model has been presented in a number of papers (Berkhout, *et al.*, 2010; Berkhout, *et al.*, 2011; van der Duin, P., 2007; Berkhout *et al.*, 2010). CIM aims to help remedy the following weaknesses of limitations of various models and schools of thought regarding innovation management that have been identified (Berkhout *et al.*, 2010, p. 480):

- i. Variations on linear thinking continue to dominate models of innovation. Most innovation models show innovation paths, representing a stage-gate type of activity, controlling the progress from idea to market introduction, rather than giving insight in the dynamics of actual innovation processes;
- ii. Science is primarily viewed as technology orientated (physical sciences) and R&D is closely linked to manufacturing, causing insufficient attention to behavioural sciences. As a consequence, service innovation is hardly addressed;
- iii. The complex interactions between new technological capabilities and emerging societal needs are a vital part of the innovation process, but are under-exposed in current models;

- iv. The role of the entrepreneur (individual or team) is not captured;
- v. Current innovation models are not embedded within the strategic thinking of the firm; they remain isolated entities.

Berkhout *et al.* (2010, p. 484) describe CIM as “a cross-disciplinary view of change processes (and their interactions) as they occur in an open innovation arena”. Its emphasis is on the interaction of both internal and external elements in the innovation process.

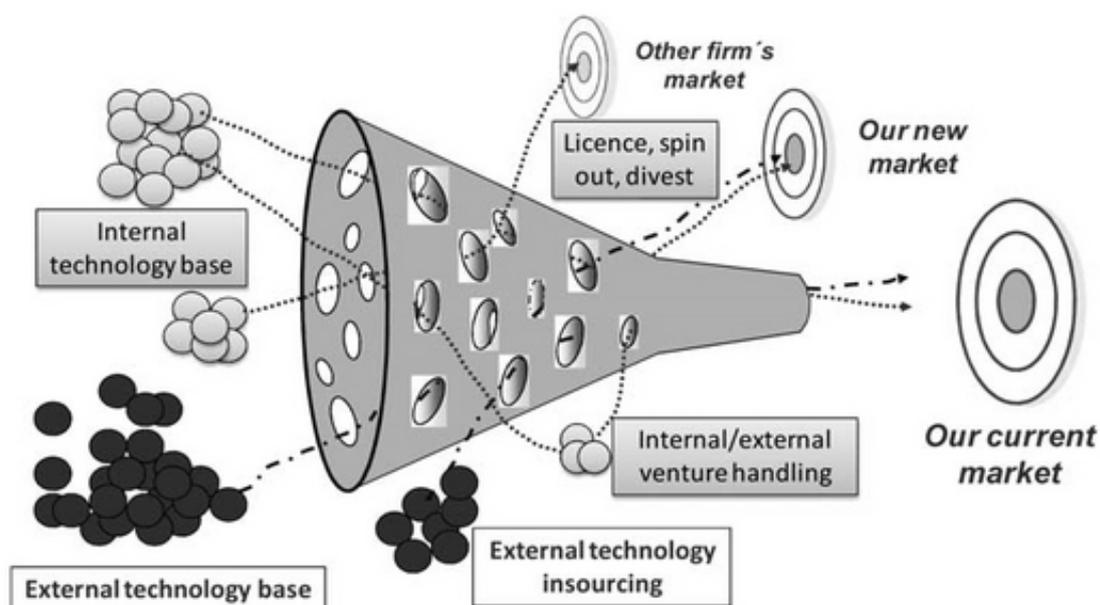
Figure 3.13: Cyclical Innovation Model (Berkhout, Hartmann & Trott, 2011, p. 64)



The open innovation arena is characterized by a ‘circle of change’. Within this circle are changes in scientific insight, technological capabilities, product design and manufacturing, and in the market. CIM therefore represents a change from the traditional sequential models, instead presenting a circle with four ‘nodes of change’, connected by four interacting ‘cycles of change’. Collectively, these four nodes represent the arena of complex, boundary-crossing processes, which occur in modern innovation management. Another distinguishing feature of CIM is the role of entrepreneurship, which has been recognised as central to successful innovation systems and economies (Schumpeter, 1934; cited by Berkhout, Hartmann & Trott, 2011).

Finally, Chesborough's (2004) open innovation concept also warrants brief mention (Figure 3.14). Whilst the concept is not presented as a model of NPD as such, his work has been extremely influential in the areas of R&D management, innovation, and NPD. It once again highlights the significance of these external network interactions in NPD understanding. However, only a few studies, involving single project cases (Huston and Sakkab, 2006; Thomke and Von Hippel, 2002; Vanhaverbeke and Cloudt, 2006), exist in the food industry, each of which had relatively positive outcomes.

Figure 3.14: Open Innovation (Chesborough, 2004, presentation at 10th Annual Innovation Conference, Minneapolis)



3.4 Research into the NPD Process in the FMCG Industry

The preceding Sections of this chapter have reviewed well recognised NPD models. The sections that follow narrow down this focus to the FMCG industry, and subsequently, the food and drinks sectors.

Whilst there is a great deal of literature examining NPD, little research has covered either process industries in general (Lager, 2000; Lager and Blanco, 2010) or the

FMCG sector in particular (Francis, 2009). Indeed, Francis (2002) suggests, “a review of the existing body of literature shows that the majority of knowledge is concerned with single product development environments, typically focusing on large automotive and electronics consumer goods industries”. This is despite the importance of NPD within the FMCG industry (Nancarrow *et al.*, 1998; Francis, 2004; Francis, 2009), and its relatively unique characteristics in terms of high volume, multi product and high variety NPD (Francis, 2002).

The following sections provide a discussion of the key NPD models developed from research within the industry. However, it is also worth briefly noting some relevant findings with respect to NPD as a whole in the industry.

3.4.1 Characterising NPD in FMCG

Arguably the strongest, most unique characteristic of the FMCG industry can be found in its increasingly powerful, sophisticated and demanding multiple retailers. Their power impacts in two key respects. First, by resulting in much of the NPD effort in the industry occurring within the retailers and their outsourced suppliers (see Chapter 2), who undertake much of the development work for own brand products on the retailer’s behalf. And second, on the NPD of brand owners.

As a result of the retailers’ power, the successful marketing of branded FMCG products depends on satisfying their needs (Corstjens and Corstjens, 1995). Retailers act as a filter in selecting products they believe are of interest to consumers, and in order to achieve economies, hence success is reliant on meeting their needs in order for the product to reach the market (Dreze, Hoch, and Purk, 1994; Broniarczyk, Hoyer, and McAlister, 1998). As a result, NPD must be focused on the needs of both the immediate and end customer (Fornari, 2009). With respect to the former - the retailer - product adoption decisions are generally based on three criteria: economic, logistic, and marketing (Fornari *et al.*, 2009). However, it has been found that most sales generated by new products are a substitute for pre-existing products, effectively cannibalising the existing product if it remained (Fornari *et al.*, 2009). Hence, retailers generally only consider adoption if incremental sales are generated, or margins improve for the product it substitutes (Fornari *et al.*, 2009).

The importance of the retailer creates a need for brand owners to develop close relationships between both retailer-focused sales personnel, who bring with them an understanding of the retailer's product demands, and marketing personnel, who provide consumer insights (Cespedes, 1993). Category managers (who have a longer orientation) or trade/customer marketing managers (who have shorter orientations) often handle this integration (Dewsnap and Jobber, 2003). Cross-functional teams can also be key (Dewsnap and Jobber, 2003).

A second characteristic that warrants mention is the low levels of innovative products and, indeed, new product success within the industry. Fornari *et al.* (2009) found that within retailer product assortments, the number of really new products is around 20%; while most are line extensions, new to company packaging adaptations, or enrichments of service contents. Their research uncovered that most successes were launched by brands in a leadership position (Fornari *et al.*, 2009). Francis *et al.* (2006) also found that, in the case of UK retailer Asda, 35% of new products developed by its supplier association were not launched, 17% of those launched were withdrawn within twelve weeks, and only just 48% lasted more than 12 weeks: clearly indicating weaknesses in the NPD process.

Finally, the research of Sakkab (2002), focusing on Procter and Gamble's Connect and Develop open approach to innovation, should also be noted. This revealed an externally focused NPD effort within this firm, with extensive use of information technology to bring new ideas on board. As the following discussions will reveal, the industry is commonly considered to exhibit relatively low levels of collaboration.

3.4.1 New Product Development Models in FMCG industry

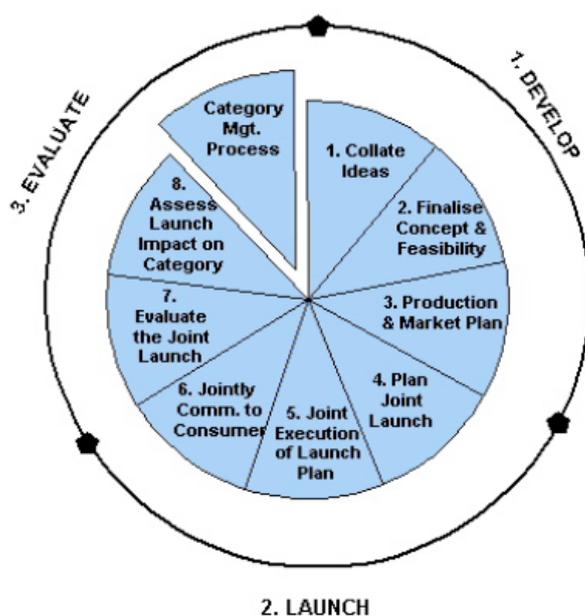
Francis *et al.* (2008)'s paper suggests that, to date, a total of four articles have been published on NPD within the FMCG industry. These include three studies by Francis (2006), Francis *et al.* (2006), and Francis *et al.* (2008), and one by Ernst and Young (1999); although a review of the literature reveals one additional article, addressed at the end of this section (Cooper and Mills, 2005). To some extent, the food sector of the industry has received greater attention (see Section 3.6.1). Few of these studies, however, provide insights into own brand NPD, despite the significance of own label products and NPD (Francis *et al.*, 2006). The following sections provide a brief overview of each model from the FMCG sector, particularly focusing on the findings relevant to this study.

3.4.1.1 The EPI Wheel (Ernst & Young, 1999)

The earliest study on NPD in the FMCG industry (Francis *et al.*, 2008) is that of Ernst & Young (1999). This was based on a consultancy led project involving AC Nielsen, resulting in the development of a model to facilitate collaborative development, launch, and evaluation of products within the FMCG sector. It is referred to as the EPI wheel, which consists of an eight-stage process for the effective management of NPD, involving a sequence of discrete activities unfolding over time.

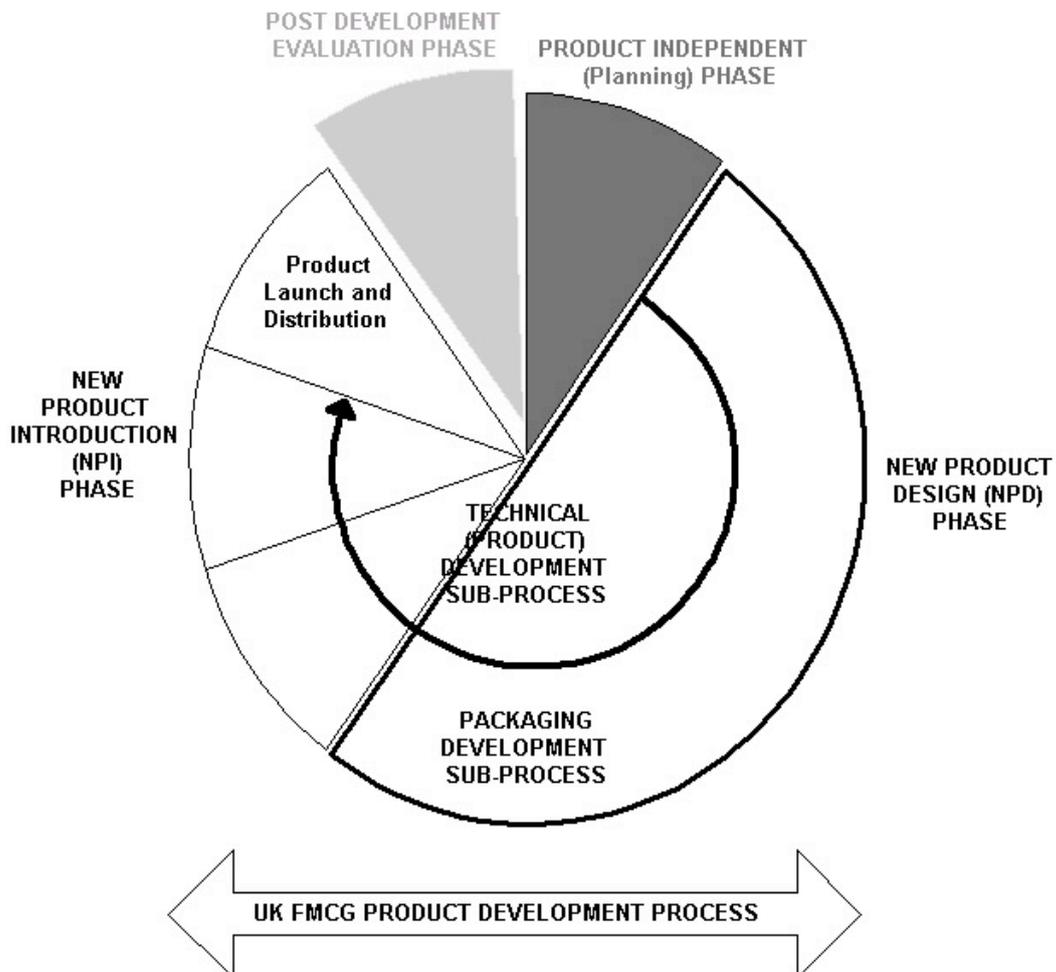
In many respects, the eight-stage process is similar to other generic stage models, whilst being represented as a circle, and is effectively linear in its format. However, the authors suggest the wheel is different in two key respects. First, it aims to integrate standalone category management more effectively, which is important within this sector due to its the key role within supermarkets. Second, it emphasises customer and supplier relationships, both of which are critical to NPD. Indeed, the latter is of particular importance within own brand NPD, as supermarkets do not develop their own products, instead outsourcing much of this to suppliers. Thus contacts between the manufacturer's account management team and retailer's commercial buying team occur throughout.

Figure 3.15: EPI Wheel (Ernst and Young, 1999: Figure Reproduced from Francis, 2006: p. 6)



Whilst Ernst and Young’s model of the NPD process is specific to the sector, it is notable that the model does not provide any detail on the management of packaging. Francis (2006) discusses this omission in his later paper on the management of NPD in Tesco, suggesting that the EPI wheel should be developed further to incorporate packaging’s important role. Figure 3.16 details his basic adaptation of the model, although it is not particularly comprehensive, insightful, or evidence based.

Figure 3.16: Systematic representation of the UK FMCG Industry Stage Model, a development of the EPI wheel attempting to capture the important role of packaging (Francis, 2006, p. 19).

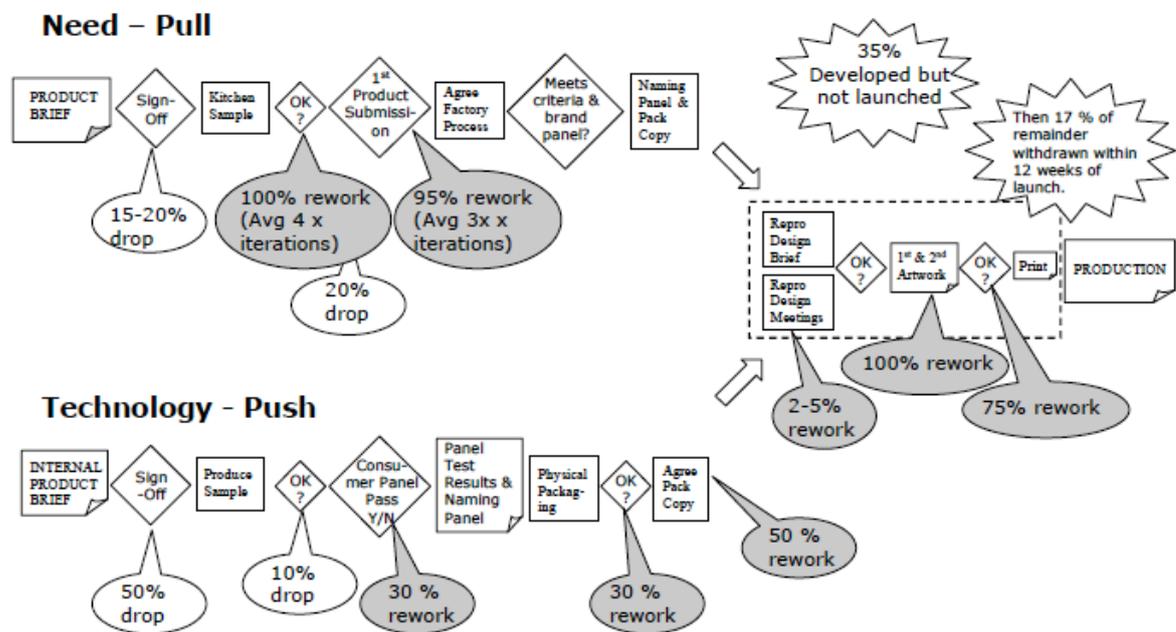


3.4.1.2 Need Pull and Technology Push Models of Asda's Suppliers (Francis, *et al.* 2006)

Francis *et al* (2006)'s conference paper on supplier-led NPD in the FMCG industry focuses on a supplier association initiated by Asda to improve their supply chain practices and promote collaboration. Within this paper, the high level of product failures and associated costs are once again noted: in this case, leading Asda to adopt the supplier association. The unique aspect of category management within the sector is also highlighted. As a result, the authors state that it is necessary to account for portfolio management within the process, based on the large number of products and categories managed (Francis, 2002). Finally, they suggest that whilst supplier incorporation is relatively common within other industries, it is relatively new within the FMCG industry.

The authors attempt to adopt a new method for mapping NPD activities. The models they generate are two simplified process models, identifying different approaches to development used by Asda's suppliers: one adopting a market driven approach, whilst the other follows a technology driven path. Their model (Figure 3.17) identifies the key activities involved in these two different approaches, as well as common end phases. High levels of rework, failures, and waste, are also revealed. Many unqualified individual decisions are found to be an issue, resulting in reworks and delays. The authors suggest these problems reflect a need to get all parties involved up front in the process.

Figure 3.17: Simplified version of the two main Asda suppliers mapped, demonstrating a need-pull and technology-push product development process (Francis *et al.*, 2006, p. 7)



The model developed, based on ‘practice’, provides little detail on the management of packaging. Within the technology push model, a ‘physical packaging’ and ‘agree pack copy’ stage are noted, whilst the market pull model notes one stage on ‘naming and pack copy’. Both then share common repro design brief, meetings, and artwork stages. The detail provided, therefore, is limited largely to labelling and design aspects of the packaging. No insight is provided into the development of the packaging, or format decisions. The researchers suggest there are key differences in the process described in the company’s manuals, versus the actual process in practice: *“The standard Asda process –according to the manual – suggests a far higher concurrency between product and packaging development than found in reality”*.

The authors refer to the ineffective and late consideration of packaging, noting that as the design and artwork activities were subject to a ten week fixed period, commencing these processes late resulted in a ten week bottleneck. They conclude from this that there is a need for the reprographics process to run concurrently, and a clear design brief from the beginning of development. These criticisms, however, clearly focus at the reprographics level.

3.4.1.3 Stage Model of Tesco and its suppliers NPD (Francis, 2006)

Francis' (2006) study on NPD in the FCMG focused on understanding the sequence of stages for incremental NPD projects, the most common type within the sector. The impetus is based on his observations of the nature of NPD in FMCG: particularly the low level of innovative products, and the high levels of complete inactivity he finds within NPD processes.

The results of five case studies of private label NPD projects run by Tesco with different suppliers are presented and analysed: leading to the development of a new model to represent the process. Particular attention is placed on identifying the supplier and retailer's activities within private label NPD, and taking account of the important process of packaging development – which suggests that this provides a more accurate depiction of processes in the industry.

Whilst Francis' depiction of packaging development provides more detail than other papers, his discussion seems idiosyncratic. Although the model (Figure 3.18) presents the processes as simultaneous, this does not reflect his discussion of the results, which suggest that packaging is considered later in the process. Similarly, while his model details a 'packaging design and concept development' stage, the discussion implies that little development actually occurs, and that the process is primarily orientated around artwork. This is also reflected in the model he presents as Tesco's standard model, which is also focused on design and artwork (Figure 3.19). Hence detail on technical packaging development and format decisions is lacking.

Figure 3.18: Stage Model of the Product Development Process in the UK FMCG Industry (Francis, 2006: p. 18)

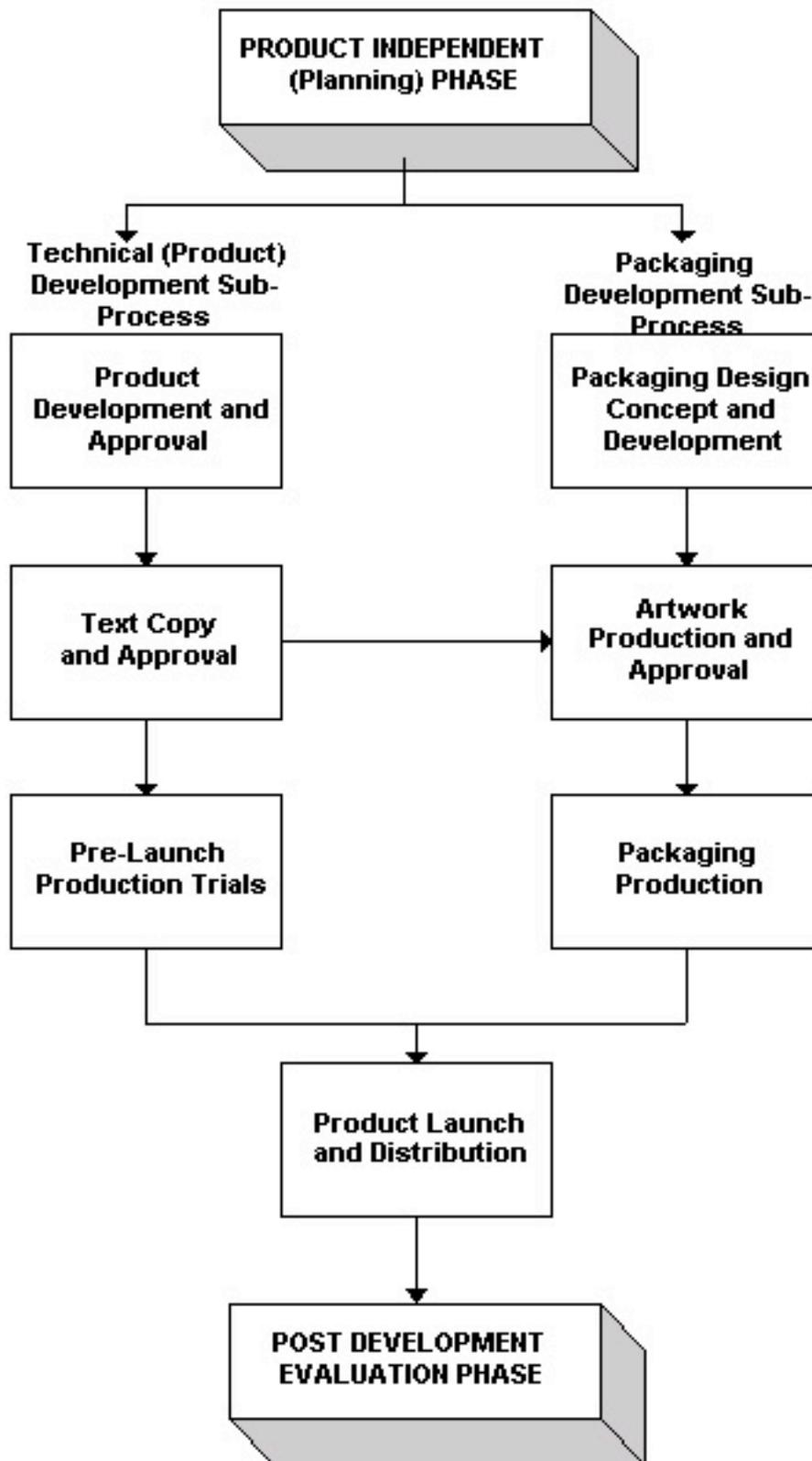
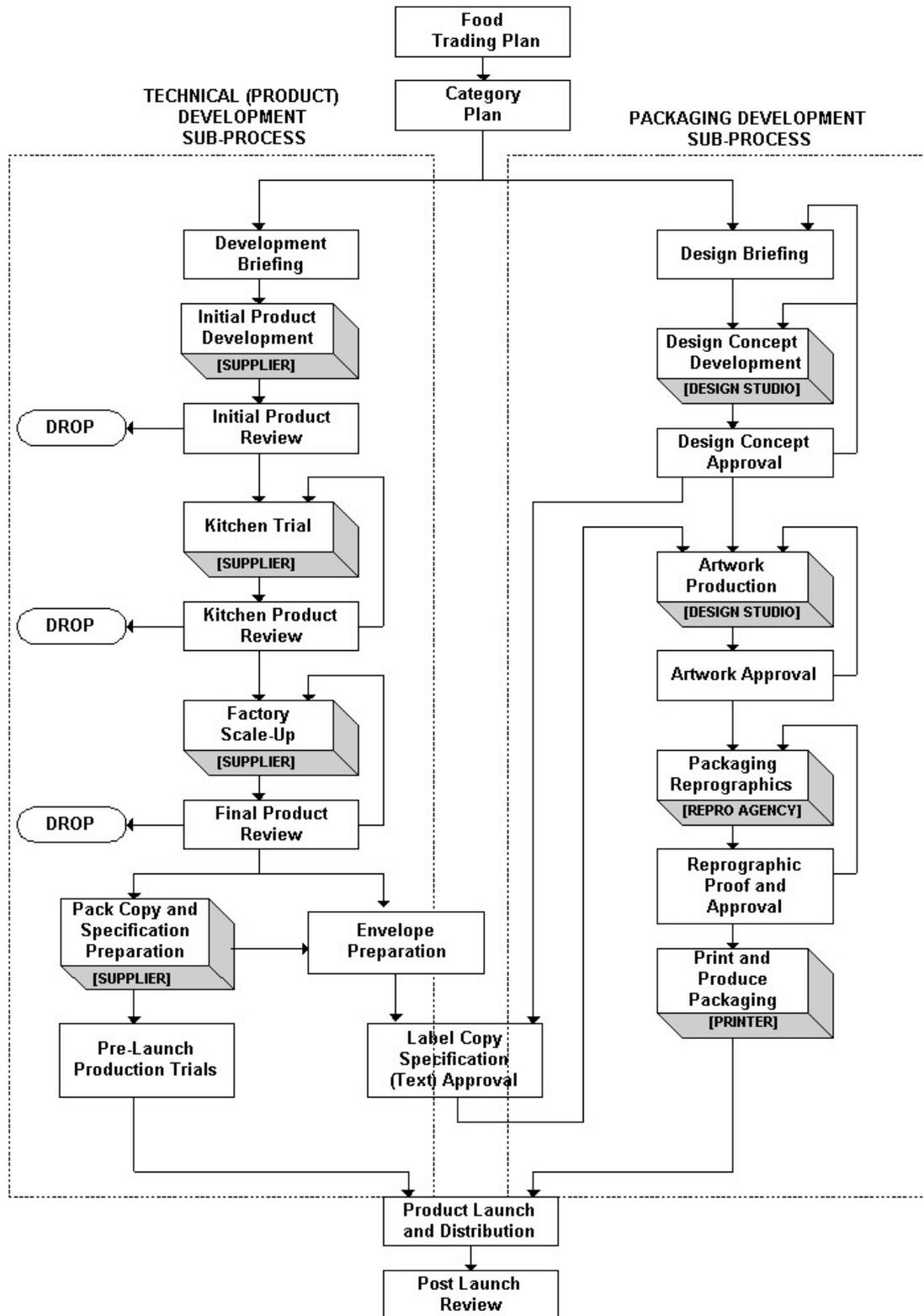


Figure 3.19: The Standard Tesco Food Product Development Process (Francis, 2006: p. 11)

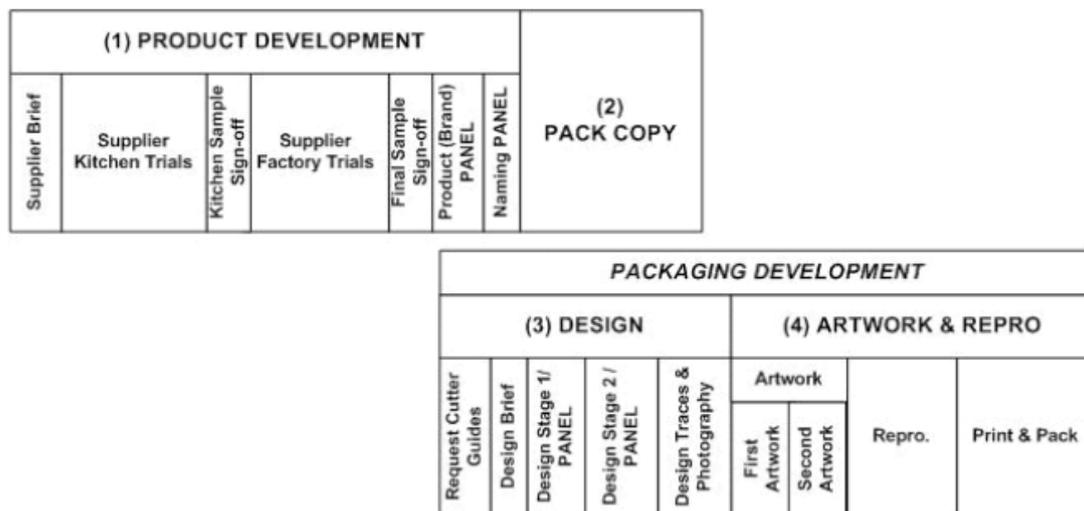


From the analysis, Francis identifies a need for a new model to recognise the dual product and packaging development imperatives within the industry. The research, however, fails to adequately provide the insights required.

3.4.1.4 The Bullseye Approach (Francis *et al.*, 2008)

Francis *et al.* (2008) generate a model of NPD based on their research into Asda. Whilst it is not intended to be a generic model, it is possible to gain insight into the company's process.

Figure 3.20: Conceived Bullseye Process configuration within Asda (Francis *et al.*, 2008: p. 210)



Whilst this research provides relatively limited insight into NPD, even fewer insights into packaging development are created. The model again focuses primarily on packaging design stages, and provides no insight into the actual development of the packaging or technical decision making. The model does, however, suggest that packaging is a relatively late consideration, largely focused on design and artwork (or pack copy). The research also suggests that much of the process may be handled by external suppliers.

3.4.1.5 Procter and Gamble's SIMPL Process: An idea to launch stage gate model (Cooper and Mills, 2005)

Cooper and Mills' (2005) article on Procter and Gamble (P&G)'s NPD efforts presents a model of this company's stage gate approach. The model presented represents the company's system, rather than how its process works in practice. It is

based on the stage gate process approach to NPD, with a focus on upfront homework and consumer research to gain insights; with a clear go/kill criteria, and an emphasis on its rigorous nature.

Figure 3.21: P&G SIMPL Process An Idea to Launch Stage Gate Model (Mills, 2004, in Cooper and Mills, 2005: p. 12)

The Five Stages:

DISCOVER	DESIGN	QUALIFY	READY	LAUNCH
Promising Consumer Proposition	Integrated Business Proposition	the Initiative	Prepare Market Launch	Execute Market Entry

The Four Gates:

	1	2	3	4
Key Decision	Staff it?	Design complete? Start implementation?	Criteria met? Launch plan agreed?	Ready for launch?
Milestone	Project Establishment	Project Commitment	Launch Plan Agreement	Launch Authorization

The model presented here represents a relatively standard stage based approach: indeed, little tailoring to the industry is evident. Within this model, packaging is clearly omitted, and the authors' discussions also fail to provide insights.

3.4.2 Research into the NPD Process in the Food and Drinks Sectors

NPD within the food sector has received greater attention within the literature in comparison with FMCG. As a result, more models exist, and are detailed in the following sections; but before doing so, it is also worth considering other salient findings from prior research in these sectors. The following two sections will characterise NPD, and detail factors identified as affecting success and failure.

3.4.2.1 Characterising NPD in the Food and Drinks Sectors

NPD is an activity of significant importance within the food sector. Table 3.7 provides a brief summary of factors contributing to its importance, identified in prior research. It is worth noting the importance of the product cycle, as Fuller, Dekker and Linnemann (1998) and Fuller (1994) have highlighted that overall profitability in the

sector relies on an organisation's ability to initiate product lifecycles regularly through new introductions.

Table 3.7: Summary of factors contributing to the importance of NPD, and the NPD process, in the food sector.

Earle (1997)	Fuller (2004)	Fuller (2004)
Factors promoting the importance of an effective NPD process	Corporate reasons promoting the importance of NPD	Factors and forces promoting the importance of NPD
<ul style="list-style-type: none"> • The need to look at the entire food production system, to ensure food products have maximum shelf life and quality, as well as integrating the entire offering from each supplier for optimum performance. • Rising consumer concerns in regards to product quality, safety, and social and environmental impact. • The ability to effectively design food products, such as utilising scientific developments and mathematical models to create new healthier products, thus requiring greater technical design skills. • The need for food producers to become more economically efficient in development, in particular becoming faster, cheaper, and developing more effective products. • Multinational competition, and the differences in consumers between different countries. 	<ul style="list-style-type: none"> • The desire to grow the business, particularly into new geographic areas, requiring new product configurations and ingredients (particularly where transport is involved) • Achieving greater market penetration (through better products, new additions to a product line, or better packaging) • Developing new products for new growth opportunities • Acquiring rivals creating new opportunities • Cutting the costs of the product, its production, or packaging. 	<ul style="list-style-type: none"> • The product lifecycle creates a need for renewal • New products offer opportunities for growth • New markets are created, such as organic and fair trade, either through changes in consumers or other factors • New knowledge and technology make new products possible that were not previously • Changes in legislation, the population/marketplace (such as growing numbers of elderly people), policies, and agriculture, among other factors, create a need for new products • Each of these factors can be critical to creating new opportunities or affecting the success of products.

Food and drink NPD involves the integration of knowledge from consumer behaviour and perceptions, neuroscience, biochemistry, physiology and genetics (De Rooij, 2000; for more details on the types of technical processes involved, see Bruin and Jongen, 2003; Jousse, 2008). Managing this complex process is of great importance, especially in meeting changing market needs and taking advantage of new opportunities (Rudder *et al.*, 2001).

Despite the importance of NPD, the sectors in general are characterised by low levels of expenditure on R&D (Galizzi and Venturi, 1996b; Earle & Earle, 1997; Mark-Herbert, 2003), which may be linked to the low levels of innovation detailed below. In Sweden, for example, R&D expenditure is typically less than 2% of turnover (Mark-Herbert). A number of reasons for this have been suggested, including takeovers leading to combined departments and funding, the industry's recent emergence as a science-based industry, the relative importance of marketing within many companies, small margins, and the difficulty of gaining intellectual property protection (Earle &

Earle, 1997). It may also be partly explained by most inventions and innovations originating outside the industry (Galizzi and Venturi, 1996b; Traill and Grunert, 1997; Braadland, 2000). This highlights the need to look beyond the food industry itself when examining NPD. This is not reflected in the existing research (Section 3.6.1).

Siegrist (2008) has suggested that after many years of being slow moving, the sector has become more focused on innovations in marketing, distribution, development of new products, and packaging. Changes in the environment are creating the need to respond customer demands (Regmi and Gehlhar, 2005). Technology is being used by companies to differentiate their products (Katz, 1998) and build long term advantages (Gehlhar *et al.*, 2009).

Prior research suggests the NPD models and processes utilised are flawed and ineffective (Rudolph, 1995; Buisson, 1993; Rudder *et al.*, 2001). The stepwise models in use are over simplistic and not team orientated (Stewart-Knox and Mitchell, 2003). Rudolph (1995) sights two issues highlighting weaknesses in the management of NPD: high product failure rates; and low numbers of innovative products. The former results in only a handful of new products surviving (Rudolph, 1995), with two in three not making it beyond their first year on supermarket shelves (Anon, 1999). The cost of this failure, as well as those projects that fail before launch, is substantial (Urban and Hauser, 1993), and the chances of new product success are decreasing (Buisson, 1993; Rudder *et al.* 2001).

The second, linked, issue is the types of products being developed. There is a low rate of innovation in the industry (Stewart-Knox, 2003), with only 7-25% of products launched being truly novel (that is, new to the consumer) (Lord, 1999; Rudolph, 1995). This is despite evidence that more original product concepts, as opposed to 'me-too' or 'copy-cat' products, are likely to be successful (Hoban, 1998; Knox *et al.*, 2001; Van Trijp and Meulinberg, 1996; Kristensen *et al.*, 1998; Van Trijp and Stweenkamp, 1998; Stewart-Knox and Mitchell, 2003). By contrast, however, Lord (2000) found that 72% of truly new products and 55% of line extensions fail. A linkage between these two issues is evident, as it seems that the high level of failures is causing companies to switch to re-developing old products in order to create 'new' products in an attempt to increase their success rates (Liori *et al.*, 2001; Kristensen *et al.*, 1998; Van Trijp & Meulinberg, 1996). In reality, this approach simply perpetuates failure (Stewart-Knox and Mitchell, 2003).

Research found decreasing numbers of new product introductions from the mid-to-late 1990s into the twentieth century (Friedman, 1990; Kantor, 1991; Harris, 2002). Fuller (2004) has suggested that a number of factors may be associated with this reduction, particularly:

- The consolidation of food companies
- Better market research, leading to fewer poor products being introduced
- Retailers giving more attention and space to their own private label products
- Saturation of some categories

Whilst some of these findings are dated, they do provide an indication that there may be problems with the NPD processes being utilised in this industry. Indeed, Earle (1997) has suggested that the process needs to become more focused, quantitative, rapid, and knowledge based. However, it is not clear if these issues have been addressed in recent years.

3.4.2.2 Factors affecting success in the NPD process in the Food and Drinks Sectors

Before examining the models of NPD in the sector, it is worth detailing the key findings of a number of articles focusing on the factors affecting product and product development success. Considering the high level of product failures, this is a key area of research.

Existing research has highlighted that consumer and market knowledge, as well as retailer involvement, are key to success (Earle, 1997b; Buisson, 1995; Hoban, 1998; Kristensen *et al.*, 1998; Stewart-Knox and Mitchell, 2003). The importance of consumer input results in a need to put them at the beginning of the 'food chain' (Costa *et al.*, 2001; Lord, 1999; Dekker and Linnemann, 1998; Moscovitz, 1994; Saguy and Moscovitz, 1999; Urban and Hauser, 1993; Von Hippel, 1978). This is particularly important because of the increasing power of buyers, their high demands and complex choice processes (Costa and Jongen, 2006; Grunert *et al.*, 1996; Linnemann *et al.*, 1999; Meulenbergh and Viaene, 1998). Research in this area, however, remains scarce (Grunert and Valli, 2002; Jager *et al.*, 2003; Costa and Jongen, 2006).

Cooperation in food supply chains has been highlighted as important to success (Zuurbier *et al.*, 1996; Van der Vorst, 2000; Benner, 2005; Olsen *et al.*, 2008; Beckeman and Olsson, 2011), as well as strategic partnerships (Hood *et al.*, 1995;

Hughes, 1996; Suwannaporn and Speece, 1998). Indeed, a great deal of R&D is imported into the industry, including in processing and packaging (Hollingsworth, 1995; Galazzi and Venturi, 1996). Creating links with these technological partners will enable the creation of new commercial processes (Fryer and Versteed, 2008). Utilising outside agencies and enlisting technical expertise have also been identified as beneficial to success (Stewart-Knox and Mitchell, 2003). However, information exchange and close cooperation in strategic projects are not commonplace in the industry (Van Dalen *et al.*, 1997; Stijnen *et al.*, 2002),

As with the FMCG sector as a whole, the retailer is a particularly significant partner. It is often more common to use them for market information, than for manufacturers to gather the data themselves (Hoban, 1998; Parr *et al.*, 2001), which arguably contrasts with other industries. Indeed, it seems that many food producers use few other sources of data, such as suppliers, consultants, research organisations, and trade journals (Stewart-Knox and Mitchell, 2003).

Stewart-Knox and Mitchell (2003) and Fuller (2004) provide a summary of key articles which provide insights into the factors affecting NPD and product success respectively (Tables 3.8 and 3.9). Whilst Fuller (2004)'s elements are focused on the product itself, they do provide some insights into aspects that need to be incorporated in to the NPD process, and its management.

Table 3.8: Factors determining success in new product development (Adapted from Stewart-Knox and Mitchell, 2003: p. 60).

Source of data	UK model (stewart-Knox <i>et al.</i>, as cited in Stewart-Knox and Mitchell, 2003)	Danish model (Kristensen <i>et al.</i>, 1998)	USA survey (Hoban, 1998)
Unique product of high quality	Original concepts more successful	Product adaptations more successful	Most important factor for success
Market/consumer knowledge	Predictive of success Assumed from retailer	Predictive of success	Second most important factor for success
Senior management involvement	No association with outcome	Predictive of success	Third most important factor for success
PD organised/technical synergy	No association with outcome	No association with outcome	Factor for success
Customer/retailer involved	Predictive of success	Predictive of success	Factor for success
Suppliers and others involved	Predictive of success	Not assessed	Factor for success
Food technologist involved	Predictive of success	Not assessed	Not assessed

Table 3.9: Elements of success and failure in new food product introductions
(adapted from Fuller, p 234).

Kraushar (1969)	Best's 4 plus 1 P's (1989)	Gershmanis 12 P's	Morris (1993)	Wang (1999)
Product not appropriate Product faddish Wrong timing Pricing incorrect Product is wrong (may not perform, or be significantly differentiated) Poor communication of a suitable image Lack of objectivity	Product Place Price Promotion Perspective	Perception Pitch Packaging Price Promotion Promises Piggybacking Positioning Placement Premiums Publicity Perseverance	Inadequate market research: no market need or changing needs Management: no commitment with budget and resources or no strategic focus Risk aversion and short-term orientation: me too products or line extensions Poor fit with company capabilities No formal NPD process	Lack of funding for long term research, combined with short-term goals Time pressures too short Career risk in pursuing innovation Poor recognition of skills for development Poor management of development skills Cannibalization of existing products Wrong research: established brands can cloud new research thinking

In addition, two other studies warrant note. Fuller (2004)'s study itself identifies five factors of importance to NPD success: organizational structure, administering technical departments, the key role of the technical manager in terms of resources, the key role of external informal networks (as part of the organization's overall structure), and the human side of NPD. The CCFRA's industry guide (2007), a well-recognised reference in the sector, highlights six prerequisites to successful NPD:

1. Company-wide commitment
2. Good use of resources and involvement of all sections of the company
3. Good communication and motivation
4. Creative liaison between technical and market-orientated staff
5. Constant awareness of commercial and technical factors
6. Clearly understood objectives and a good brief

Finally, the study of Costa, Dekker, and Jongen (2001) also raises the potential importance of a Quality Function Deployment approach (QFD) within the industry, which may enable companies to bring together and integrate different disciplines, expertise, and consumers, into the process.

Overall, the above studies highlight a wide variety of factors. In many respects, these reflect the wider literature on NPD (appendix 3.3). However, a number are relatively unique to this sector, particularly:

- The importance of the retailer
- High levels of product failure
- Low levels of innovative products, and aversion to risk
- The significance of packaging
- Product placement
- Short term orientation
- The need for food technologist involvement

It is interesting to note the short-term orientation, low levels of innovation, aversion to risk, and high failure rates: all of which may be linked, and suggest a need to ensure the process is focused on longer term and more radical (less incremental) development projects (this issue is covered further in Section 3.5). Finally, with respect to this research, it is noted that only one of the above studies indicates packaging as one of these factors. The following Sections explore the existing models of NPD in the food and drinks sectors.

3.4.2.3 Models of the new products process in the Food Industry

Research into the food NPD process began in the 1960s (Benner, 2005), with the work of Buzzell and Nourse (1967). This focused on the set of technical stages in the process; and was later built on by Earle *et al.* (1968), who looked at go-no-go decisions and the role of the both management and the consumer. Earle (1997) provides a useful summary of some earlier models in the literature (table 3.10).

Table 3.10: Emergence of stages in process, 1967-95 (Adapted from Earle, 1997, p. 20)

Stage	Buzzell and Nourse (1967)	Desrosier and Desrosier (1971)	Meyer (1984)	Rudolph (1995)
Business strategy		Management determination of product fields – improved, new and 'new-look' products	Develop clear corporate objectives Draft strategies and operating plans	Strategic plan Market opportunity assessment Product business plan Product definition
Product and process development	R&D	Exploration Screening Evaluation Development	Generate new concepts Screen, test and prioritise new concepts Translate concepts into optimized prototypes Refine prototypes with consumer sensory tests Scale up production from pilot plant to commercial operations	Prototype development Scale up and trial production run
Product testing	Product testing	Testing	Conduct in-home use test	
Market testing	Test marketing	Marketing communications development Market testing	Products in market simulation tests Test new product line	Market strategy and testing
Product launch preparation		Building production capacity and inventories Readying sales force and distribution		Product introduction
Product launch	Limited area introduction Full scale introduction	Full-scale introduction	Product line into national distribution	Product support
Post-launch evaluation		Measurement and evaluation		

Fuller (2004) provides an update to Earle (1997)'s overview, by citing a number of models generated through the period from the 1970s to late 1990s (Table 3.11). He notes that differences in these models represent the changing, evolving thinking and philosophy of NPD through this period.

Table 3.11 Models of the NPD process (Adapted from Fuller, 2004: p 26)

Holmes (1968, 1977)	Crockett (1969)	Mattson (1970)	Oickle (1990)	Graf & saguy (1991)	Skarra (1998)
Company objectives Exploration Screening Business analysis Development Testing Commercialization Product success	Search opportunities Transaction of concepts into products Marketing plan Implementation of marketing plan	Idea generation Concept screening Preliminary formulation Taste panels Final formulation Trial placement Fine tuning Package design Co-packers Mini-market test Symbiotic distribution	Exploration Conception Modelling (prototypes) Research and development Marketing plan Market testing Major introduction	Screening Feasibility Development Commercialization Maintenance	Assessing management commitment Finding the right idea Developing the business case Development and commercialization

The models identified within these tables are largely stage based and sequential, which reflects the nature of the process within this industry (Buisson, 1995; Fuller, 1994; Stewart-knox and Mitchell, 2003, van Tripp and Steenkamp, 1998). Hence they can be criticised for this stage-based thinking. However, Fuller (2004) suggests that whilst their presentation is sequential, they should not necessarily be viewed in this way.

The above tables provide a useful overview, and insight into the evolution of these models through the years. However, a review highlights a number of more recent models that have not been addressed in the preceding discussions. Tables 3.12 & 3.13 summarise these, using the same structure to classify the stages as in Section 3.3.3. These tables are not intended to be comprehensive; rather, they provide an overview of selected relevant and key papers. For example, a number of other frameworks are excluded as a result of their focus on particular issues, such as knowledge management (Bogue and Sorenson, 2009), continuous learning (Suwannaporn and Speece, 2000), functional foods (Granato *et al.*, 2010), nutraceuticals (Broring and Cloutier, 2008), reduced fat NPD (Knex *et al.*, 2003), and a QFD or chain driven approach (Benner, 2005).

Table 3.12: Comparison of models of new food NPD models within the literature 1991-1995

	Graf & Saguy (1991)	Urban & Hauser (1993)	Fuller (1994)	MacFie (1994)	Rudolph (1995)
<i>Research type</i>					
<i>Pre-development</i>					Strategic plan
<i>Ideas stages</i>	Screening	Opportunity identification	Idea screening		Market opportunity assessment
<i>Concept development and testing stages</i>		Design	Screening of ideas	Concept generation	
				Concept screening	
<i>Analysis and evaluation stages</i>	Feasibility	Testing			Product business plan
<i>Development stages</i>	Development		Development	Product development	Product definition
			Production		Prototype development
<i>Testing stages</i>			Consumer trials	Product testing	Market strategy and testing
				Packaging development	
			Test market		Scale-up and trial production
<i>Launch and commercialisation stages</i>	Commercialisation	Introduction		First production run	Product introduction
	Maintenance	Life-cycle management		Launch	Product support

Table 3.13: Comparison of models of food NPD models within the literature 1997-2008

	Earle (1997)	Linnemann <i>et al.</i> (1998)	Earle and Earle (1997)	Stewart-Knox & Mitchell (2003)	Fuller (2004)	CCFRA (2007)	Jousse (2008)
Research						Industry Guide/experience	Literature review
Pre-development	Product strategy and planning	Analyze socioeconomic developments in particular markets	PRODUCT STRATEGY DEVELOPMENT		Company objectives Perceived needs of the market		
Ideas stages		Translate preferences and perceptions of consumers into consumer categories	Initial screening, market assessment, & research.	Consultation	Ideas	Need identification Idea evaluation and selection	Consumer understanding/ modelling
Concept development & testing stages		Change consumer categories into 'product assortments'	Product concept development	Concept	Screening	Concept development	
		Group 'product assortments in product groups in different stages of the food supply chain'					
Analysis and evaluation stages		Identify processing technologies required for particular product groups Analyze the state of the art in required processing technologies Compare the state of the art with future needs	Financial feasibility study			Preparing the brief Feasibility and viability Planning and project management	
Development stages	Creation, design and development of the product		PRODUCT DESIGN AND PROCESS DEVELOPMENT Prototype design	Recipe	Development: bench top and pilot plant	Implementing product development	Product development/ Package selection
	Production process, marketing strategy, quality assurance, commercial product			Technical development	Production		Process development
							Supply chain selection
Testing stages			In house testing, consumer testing		Consumer trials		Factory trouble shooting
			Scaling up		Test market		
Launch and commercialisation	Launch and post-launch		PRODUCT COMMERCIALISATION Trial production	Market			Product-consumer interactions

<i>stages</i>			Market test				
			PRODUCT LAUNCH AND POST-LAUNCH Business analysis, Production start up, Market launch, Post launch operational & financial analysis			Reviewing the outcome	

Seven of the models presented above warrant further examination. First, Rudolph (1995) develops a model of the process based on his study of a single firm, which aims to overcome weaknesses of other models in prior research. The models of Fuller (1994), and Gray and Saguy (1991) are also worth examining: Rudder *et al.* (2001) suggest that these are most appropriate to the food industry. MacFie (1994)'s model is discussed, due to its mention of packaging. Finally, the study of Bigliardi *et al.* (2011) is included, as it uniquely addresses the influence of the production process.

3.4.2.3.1 Rudolph's Model of NPD in the Food Industry

Rudolph (1995) studies the NPD process of a single firm, 'Arthur D. Little', in the food industry. Whilst this model is summarised in Table 3.12, it can be expanded on further, based on the three main phases (Table 3.14).

Table 3.14: Summary of Rudolph's (1995) Model based on Arthur D Little

Phase 1: product definition phase	<ul style="list-style-type: none"> Strategic Plan-combining; company direction, market served, market positioning, competitive environment, regulations, core competencies, profitability etc. Market Opportunity Assessment-consumer research characterising the market opportunity. Business Plan-documentation that describes the market opportunity and the program required to realise the opportunity. Product Definition-integrating consumer perceptions, business objectives, the definition of the product requirements, and regulatory requirements.
Phase 2: Product Implementation phase	<ul style="list-style-type: none"> Prototype Development-development of the product prototype to meet the objectives. Benchmarking Product Optimisation Market Strategy and testing-long-running sales forecasts based on market test analysis. Scale-up and trial production-Manufacturer the product and total quality program.
Phase 3: product introduction phase	<ul style="list-style-type: none"> Product Introduction-led by sales, supported by marketing and its solution. Product support-building success and repeat business, and providing feedback to functional areas of the organisation.

The interesting aspect of this firm's process model is that Rudolph suggests that it is flexible, evolving, and milestone driven, and therefore superior to the flawed models adopted by other firms in the industry. In particular, the milestone focus of the model is suggested as important, as it requires key deliverables at each stage. Interestingly,

packaging features little in this product development process, and is not cited as a source of new products, but briefly referred to as a consideration only after product opportunities have been identified and evaluated. Despite its apparent advantages, the model makes no reference to the management of packaging, and also provides little detail on the influence of the production process.

3.4.2.3.2 Graf and Saguy (1991)'s model of NPD in the Food Industry

Graf and Saguy (1991)'s model of NPD divides it into a five-stage process, or what they refer to as 'phases':

1. Screening
2. Feasibility
3. Development
4. Commercialisation
5. Maintenance

Although the generation of ideas is not referred to as part of this process, the authors do discuss this as denoting the start: suggesting that in this industry, it may involve brainstorming, incorporating food technologists, home economists, and marketing personnel. The output of this involves a list of products and quality attributes. After developing ideas, factors such as quality, potential for processing, shelf-life, distribution, and the type of packaging, would need to be considered before proceeding to feasibility analysis.

This model is relatively comprehensive and deals with the food industry in a specific manner, but it does arguably need to be broken down further for effective use as a management tool. The authors also refer to the development phase considering packaging requirements, but provide no detail on this.

3.4.2.3.3 Fuller (1994)'s model of NPD in the Food Industry

Fuller (1994; p. 22)'s book on food NPD presents a six-stage model of the process:

1. Idea screening (company objectives and market needs/wants)
2. Screening of ideas (financial review/feasibility)
3. Development
4. Production
5. Consumer Trials
6. Test Market

Whilst the model does not identify idea generation specifically as one of these stages, it is encompassed in what is referred to as idea screening. This incorporates the company's objectives and needs of the market. The model is similar to that of Gray and Saguy (1994), but does create more emphasis on screening and testing. It also highlights the importance of the process being consumer led, promoted by other researchers within this area (Avermaete *et al.*, 2004; Harmsen, 1994; Meulenber and Viaene, 1998; Trail and Grunert, 1997).

Despite the advantages of this model, it lacks detail on the management of packaging. It also adopts the common stage based perspective on the process, despite its weaknesses.

3.4.2.3.4 Earle's (1997) Model of the NPD process for the Next Decade

Earle (1997)'s model of the product development process for the next decade (Table 3.15), is heavily influenced by the factors he identifies as having influenced it over the preceding century: in particular; new processes, distribution, the significance of marketing and market research, and new technologies. The model developed is more detailed than the preceding ones, breaking down the process into stages, activities, outcomes, and management actions and decisions. However, despite this, no detail on packaging is provided.

Table 3.15: Product development process for the next decade (Adapted from Earle, 1997: p. 22).

Stage	Activities	Outcomes	Management actions & decisions
1) Product strategy & planning	Development of business strategy	Product-mix strategy	Identification of areas for product improvement & innovation
	Analysis of consumer, market, and technology advances	Product development possibilities	Formulation of overall NPD plan for next ten years
	Coordinated analysis of market & technological requirements	Specific product development projects	Selection of specific projects: definition of available investment & desired timing of projects
Top managements go or no go decision			
2) Creation, design, & development of product	Setting up the project	Definition of project aim & considerations	Compatibility of project with business strategy
	Creating & screening product ideas	Product concept	Critical analysis of product concept & target market
	Product concept engineering	Product design specs.	Determination of technical feasibility
	Product design	Product prototypes	Analysis of consumer & technical evaluations of prototypes
	Process design	Process flow chart & conditions	Evaluation of technical success & cost feasibility
Top managements go or no go decision			
3) Production process, marketing strategy, quality assurance, commercial product	Product testing	Final product and target market, product positioning and image	Evaluation of predicted market success of product
	Hazard analysis & definition of critical control points of process	Process control method	Evaluation of safety of process and product
	Engineering of production process	Production method and commissioning of plant	Development of total quality management plan for product & process
	Study of marketing & marketing mix	Market strategy and plans	Quantitative prediction of the outcomes of the launch
	Financial analysis	Costs, prices, profits, investments and risks	Predicted return on investment
Top managements go or no go decision			
4) Launch & post launch	Launch on the market	Purchase & repeat purchases by consumers	Sales analysis and marketing changes
	Study of product quality & production efficiency	Improvement of production process & product quality	Re-evaluation of costs & pricing
	Study of buying behaviour, consumer attitudes, marketing methods and retailers	Improvement of product positioning, market targeting and marketing methods	Prediction and planning of product's future
Top managements acceptance of product in product mix			

In his discussion, Earle (1997) provides a number of insights into the activities at each stage:

1. Idea generation is likely to include focus groups, brainstorming, morphology analysis, and check-list screening.
2. The concept development is likely to involve quantitative measuring techniques to assess customer needs and the technological capability of the product. This is followed by senior management assessing the probability of success, and time and costs involved in the development.
3. At the end of the third stage of development, top management will assess the feasibility of the production process, marketing strategy required, financial and other resources, and the likely return on investment.
4. The fourth stage involves setting standards from which a judgement can be made as to the relative success of the product after its launch.

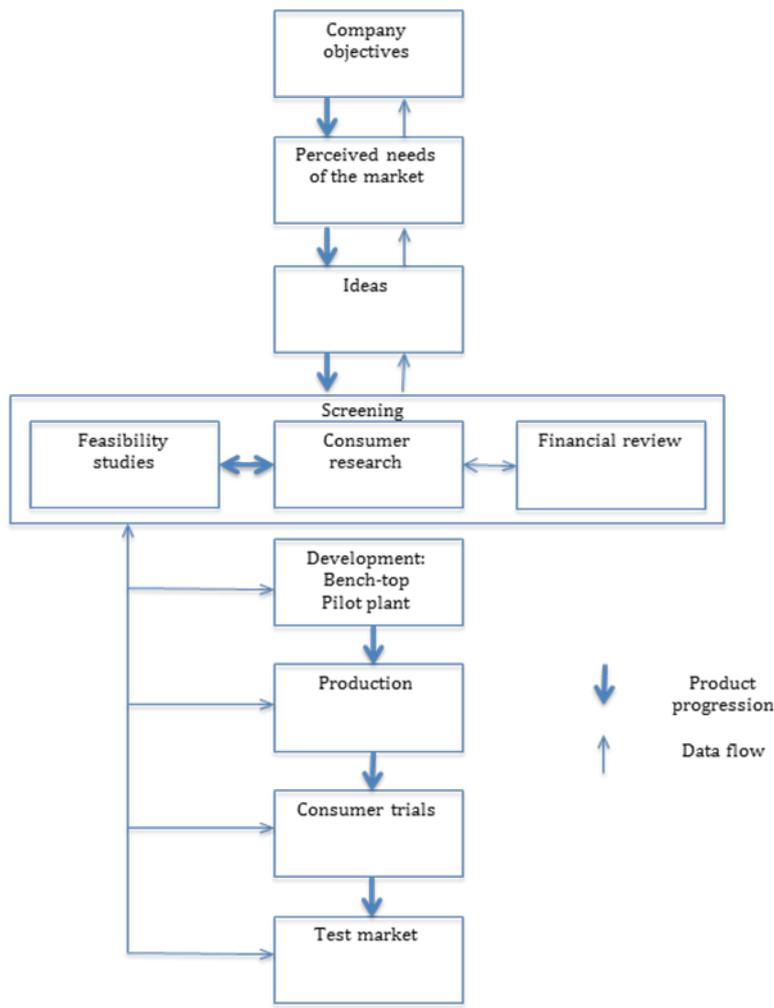
This provides further insights into the development process utilised in the industry. This model does provide greater detail on packaging's management, but still not enough of it: in effect, a list of considerations is provided, with no discussion of the influence of the process on product development.

3.4.2.3.5 Fuller (2004)'s Model of Food NPD

Fuller (2004), in his relatively well accepted textbook on new food product development, presents a model of the process (Figure 3.21). Whilst being broadly similar to many of the others, this model does provide some additional insights into the technical processes. Fuller points out that food technologists will start working on recipes early on in the process, to identify potential problems with large scale manufacture (including quality and safety), enable consumer testing, and provide for the financial costing of a recipe. The actual process will therefore involve several distinct technical stages: including creating initial, small scale 'stove top' samples, then scaling up the production to identify any issues created in regards to changes in the characteristics of the product that affect its taste, quality, or appearance.

The recipes used will probably change based on a number of factors, including safety and stability of the recipe, lowering costs, ensuring uniformity of ingredients, changes required to make the recipe capable of volume production, and ensuring it can meet the expectations of a wide range of consumers.

Figure 3.22: Fuller’s model of the new products process in the food industry (Adapted, 2004 p. 26).



Whilst the effect of large scale production on the food recipe must be considered, it is also necessary to consider the production process itself and specifications required in this respect: such as temperature, cooling the product, pressure changes, and the effects of any pumping of the product (around the factory) on its quality or characteristics (Fuller, 2004). This provides some additional insights into the development process.

It is also worth noting that Fuller (2004) highlights that companies in the industry often look outside (whether through outsourcing, joint ventures, partnerships, hiring consultants) in their new product development process. However, the management of packaging or its links to the production process are not addressed by Fuller in this model, or the paper itself.

3.4.2.3.6 The Camden and Chorleywood Food & Research Association (CCFRA, 2007) Model of NPD in the Food Industry

The CCFRA, a widely recognised food industry research association, has generated a guide to NPD. Within the guide (2007), there is no specific model or process presented, but there are clearly a number of key/inherent stages evident within the process (Table 3.16).

Table 3.16: Summary of CCFRA's stages to NPD (compiled by author)

1. Identifying the need	Coming up with good ideas- knowledge/ideas gained through: shopping, TV adverts, trade publications, market place watch services, food exhibitions, eating out. It is suggested that this would lead to a brainstorming session to develop specific ideas.
2. Idea evaluation and selection	The use of staff sessions to hone things down, this involves looking at issues such as: the market, price point, production costs, technical development, capital expenditure, distribution issues, product portfolio considerations, fit with company philosophy (such as producing healthy produce). Finally this stage leads to the selection of the main ideas, and a report on these ideas.
3. Concept development	Involves developing on the basic idea, possibly with outside designers and consumer research. This stage involves the consideration of the following questions, leading to the development of a more complete concept: <ol style="list-style-type: none"> 1. Who is the target market? 2. When will the product be consumed? 3. What will its price be? 4. Where will the products be made? 5. Is the product seasonal? 6. How much will it be worth to the company
4. Preparing a brief	The fourth significant activity in the product process. This stage ensures the product is well understood by all, and the production requirements are defined. This brief contains information such as: the product description, target prices (wholesale and retail), capital availability, projected volumes, packaging size, shelf life/storage, packaging and mode of distribution, target customers, labelling claims, time scales, relationship to other product lines, sensory attributes of the product.
5. Feasibility and viability	Focuses on understanding whether or not the product is feasible to develop. This may involve creating samples of the product to understand any issues that may occur. The issue of feasibility and viability will be established through examining technical and financial criteria, as well as market based feasibility.
6. Planning and project management	Involves looking at the resources required to ensure the project is successful, these include: people, capital, labour capacity, factory storage, consumables, market research. This stage often involves considering the outsourcing that may be required for any of the development or marketing.
7. Implementation of product development	Actually consists of four technical sub-processes: <ol style="list-style-type: none"> 1. Small-scale bench work- This establishes whether the product can be made in a reproducible manner, using samples and possible consumer tests. This may also examine: ingredients, recipe, manufacturing, product assessment, costs, and packaging (at which point contact may be made with a packaging manufacturer for supply). 2. Pilot scale production- This acts as a link between small-scale bench work and full-scale commercial production. The stage involves using the same types of equipment, processing, and packaging, that will be used in full scale production, to test the ingredients and make small batches for refinement. 3. Pilot scale factory trials- This tries to mimic the production process to iron out technical problems. Part of this stage will also assess the suitability of the packaging. 4. Full scale production with regular monitoring- At this stage the product is being produced and ready to launch.
8. Reviewing the outcome	Involves monitoring success on each of the criteria already determined, and monitoring for possible changes required or new opportunities that may emerge from the product launch or feedback.

The stages are broadly similar to many of the preceding models: but again, the guide does provide insights into the technical stages of development; and the issues of scaling up, clearly required for many food products. Surprisingly, despite the guide's practical nature, little detail on the management of packaging and its development is provided. Stages in the development of the production process are detailed; but information on its influence on development is scarce.

3.4.2.3.7 MacFie (1994)'s Model of NPD

MacFie (1994)'s research, which focuses on the role of computer programs in NPD, generates a seven-point plan on NPD, consisting of the following main stages:

1. Concept generation
2. Concept Screening
3. Product Development
4. Product Testing
5. Packaging development (including advertising material)
6. First production run
7. Launch

This model is unique in highlighting packaging as a specific stage of development, whilst others only account for it within stages. However, detail on the management of packaging development is lacking. The stages identified are relatively generic and basic, lacking detail overall.

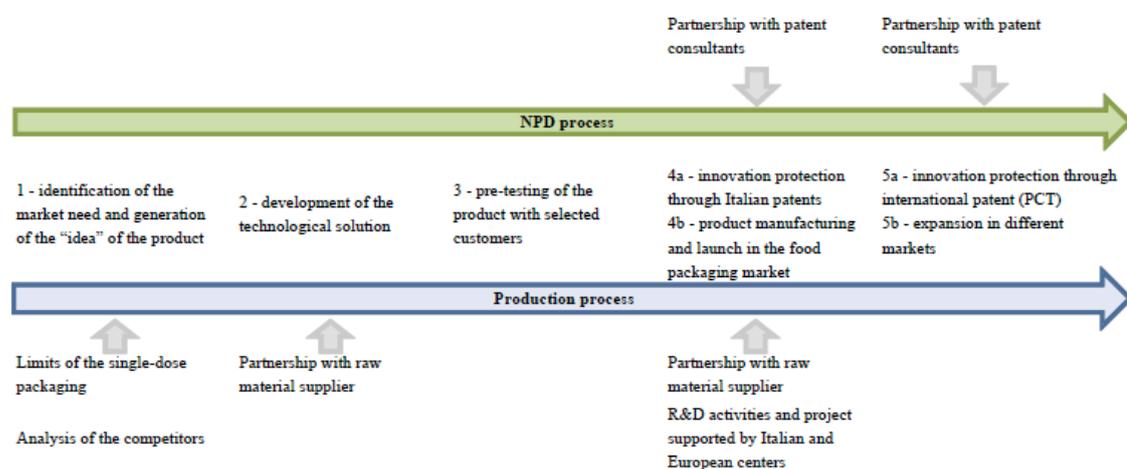
3.4.2.3.8 Bigliardi *et al.*'s (2010) Model of NPD in the Food Packaging Industry

The Final Model to discuss is that of Bigliardi *et al* (2010). It is based on a single case study within a food packaging machinery company in Northern Italy, that develops a new pack in order to enter the product packaging market. The study's aim is to generate new guidelines on the process. The research focuses on a packaging manufacturer, but fails provide full insights into how this process links to the development of food. Whilst not well recognised, the case is relatively unique in that it provides unique insights into the development of new packaging.

Bigliardi *et al* (2010)'s model reveals the importance of the product and production development process, identifying two sets of stages (Figure 3.22). The product-focused process details similar steps to other models, but the stages associated with the production process differentiates it. Arguably, this difference reflects the engineering and technology orientation of the article.

Four other factors are somewhat unique. First, it is market driven, based on the nature of the single case discussed. Second, early in the process, the writers highlight the crucial role of pre-testing, which enabled them to “*collect the voice of the customer... and modifications to be made*” (p. 19). Third, a patenting stage is highlighted as key to the protection of the technology, and ensuring payback on the significant engineering and manufacturing investments. Finally, and importantly with respect to this research, a key finding is the overlap between the development of the new packaging and the new production process.

Figure 3.23: The New Product Development and Production Process of ‘Easysnap’ (Bigliardi, 2010: p. 18)



From their analysis of the case, Bigliardi *et al.* (2010) suggest five key points that were important to the success of the project:

1. Differentiation, which made the product superior when compared to the competition
2. The voice of the customer, which ensured the product was optimised to consumer needs
3. The market launch was carefully planned
4. Innovation protection mechanisms in the form of patents
5. Reduced time to market, which benefitted market share, profits, and long-term competitiveness

That the innovation originated from a packaging firm, as opposed to a food firm, is also a significant revelation. The preceding studies fail to capture the role of the

packaging supplier. The input of a plastics materials supplier is also noted, alongside the input of universities and other foreign research centres.

3.5 Summary

This chapter has revealed the significant omission of packaging development activities within the existing NPD models. These models fail to capture the management of packaging, beyond basic design and artwork activities. Moreover, the limited insights of Francis' (2008) and MacFie (1994)'s papers suggest that it is a late consideration within the process, and that technical development receives relatively little attention. None of the existing models provide detailed insights into the management of new packaging developments, or the integration of packaging into the NPD process.

Contrasting the two parts of this chapter reveals that those models focused on the FMCG industry, and food and drinks sectors, adopt a stage or activity based perspective. This represents a weakness. The models lack insight into the iterative and concurrent nature of the process, as well as network inputs. Indeed, the input of suppliers is largely overlooked, other than in those studies focused on retailers (where development and production is outsourced), in which only the primary product supplier is addressed. This may partly explain the lack of coverage which packaging receives, as many activities are undertaken by an outsourced supplier.

Two other limitations of the existing models also warrant mention. First, only those models generated in the FMCG industry incorporate retailers, despite their significance. Second, only the model of Bigliardi *et al.* (2010) accounts for the significance of the production line. Considering that this is a process industry (to be discussed in the following chapter), this would seem a critical omission.