Managing product innovation through rules

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RESUMÉ

Ledelse af innovation gennem regler

Formålet med nærværende studie er at analysere hvordan det mest almindelige ledelsesværktøj, Stage-Gate, for produktudvikling kommer til anvendelse i en organisatorisk praksis. Flere kilder peger på relevansen af styring af innovationsprocessen i forhold til performance kriterier, men den eksisterende litteratur har ikke haft en sociologisk tilgang til forståelsen af dette område og dermed peget på en mulig forklaring for denne sammenhæng. Det problem som adresseres hér, er, således orienteret omkring en forståelse *hvordan* Stage-Gate som repræsentant for forskellige versioner af faseopdelt og strukturerede måde at bedrive produktudvikling virker.

I den første version af Stage-Gate er dette system designet med et projektsyringsformål i NASA men har haft stor udbredelse og udvikling, og er i dag det mest gængse system for at drive produktudvikling (i USA), men har muligvis ligeså stor udbredelse i Danmark. I sin ideal form opdeles produktudviklingsprocessen i en række standardiserede og formaliserede faser adskilt af beslutningspunkter med henblik på at reducere usikkerheden samtidig med ressourcerne øges. Som påpeget af den tilgængelige litteratur er Stage-Gate et beslutningstagningsværktøj, men værktøjet skal selvsagt leves ud gennem aktører som skal omsætte de standardiserede forskrifter til konkret handling.

Cyert and March (1992) adresserede allerede i 1963 standardprocedurer for beslutningstagning, men omtalte i epilogen til *A behavioral theory of the firm* en yderligere teori af en adfærdsmæssig karakter, som senere blev udbygget af March (1994), hvorigennem aktører antages at handle ud fra hvad som er passende ved at matche den situation som de befinder sig i med deres identitet. Dette rationale, beskrevet som teorien om

appropriateness antager således at reglers anvendelse ikke nødvendigvis er identisk med foreskriften men skal fortolkes i en kontekst dersom regler i deres normativitet er akontekstuelle. Regler kan derfor *fornuftigvis* afviges af aktøren, hvis de ikke er passende i forhold til hvordan aktøren fortolker situationen og sin identitet. Stage-Gate har en række ligheder med Webers ideal bureaukrati som endvidere kan kategoriseres indenfor de fire regeltyper som beskrevet af Cyert og March (1992). Disse analyserede dog ikke implikationerne af teorien om appropriateness for standardiserede beslutningsprocedurer (og regeltyperne) i produktudvikling, hvilket selvsagt derfor er et af bidragene med nærværende studie. Her udvikles dette i en model. Både det instrumentelle (Weber) og adfærdsmæssige perspektiv (*appropriateness*) applikeres i analyserne af fem udvalgte case-virksomheder hvoraf PLASTIC blev udvalgt for nærmere analyse. Hovedvægten af studiet er på den adfærdsmæssige forståelse hvorved studiet af hvordan regler bidrager til at gøre innovation ledelsesbar får en sociologisk karakter.

Det instrumentelle perspektiv afslører, at en række af de organisatoriske effekter som Weber (og ledelsesværktøjet) lovede kan opnås, herunder stabilitet på kort sigt, men samtidig at der er stor variation i måden hvorpå regler applikeres. Den videre analyse gennem appropriateness-perspektivet afslører imidlertid at regler mere applikeres som ’guidelines’ end egentligt ufravigelig regler. Regler påvirker den organisatoriske identitet, skaber et sprog og giver fokus på eksempelvis kalkulation lige som politisk inerti kan reduceres. Den multiple-case analyse afslørede endvidere, at applikationen af regler i faserne er mere formaliseret end i beslutningspunkterne hvor formaliseringen angiveligt fastholdes. Netop fordi, at dette var i fokus, blev næste trin i empirien at udvælge PLASTIC for nærmere analyse af disse beslutningspunkter.

Her afslørede analysen af reglerne, at regler også betragtes som guidelines og ydermere kræver fortolkning fordi reglerne skaber inkonsistente krav på aktørerne i produktudvikling, men også fordi andre regelregimer uden direkte tilknytning til produktudvikling gør det mere passende at mobilisere disse regler end dem som ideelt foreskrives af det normative regelsystem (Stage-Gate). Endvidere bliver den objektive beslutningstagning ’kompromitteret’ af, at al information ikke er tilgængelig, men selv i de tilfælde, hvor der er information til rådighed omkring et produktudviklingsprojekt, anvendes den ikke. Information kan også indsamles efterfølgende for at bekræfte en beslutning og generelt tillægges selve kalkulationen som et entydigt tal ikke stor vægt i

den formelle beslutningssituation. På baggrund af disse analyser blev appropirateness-perspektivitet konstrueret i en model, som illustrerer, hvordan en række variable påvirker hvordan regler bliver anvendt, herunder for eksempel aktørernes ønske om at være socialt pålidelige er mere centrale end at følge de rationelle regler.

Konklusionen, er, at regler faktisk har en organisatorisk indflydelse, men ikke fordi regler automatisk følges af medarbejdere i produktudvikling. De regler, som anses om passende, anvendes og fortolkes af aktører, hvorfor Stage-Gate i sin normative form mere er et styringsværktøj end et ledelsesværktøj, fordi det ikke tager højde for hvordan aktører agerer i en organisatorisk sammenhæng. Aktørerne skal motiveres til at følge regler og i de tilfælde hvor kontrolsystemer overvåger regeloverholdelse, bliver disse mere fulgt som en pligt uden nogen afgørende adfærdsmæssige ændringer. Ledelse mere end styring er derfor påkrævet, hvis regler skal have en organisatorisk effekt. Endelig *indikerer* observationerne, at regler ikke stopper innovation og kreativitet. Tværtimod. PLASTIC har store problemer med at få nye projekter frem, hvilket tilskrives den manglende mobilisering af regler af aktørerne, og samtidig må det fastslås at Stage-Gate mere er et innovationssystem end et kreativitetsværktøj, idet formålet ikke er at producere produktidéer men at implementere og vælge blandt disse. Paradoksalt nok kunne kreativitet og innovation i PLASTIC have været fremmet, men som antydet skulle reglerne have været mobiliseret, hvilket havde krævet opmærksomhed på appropriateness og de ledelsesmæssige implikationer herved.

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My mentor, Hanne Paludan-Müller, inspired me to undergo this education by returning to university, and has been a constant source of support ever since. Especially, when I vented my frustrations, she was there to immediately rebut them and give me back a sense of conviction. The source of these frustrations often lay in the altered nature of work, from previously being used to a day filled with hectic duties and a constantly ringing telephone to suddenly being thrown back in the world of academia (just as hectic, but for other reasons). Naturally, this confused me with respect to gauging what I had actually accomplished in a working day. Moreover, I was forced to undergo the transition from 'religious instrumentalist', in the traditional sense, to the sudden recognition of social constructions and, more generally, the complexity of human behavior itself. Thus, at a personal level, I have also added new paradigms and acquired a more differentiated view of people and their organizations.

Early in the process, Professor John K. Christiansen proved himself to be one of the supporting pillars of this undertaking, through constant inspiration and constructive problem–solving. This, more than anything, pushed me forward above all else. Secretly, I believe he suspected that these frustrations and transitions were taking place, but (politely) never mentioned it. In my opinion, he has fully mastered the supervisor's role.

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CHAPTER ONE

Introduction

This is a study of the role of formal and structured approaches to managing Product Development (PD), and the first chapter of the study is concerned with setting 'the stage'. The chapter includes an introduction to the understanding of PD in this study and the theoretical perspectives used for the analysis, formal and structured approaches and rules in Stage-Gate as a management technology, and following these motivational sections of the chapter is the formulation of the problem statement guiding the present study. Subsequently, the research strategy and methods and the organization of the study are introduced.

1.1 PRODUCT DEVELOPMENT

Often, new products are the output of an innovation process of which PD can be regarded as a sub-process (Trott 2002: 12) in line with organizational innovation (e.g. a new communication system), a management innovation (e.g. an introduction of SAP), or a production innovation (e.g. just-in-time manufacturing). Trott (2002: 14) argues product innovation is a *type* of innovation and can be defined as "the development of a new or improved product". To many firms, PD can be considered a requisite for business survival (Ayers et al 2001) and also a source of competitive advantage (Hamel 2000; McDermott, 1999). Brown and Eisenhardt (1995: 343) argue:

> Product development is critical because new products are becoming the nexus of competition to many firms.

Compared to acquisitions and mergers, PD is also a critical means by which members of the organization diversify, adapt and even reinvent their firms (Brown and Eisenhardt 1995: 344):

> Thus, product development is among the essential processes for success, survival, renewals or organizations, particularly for firms in either fast-paced or competitive markets.

The aim of PD projects is to transform product ideas into launch in the marketplace where the needs of customers are met and, in addition, are technologically feasible. Although the needs may not be articulated and the boundaries of the technical feasibility can be challenged, a central issue to many managers, and a subject of many PD scholars, is to address the process in which the ideas materialize. The specific PD activities include idea generation, concept development, prototypes, design specifications, engineering, screening, production, business analysis, test marketing, etc. Managing innovation concerns the conditions that have to be in place in order to ensure that the organization is given the opportunity to develop new products, and the actual development of products is the process of transforming business opportunities into tangible products or services (Trott 2002), as also suggested by Ayers et al (2001: 133-134).

> Indeed, the magic in new product development efforts lies not in an organization's ability to generate new product ideas, for they are a dime a dozen, but rather in an organization's ability to nurture and manage the product development process.

Thus, PD encompasses the management of various disciplines involved in the development of new products, including marketing, economics, production management, and design and engineering (Trott 2002). Accordingly, production management participates in PD with a manufacturing perspective in terms of an effective production of the product in question, whereas marketing takes the perspective of understanding the needs of the customer or user and of how the business could best meet these needs (ibid.).

1.2 FORMAL AND STRUCTURED APPROACHES

Formal and structured methods were questioned by Clark and Wheelwright (1992) suggesting that too much bureaucracy is the reason why the US cannot compete with Japan. More recently, Hamel (2000: 202) has criticized the formalization of PD and has suggested that innovation has to be led by rule breakers. In other words:

> To grow, new opportunities need to escape bureaucratic controls and orthodox thinking.

By contrast, Baker and Hart (1999) suggest that formal and structured methods influence the product development process in a facilitating manner. On the basis of the Miles and Snow strategy typology, Simons (1987) argues that prospectors are more likely to apply management control systems than companies applying a defender strategy; Baker and Hart (1999) suggest that companies with a structured development process do have a higher survival rate; and Davila (2000) addresses the question of whether management control systems have a decisive role in relation to managing PD or whether management control systems can be considered an impediment for PD. Davila (2000: 405) suggests in this respect that:

> Management control systems are important for the performance of the project, but the research does not reveal why, nor provides detail on how these systems are designed.

Despite the differing opinions, the debate on the relevance of the formal and structured approaches seems to be more an issue of the implementation and intensity of the 'bureaucracy' rather than a direct dismissal of these methods' general ability to contribute to making PD manageable. One the other hand, only a few have addressed how to make formal and structured PD approaches a managerial technology in everyday organizational life through the very rules of the formal and structured approaches, particularly with respect to the interplay between decision-making and management control systems in the form of rules for PD.

Griffin et al (1997) categorize process types into a sequence based on five levels of sophistication, suggesting that some process types are less sophisticated and that third-

generation stage gate is the most sophisticated and characterize it as “fuzzy” with, e.g., overlapping development activities. The “others” category is not categorized as sophisticated but does include companies applying an informal approach to making the PD process manageable. “Sophistication” is not defined by the authors, but does include whether there is formal process ownership and whether the process is facilitated (Griffin et al 1997). The 1997 PDMA Handbook (Griffin et al 1997) disclosed that 60 percent of the investigated firms apply a formal NPD process and that all these formal PD-processes are versions of a Stage-Gate (SG in the following) approach, making it the most widely dispersed approach in product development (Griffin et al 1997). The remaining companies applied an informal process or no process at all. The existence of both informal and formal ways of making the NPD process manageable raises the issue of whether PD rules exist in Danish companies and how these systems use and influence PD. In order to develop an understanding of the workings of formal and structured methods in an organizational context, a study of how these systems of rules work within an organization needs to be undertaken.

In its generic form, the SG approach, as described and defined by Cooper (e.g. 2001), divides the product development process into five decision-making opportunities succeeded by five information-generating stages. All five decision-making opportunities are structured according to the same format required for documenting the information gathered: a decision-making format in the form of an evaluation against a set of predefined criteria measured on a ten-point Likert scale, and five types of decision-making outcomes. SG departs from the recognition of an inherent uncertainty in product development and is designed to decrease this uncertainty by generating information in parallel with a gradual increase in product development costs. The reasoning underlying SG’s design can therefore be characterized within the limited rationality perspective where it is assumed that uncertainty can be decreased through information gathering until the costs of gathering information exceed the benefit of the additional information.

The claimed advantages of the SG system include efficiency, effectiveness, reduction of time-to-market and increased commercial success according to the intentions. The early work of Cooper and De Brentani (1992), Cooper (1992), Cooper and Kleinschmidt (1993a), Cooper and Kleinschmidt (1993b), Cooper and Kleinschmidt (1993c) focuses on the activities (stages) required to be undertaken, whereas the more recent

work (Cooper 2001; Cooper and others 2002a; Cooper and others 2002b) emphasizes decision-making opportunities (gates). The SG approach can be regarded as a 'rationalization' of the product development process and contains three elements for achieving the intended advantages. First, Cooper (e.g. 2001) is concerned with decision-making as a gradual allocation of resources as the likelihood of succeeding increases with an increasing amount of new information. The product development process must, therefore, be regarded as a gradual decision-making process in which at the moment the anticipated commercial success of a project is negatively evaluated, the project is either killed, approved for continuation, made to hold or ordered to be reworked. Second, the other element of the SG approach is to prescribe different types of activities (market, technical and financially-related) that must be carried out so that qualities of the decisions are not compromised. Finally, the information must be produced in the activities of the stages before the decision-making point is documented and made available to the decision-makers in the decision-making situation (gates).

1.3 RULES IN SG AS A MANAGEMENT TECHNOLOGY

Structured and formal approaches to product development, like the Stage-Gate approach, consist of a set of rules, and rules can be regarded – among other things – as a managerial technology, employed by organizations for one purpose or another.

Organizational rules have been studied for a long time within organizational theory, as early as Weber (1968), but also in terms of administrative rules as argued by Cyert & March (1992) who defined four types of rules and discussed how standard operational procedures provide organizations with stability and coordination mechanisms (ibid.). Moreover,

> [I]n a broad perspective, rules consist of explicit or implicit norms, regulations, and expectations that regulate the behavior of individuals and interactions among them (March et al 2001: 11).

March et al (ibid.: 11ff) argue that we can distinguish between four images of rules in the literature: a) rules as rational efforts to organize; b) rules as proliferating mecha-

nisms governed by self-evolving processes (the idea that bureaucratization is expanding and producing even more rules); c) rules as constructions of meaning and presentations of what the organization wants to be or be known for (a signal and a symbol) and how it meets the expectation of what a proper organization does (e.g. to manage NPD); and finally d) rules can be seen as the coding of history-bearing experiences from the past and represent a learning process. These perspectives might also explain some of the various views on formal, structured NPD methods, as reported in previous research on the SG approach[1]. While the intention of rules might represent a rational effort to organize, some might criticize rules for being a "spreading disease", while others in turn might focus on the learning inherent in the rules. In the present analysis, we will only focus on the formal, explicit PD rules and how they are constructions of meaning, since they represent the structured approaches that companies have implemented, modified and changed according to their needs. Rules spread from one company to another, but over time they are often changed for numerous reasons.

PD rules[2] can be seen as a managerial technology (Miller et al 1993; Mouritsen 1999; Hatchuel and Weil 1995) used to manage product development at a distance by means of factual and calculable knowledge of the product development process, its situation and status. Managerial techniques, such as SG approaches, include an important promise of neutrality, objectivity and calculability, which enables cooperation to be governed and administered according to facts, as expressed by writers on other managerial technologies (Hopwood 1984; Loft 1986; Miller et al 1993 and Miller 1991). Gate approaches, for instance, hold the promise of mastering and handling the complex, delicate and ambiguous undertaking of PD from a distance. Such managerial techniques are intermediaries and facilities that help to mobilize, support and implement systems of management control. Managerial techniques[3], such as gate approaches, might be introduced and implemented for a number of reasons, but become a management technology through the interpretation of local managers, employees in product development and others in the company who influence the practical design and application of the general

[1] Chapter three addresses and summarizes previous research on the SG approach.
[2] Please note other tools (e.g. QFD) also generally are available in PD but the object of analysis here are the rules defined by the SG approach which is the managerial attempt to intervene in the innovation *process*.
[3] Hatchuel and Weil, (1995) proposes a management technique is constituted by three interrelated elements, which all can be identified with the SG approach including: 1) a technical substratum, 2) a management philosophy, and 3) a simplified view of organizational relations.

concept through modifications and translations (Latour 1991; Mouritsen 1999) or what Hatchuel and Weil (1995: 100) refers to an intense process of contextualization where

> …modeling is not an object and in itself not aimed exclusively at decribing certain bjects. It is mostly guided by potential material and relational stakes which it progressively makes credible and which each management technique has to express, represent or imagine in order to become a mobilizing project (Hatchuel and Weil, 1995: 97)

According to Latour (ibid.), a gate model is a non-human "actant" that needs to be communicated, interrelated, linked and mobilized in order to be translated by "human actants" (not transmitted) within a context of use and woven into what Latour labels a strong technology. Management technologies, such as gate models, compete with other actant "programs" in the context, as will be become apparent in the analyses to come. To generate “strong” managerial technologies, supporting elements must be added to the initial statement: we want PD employees to use the structured approach. The reason is that the "listeners" of the message (the employees involved in product development) normally call for “anti-programs” (other interests and issues on the agenda) that compete with the official “program” of structured methods. Such supporting elements may come in many forms, such as explicit top-management support, communication of the structured approach, facilitation of user tools for the methods in various ways, consulting services, training in structured approaches, etc. Structured approaches in the form of rules must also be adapted to the situation, as rules are general and situations are specific (March et al 2001). Thus, formal rules prescribe activities that must be carried out in order to make management at a distance possible, but rules, however, are translated by actors in an organizational context and practice through interpretation of what is appropriate (March 1994). By so doing, attention is directed to problematization (Miller and O’Leary 2002) and the relationship between problem and solution, which in this study we assume to be indirect rather than direct Miller and O’Leary (2002: 92). Solutions might *not* be direct, functional responses to “problems”.

> “*By technologies, we mean devices for intervening, instruments for acting, upon people, objects, and processes so as to shape or influence them* […]” (ibid.), and moreover “[…] *seeking to transform the identities of the individuals”* (ibid: 93) [italics emphasized].

In the terminology of Miller and O'Leary (2002) this study is about the *shaping* of actors and investigates how they translate the formal rules (program) in an organization into context and practice (Latour 1991) whereby the management technique (the SG approach) becomes a management *technology*. As a consequence, the anti-programs mobilized by actors are revealed through the perspective of appropriateness, suggesting that the application of rules results from an interpretation of the situation and an actor's perceived multiple identities constituting the actor's collective self (March 1994).

1.4 PROBLEM STATEMENT

Although management control is decisive to innovation (Davila 2002; Baker and Hart 1997; Simons 1987), little research has examined the *use* of these systems in an organizational context, which is crucial, however, when attempting to manage what is one of the most complex processes of a company (Hustad 2000), in which ambiguity is an existential condition (Martin and Meyerson, 1998; McKaskey, 1982). Disciplining management control systems claims to facilitate the management of PD processes by objective decision-making, for instance, and the conformation of actions into programmed activities (Simon et al 1954) to the extent where the most common of these systems share similarities with the ideal Weberian bureaucracy. Nevertheless, March (1994) questions these systems since ambiguity is prevalent in an organization. Programmed actions must also be comprehended through a construction of appropriateness, making the management of innovation a behavioral issue, through the use of rules, and a matter of how this managerial technology is adapted, made sense of and applied. Wheelwright and Clark (1992) and Hamel (2000) criticize innovation for being too 'bureaucratic', which suggests that the disciplining systems can become a bureaucracy and, therefore, also rigid when applied in an organizational context (Ottossen 1996 and Jenkins and Others 1997a; 1997b; Olin and Wickenberg 2001). So, does a management control system become a bureaucracy? And if so, does this impede the facilitation of the PD process otherwise claimed by the normative literature as the most frequently applied approach (Griffin 1997), i.e. stage gate (Cooper and De Brentani 1992; Cooper 1992;

Cooper and Kleinschmidt 1993a; Cooper and Kleinschmidt 1993b; Cooper and Kleinschmidt 1993c; Cooper 2001; Cooper and others 2002a; Cooper and others 2002b)? What are the managerial implications of PD rules? Are the assumptions underlying the structured and formalized approaches compromised? These are some of the fundamental puzzles motivating the present study.

Management of the PD process is attempted through formal and structured approaches, and the (main) question arises: *how is a specific, formal and disciplining management tool applied to PD and how does it become a managerial technology through appropriate rule application?* This main question can be substantiated through four questions:

(1) What constitutes the SG approach and what issues have been raised regarding the approach in previous literature?

(2) How can rules in organizations be studied?

(3) What are the implications of rules in an instrumental perspective?

(4) What are the implications of rules in a perspective of appropriateness?

1.5 RESEARCH STRATEGY AND DATA GATHERING

The overall structure of this study is to undertake two analyses based on two different perspectives on rules, as previously suggested. The *first* analysis concerns what is referred to as the instrumental rule perspective in which activities are assumed to be conformed and aligned with what is prescribed by the rules. Within the perspective of instrumentality, theoretical analysis suggests that the SG approach (Cooper 2001) resembles the ideal Weberian bureaucracy (Weber 1968; Weber 1972), and consequently, the SG approach can be understood as a set of rules, since the primary characteristic of a bureaucracy is rules[4]. Moreover, the set of rules normatively defined by Cooper (2001)[5]

[4] The analyses are carried out in chapter four.

can be compared to the four types of rules assumed to constitute a Standard Operating Procedure (SOP) by Cyert and March (1992). This first perspective can be associated with the open-rational models of Scott (2003). The *second* perspective applies the appropriateness perspective to rules used within a specific context by matching the situation recognized by the actor with how the actor defines himself. The second perspective of appropriateness challenges the instrumental perspective by claiming that rule-following is not automated (Simon et al 1954). This perspective can be aligned with the open-natural model (Scott 2003: 119-120) and more specifically within the institutional theory perspective:

> […] it is not only competitive and efficiency forces that are at work. Socially constructed belief and rule systems exercise enormous control over organizations – both how they are structured and how they carry out their work.

A number of things could be argued in this respect. On the one hand, it might seem unfair to take the normative theory as proclaimed by Cooper (2001) into another paradigm, but on the other, this triangulation (Yin 2003) of analytical tools does enhance the understanding of the phenomena compared to only applying one perspective. The premise of this study is that subscribing to one of the models presented by Scott (2003) can be one-sided. Yet even though keeping the two perspectives separate in the analytical process has been difficult, I believe that the second perspective in particular has contributed to new understandings of the workings of the SG approach in an organizational context and also enhanced an understanding of the fragility of normative systems when exposed to the ambiguity and complexity intrinsic in PD. Moreover, as will be discussed in the last chapter of this study, the implications for management can be different when attempting to manage the PD process with actors characterized by March (1994: 10):

1. *Problems of attention.* Time and capabilities for attention are limited. Not everything can be attended to at once […]

[5] The SG approach is described in chapter two.

2. *Problems of memory*. The capabilities of individuals and organizations [for storing] information [are] limited […]
3. *Problems of comprehension*. Decision makers have limited capacities for comprehension. They have difficulty organizing, summarizing, and using information to [make] inferences about the causal connections of events and about relevant features of the world […].
4. *Problems of communication*. There are limited capacities for communicating information, for sharing complex and specialized information […]

As a consequence, it makes sense to the actors not to follow rules, for instance, and the perspective of appropriateness offers understanding rather than judging and claiming irrationality of organizational members.

Furthermore, *each* analysis poses a two-fold structure. An empirical study of five case companies was carried out through a cross-case analysis based on Yin's (2003) methodology. Subsequently one company, PLASTIC, was singled for further case analysis based on the same methodology, because this company insisted on formalization and most recently had employed a new set of rules. Therefore, it was assumed that the actors were more aware of the formal rules influencing their behavior. The cross-case analyses are undertaken at what can be characterized as an 'organizational level' of analysis, suggesting that the set of PD generally was investigated whereas the single-case analysis focused on decomposing the set of rules of the SG approach into gates, information and documentation, and stages, and as such added closer proximity to the empirical phenomena. As will be described in the forthcoming section, the instrumental perspective and the two levels of analysis are framed in one chapter, whereas the perspective of appropriateness is framed separately in two chapters. Thirty interviews with a variety of respondents employed in R&D have been undertaken to collect evidence (Yin 2003). All recordings from observations and the majority of interviews were transcribed in full for subsequent analysis (Yin 2003), and approximately 1,062 pages of transcription together with 100 pages of written material were available for analysis in QSR Nvivo ® 2.0.163, see appendix A for contact points of activities. The total observation time was eleven hours for two gate meetings. Please note that not all interviews could be transcribed within the timeframe and that only the first gate meeting was ana-

lyzed in detail due to time limitations (see appendix A). This was accommodated, however, by listening to the recordings, which fortunately were digital at this point. Other limitations to the study include a lack of observations of the milestone meetings at a project management level, but comprehensive secrecy agreements prohibited a close proximity to the actual project work and content of the individual project, a factor which restricted the study and added extra complexity. Furthermore, access to company databases and intranets was not opened up for investigation. PD was generally considered an area shrouded in secrecy and raised great concerns.

The first empirical probe involved the multiple-case analysis and focused on general PD rules, whereas the second empirical investigation analyzed the gate meetings and not only the participants participating in the meeting, but also the project managers subject to these decisions from the gate meeting. As will be discussed in the analyses, the decision-making meeting (gates) became particularly interesting since the literature available on the SG approach highlights the decision-making functionality and the first empirical investigation pointed to gates as a focus of attention. Three interview guides were designed to accommodate this successive data-gathering strategy covering the multiple-case study (one interview guide) and the single-case study (two interview guides), the latter separated whether being involved in stages or gates, see appendices C and D accordingly. The wish to validate (Yin 2003) the relevance of the study was a central motive of this two-part data gathering, which made it appropriate to undertake an initial probe before developing the study and investigating a specific company in detail. In order to address validity, the main findings were presented before an "Innovation Process Steering" meeting at PLASTIC seven days before submission, and the immediate response was that some of the findings were already in the process of being corrected, but also that some of the findings should be elaborated further and made available to the executive committee[6].

The coding in QSR Nvivo ® 2.0.163 was set up founded on the research questions and the theoretical framework. Code no. 4[7] is of the type "tree" (see appendix B) and is descriptive in nature encompassing the normative rules in PLASTIC (codes 9-11) based

[6] Because of the close proximity to the submission of the thesis, it was not possible to transcribe these discussions, but recordings are available.

[7] Please note codes 1-3 not are listed in appendix B. The appendix is taken from a "list all nodes" in QSR Nvivo ® 2.0.163 and redesigned in Word for presentation purposes. However, due to technicalities the codes were not numbered from 1 and codes 1-3 is thus not listed.

on a three-fold structure: gates (code 9), stages (code 10) and what is labeled information and documentation rules (11) according to the general decision-making structure of the SG approach where gates are supplied with information documented through the activities in the stages but also analytic with an analysis of the two normative set of rules described in chapter two and PLASTIC in main code 5 and sub-codes 6-8 respectively (see appendix B). Based on the same structure code 12 (and sub-codes 13-15) analysis how these normative rules are used or applied by the respondents whether being part of the formal decision-making situation (gates) or taking part in the stage-activities as project managers. Code 16 (and sub-codes 17-26) is concerned with the organizational influence of rules with respect to competence (code 17), identity (code 18), decision-making (code 19), rule-regime competition (code 20), innovation rules competition (code 21), and new rules (code 22), which all are based on the theory of appropriateness (see chapter four). Code 23 on bureaucracy, code 25 on implementation, and code 26 originates from the criticizing literature in chapter three. Code 24 was also included to be aware of distinct comments made respondents on ambiguity. Finally, code 27 on the Portfolio Management Meeting (PFMM) or gate meeting, September 12, 2003, is based on the empirical data so that the discussions made on the various projects has been coded accordingly. This proved, however, to be a real challenge since the participants not during the meeting stated for instance that ‘we now are going to discuss project no. 14’. Some of the discussions were very technical and although my work experience has provided me with a broad technical understanding it was difficult to follow some of the specific discussions on for instance polyethylene properties.

Griffin et al (1997) suggest that 60 percent of all US companies apply versions of the SG approach when attempting to make the PD process manageable, and since the focus of the study is on formal rules, it proved useful to select companies that use the SG approach since they would have formal rules in place (replication logic[8]). Surprisingly, a company was interviewed (that initially indicated that it not applied any formal and structured approach), but it turned out that they did not employ any formal approach in the organization. Nevertheless, the company was forced to adapt a phased development process due to official requirements, since the company developed drugs for human use. This company is referred to as CONTROL in appendix A but is not included in the

[8] Voss et al. (2002: 203).

analyses, however. If companies without a formal and structured approach in the PD process were to have been included in the empirical basis, the problem statement framing this study should have been formulated differently and, for instance, should have centered instead on informal vs. formal ways of managing PD with respect to yielding the highest profits or the highest number of radical new products.

Triangulation provides stronger substantiation (Yin 2003) and has been applied to this study not only through the two perspectives (analytical tools) described above but also through several sources of evidence. The research instruments include semi-structured interviews, direct observation and archival sources, particularly documents where the formal rules were written down and formal reports from the gate meetings observed. My role in the gate meeting was that of a passive observer, but whether I intervened in the meeting anyway is naturally open to question, particularly since the participants in the second meeting made much more eye contact (with me) than in the first meeting. Generally, however, I made a great effort not to intervene, although I was asked to sit next to the table with an approximate area of 5 m^2 or more. I have the distinct impression, though, that I would have intervened more by sitting away from this table, since this was quite uncommon and would have attracted more attention. Two meetings in September and November 2003 were selected in order to reduce causal variety (Yin, 2003) and to reduce the risk of misjudging a single event (Voss et al 2002). Yet since the analysis of just one meeting proved to be extremely resource-consuming and the second meeting (November) had many similarities, the first meeting was singled out for investigation. Even so, a limited number of observations from the November meeting are referred to in the forthcoming analyses. In this study, ambiguity is assumed to be a condition that underlies PD (Martin and Meyerson, 1998; McKaskey, 1982), but it is also assumed to be possible to analyze through triangulation, for instance, between an observation and interviews, but also with a single source, since it is assumed that respondents are able to express concerns in this regard. The meeting participants were also interviewed subsequent to the meeting, however, in order to cope with post-rationalization (March 1994; Voss et al 2002) and enable an analysis. Still, it should be noted that it proved somewhat difficult to interview all the participants shortly after the meeting, since I decided to transcribe the September meeting before interviewing the respondents. The transcription was necessary in order to comprehend when the partici-

pants addressed a specific project and where the discussion was headed in terms of the agenda, since the portfolio contained 62 projects, 34 of which were discussed at the September meeting. Furthermore, as already noted, being a non-technician, the understanding of a discussion relating to a project was to some extent cognitively prohibited when the character of the discussion became too technical, but also because of an agreement with the company not to investigate the content of the projects themselves.

The study is guided by a "how" question focusing on explaining the application of formal, structured approaches and investigating *how* it becomes a management technology through appropriate rule application. Case studies in particular are recognized by Yin (2003) as suitable for examining precisely this type of question. The use of surveys was also contemplated as part of the case analyses, but this approach was abandoned since exploratory surveys are difficult and very time-consuming to implement and thus start out with an in-depth understanding. Had time allowed, it would have been interesting to develop a survey based on the findings in order to validate the findings further and explore the limits to the inherent generalizations of the conclusions. New theory was never an ambition of this study, which sought instead to *understand* phenomena. It could be argued, however, that the model of appropriateness (figures 8.1 and 8.2) is a development or an elaboration of existing theory for which the case study research method is also suitable (Yin 2003; Eisenhardt 1989). Voss et al. (2002) argue that single cases have limitations, which was attempted to be accommodated by undertaking a multiple-case study with five case companies before a company was singled out for in-depth analysis and, importantly, to use the findings with care.

1.6 ORGANIZATION OF THE THESIS

The first questions involving the SG approach and the issues it raises in previous literature are examined in two separate chapters. In chapter two, the most common, formal and structured PD approach (Stage-Gate) is described on the basis of normative literature, including the content of the SG functionality specified in stage and gate activities, historical context, the most recent version of this approach, and the claimed advantages of the approach. The chapter is the first part of the frame of analysis and aims to explain

the content of the management tool for PD. In chapter three, the previous literature on SG is addressed with respect to a number of issues including idea generation, rigidity, stages, management control and strategy, but the chapter also presents a minor review of the literature on PD decision–making, since decision-making is emphasized by the literature when discussing the SG approach. As the second part of the frame of analysis, the objective is to frame a number of issues for further exploration in the analytical chapters.

The second question of how rules in organizations can be studied is answered in chapter four where the SG approach is discussed with respect to the Weberian bureaucracy, similarities and differences and finally translated into a set of PD rules to be explored in organizational practice. Subsequently, March (1994, 1999) and March et al (2000) present two different perspectives on rule-following: 1) instrumental: rule-following where actors are shaped by the rules and instrumentally undertake the prescribed activities required; 2) appropriateness: 'rule-following' instead based on rules emphasizing their influence, rather than assuming that behavior is subdued and automated actions are shaped in accordance with rules. Rules, identities, and situations are constructed, and the calculable rules mentioned by Weber (1968) as being central to objective decision-making are subject to interpretation, however. As the last part of the frame of analysis, each of these two perspectives ends up with a number of research questions to guide the analysis.

The third question departs from the instrumental perspective and investigates the implications for the PD process. The first empirical probe is undertaken on the basis of an instrumental view of rules through a multiple-case analysis and a single-case analysis of which rules can be identified in an organizational practice surrounding PD. One company, PLASTIC, is singled out in order to analyze the PD rules in depth. Both analyses in this chapter discuss the issues raised in chapter three on the previous SG literature. The level of analysis is organizational in the multiple-case study and local in the in-depth case study.

The final question of the implications of rules in a perspective of appropriateness for the PD process departs from an analysis of the *extent* of rule-following, since some rules are mandatory whereas others are rather laxly applied. Therefore the question discusses the first understanding of PD appropriateness by analyzing the interplay between rules

and the organization in chapter six. The level of analysis is organizational. In chapter seven, the same theory of appropriateness is applied in order to understand the use of rules at a local level in PLASTIC, singled out in chapter five, with respect to analyzing the extent of rule-following in terms of the three elements of the SG approach: gates, information (and documentation) and stages. Decision-making is analyzed in the second part of chapter seven by adding observation as a data-gathering technique to comprehend ambiguity in a decision-making situation. The multiple-case analysis is based on data gathered through interviews and formal documents, which makes it difficult to comprehend how actors interpret situations. A gate meeting lasting five hours is observed in order to understand the influence of rules, especially the calculable rules.

Chapter eight summarizes the two perspectives on rules with respect to PLASTIC. The first section summarizes chapters six and seven, whereas the second section of chapter eight discusses how decision-making in practice is constructed on the basis of chapter four where the SG approach is broken down into the types of administrative rules as defined by Cyert and March (1992), but explained and understood within the context of behavioral issues in terms of appropriateness. In chapter nine, the conclusion answers the problem statement framed in this chapter, and in the second part of chapter nine, some managerial implications of the findings are pointed out. The chapter ends by suggesting a number of issues for further research.

CHAPTER TWO

Stage-Gate: a selected structured and formal approach

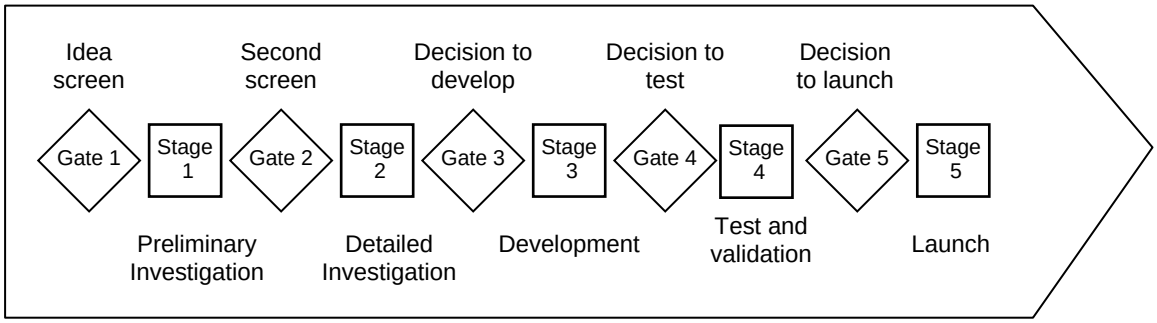
The purpose of this chapter is to describe a selected formal and structured approach and identify new ways to analyze such an approach. The SG approach is the most common way to manage the product development process (Griffin 1997a), and therefore it has been selected as an example of formal and structured methods. To establish a frame of reference for the subsequent chapters, this chapter looks at the content and history of the SG approach as described by Cooper, Kleinschmidt et al.[9]. As mentioned in the introductory chapter, the normative SG approach is seen as an installation of rationalization in the product development process. It includes three fundamental mechanisms to achieve the promised advantages.

First, the SG approach focuses on decision-making as a gradual allocation of resources in addition to an increase of information on the project. Ideally, this procedure should reduce the risk. Therefore, the product development process must be seen as a gradual process where the project will be killed or reworked as soon as the evaluation of its commercial success is negative. Second, uncertainty is part of product development and information is normatively a means to deal with the uncertainty of a product's

[9] Cooper 1975; Cooper 1979a; Cooper 1979b; Cooper 1982; Cooper 1985; Cooper and Kleinschmidt 1986; Cooper 1988; Cooper and Kleinschmidt 1988; Cooper 1990; Cooper and De Brentani 1991; Cooper and Kleinschmidt 1991b; Cooper and Kleinschmidt 1991a; Cooper and Kleinschmidt 1991c; Cooper and De Brentani 1992; Cooper 1992; Cooper and Kleinschmidt 1993a; Cooper and Kleinschmidt 1993b; Cooper and Kleinschmidt 1993d; Cooper and Kleinschmidt 1993e; Cooper 1993; Cooper and Kleinschmidt 1993c; Cooper 1994a; Cooper 1994c; Cooper and Kleinschmidt 1994; Cooper 1994b; Cooper and Kleinschmidt 1995; Cooper 1996; Cooper and Edgett 1997; Cooper 1997; Cooper 1998; Cooper and others 1998; Cooper and others 1999; Cooper and others 2000; Cooper 2000b; Cooper 2000a; Cooper 2001; Cooper et al. 2001; Cooper et al. 2002a; Cooper et al. 2002b.

physical materialization, which is unknown from the outset of the process just as the product cannot be tested until it has been designed conceptually. Information produced in the stages must therefore be made available at the gates, which in turn must apply the documented information in a standardized manner. Third, a mechanism of the SG approach is to prescribe the performance of a number of different activities to ensure that the qualities of the decisions in the system are not compromised through a lack of sufficient information. This applies particularly to marketing related activities where Cooper identified a number of shortcomings and consequently a negative influence on performance. The SG approach was initially developed on the basis of research into factors determining success and failure of product development projects in a number of industrial companies. The functionality of the stage-gate approach is illustrated in figure 2.1 where documented information is the link between gates and stages.

Figure 2.1: The generic SG approach (Cooper 2001)



The SG approach is divided in five gates and five stages. Initially, the approach started with a gate or evaluation of a product idea as illustrated in figure 2.1, but later idea generation or a discovery stage was added to the initial stage. As indicated in subsequent sections, the description of the SG approach goes into more details about the gates, whereas the description of the activities in the stages can be characterized as a checklist outlining activities to be performed by the organization. Gate 1, stage 1, gate 2, and stage 2 include the predevelopment activities before the physical development is approved in gate 3 and developed in stage 3. *Post*-development activities in gate 4, stage 4, gate 5, and stage 5 deal with testing and launching the product into the market.

Predevelopment: The initial stage may involve basis research, seeds or unfounded projects, and a variety of customer-based and creativity techniques. The stage is labeled

‘ideation’ and is followed by the first gate, which is the first formal decision setting (or gate review) screening the idea and deciding whether to commit initial resources to the project: “The project is born at this point” (Cooper 1993). If the decision is go, the process is now in the first preliminary investigation of the idea. This stage basically comprises a quick scope of the project, often done in less than a month's time (Cooper 1993). A market and technical assessment must be made together with a first-pass financial analysis. The screen in gate 2 is more rigorous involving a re-evaluation of the project in the light of the new information obtained in stage 1. The financial return is assessed again at gate 2, but it is only a quick and simple financial calculation (e.g. the pay-back method). A go-decision leads to stage 2 where the project is investigated in more detail and a business case is formulated and put forward. At this point, the definition "[…] protocol for the winning product" (Cooper, 1993) is a major facet of stage 2. A detailed technical appraisal is conducted with focus on the "do-ability" of the project. The result of stage 2 is a business case in combination with the development of a thorough project justification and detailed plan.

Development: The final gate prior to the development stage is gate 3, and it is the last point at which the project can be terminated before the costs will increase significantly (Cooper 2001). After gate 3, financial commitments become substantial. The results of the financial analysis at this gate are an important part of the entire process. If the decision is go, gate 3 includes the commitment to the product definition and an agreement on the project plan that charts the path forward (Cooper 1993). Plans for development, preliminary operations and marketing plans are reviewed and approved at this gate. A project team and a team leader are assigned to the project at this point. The subsequent third stage will witness the physical development of the product. The outcome of stage 3 is therefore an in-house-tested prototype of the product. The emphasis in stage 3 is on technical work, but marketing and manufacturing activities proceed in parallel, e.g. market analysis and customer-feedback activities continue concurrently with the technical development. Customer opinions on the product are sought on an ongoing basis as the product is developed.

Post-development: Gate 4 is characterized as the "post-development" review (Cooper 1993) and involves a continued evaluation of the product’s attractiveness. Development activities are reviewed and checked ensuring that the work has been completed in a

quality fashion and that the developed product is consistent with the original definition specified at gate 3. Another important activity is a revised financial analysis based on the new and more accurate data. Stage 4 tests and validates the entire viability of the project: the product itself, the production process, customer acceptance, and the economics of the project. Several activities are conducted, which will later be described in detail. The final gate, gate 5 is labeled the "go to launch"-stage and can metaphorically be described as "the door to full commercialization" (Cooper 2001). Stage 5 includes the implementation of both the marketing launch plan and the production or operation plan. Finally, the project must be terminated within a period of 6-19 months after which the new product will become a "regular product" in the firm's product line (Cooper 1993).

The chapter continues as follows: First, the historical context will be addressed briefly. The second and third section of the chapter will include a detailed description of the gates and stages respectively, whereas the final section will focus on the third generation, which (Cooper 1994c; Cooper 2001) has only described briefly.

2.1 HISTORICAL CONTEXT

NASA developed the first generation model in the 1960's and termed the process Phased Project Planning (PPP). PPP was a detailed planning scheme for cooperating with contractors and suppliers and broke development into discrete phases with review points (Griffin et al 1997)[10]. According to Cooper (1994c), the method focused on control and measurement to ensure that the project proceeded according to schedule and that every activity was completed in time. The PPP-method was engineer driven and applied to the physical design and development of the project. Therefore, it did not include any of the business disciplines as e.g. marketing. Cooper (1994c: 5) describes a NASA-executive, who

[10] Addressing the origin of SG, Richard Anderson argues, "Historically, the PPD approach derives its conceptual firepower from the Phased Program Planning (PPP) used by NASA to develop missiles and other large-scale development programs. Today's industry users have modified NASA's PPP approach, variously calling the resulting system "Phased Development Process, "Structured Development Process, "Stage-Gate, or sometimes "Phase Review Process" (Anderson 1996).

> […] claims that the bureaucracy inherent in the method meant that NASA's PPP-method managed to double the development time of every project it was used on.

The second-generation SG process resembles the first-generation method to the extent that it also includes identifiable and discrete stages preceded by review points or gates (Cooper 1990; Cooper and Kleinschmidt 1991b). The second-generation SG process was described in detail in (Cooper's 1993) first book. It was based on extensive research into which factors separate the successful projects and firms from less successful ones (Cooper 1994c). The second-generation SG process differs from PPP primarily in two ways: First, the process is cross-functional involving activities from many different departments within the firm. No stages are "owned" by one function. Cooper argues that the "nature of the activities virtually forces the use of a cross-functional project team approach" (ibid, p. 5). Second, marketing and manufacturing are integral parts of the product development process contrary to the PPP method, which tended to focus solely on engineering or technical schemes (Cooper 1994c). Subsequently, Cooper (1994c) and Cooper (2001: 8) introduced the third generation process with

> […] particular emphasis on efficiency: on speeding up an already effective second-generation stage-gate process and on more efficient allocation of development resources.

The third generation differs from the second generation with respect to a number of "fundamental F's" (Cooper 1994c), which have developed from five to a total of seven (Cooper 2001). The F's will be described in detail in a later section of the chapter, but deal e.g. with the effect of making the SG approach more 'fluid' with overlapping and fluid stages. The SG approach described in this study will primarily be based on the second generation, but it will also include the latest generation[11].

Cooper developed NewProd III in the eighties, a database containing more than 203 retrospective analyses of new product projects in 125 industrial product firms. Here, the success of a new product was analyzed with respect to whether the product's profit expectations were met or exceeded the company's financial or profitability criterion for success, the profitability level, the new product's market share after year three, and the

[11] Material on the third generation SG approach is scarce. Some firms may experience the effects of a second generation without considering the claimed extra benefits from the third generation SG process.

degree to which the product met the company's profit and sales objectives (Cooper 1997). Some of the products were successes and others failures. Based on these findings, Cooper (1993; 1994a) identified a pattern for success summarized in the following factors for product success (Cooper 1993) in a descending order of importance: 1) Superior products that deliver real and unique advantages to users tend to be far more successful than "me too" products. Superior products meet customer needs better than competitive products and have a relatively higher product quality. A primary condition for gaining superiority is working with the goal of superiority and advantage, 2) successful products must have a sharper definition prior to development. Cooper (1993) claims that the projects with a sharp definition were 3.3 times more likely to be successful with NPD, 3) quality of execution of technological activities, 4) NPD must be attacked from a position of technological strength, 5) quality of execution in predevelopment activities, 6) a strong link between the sales force, distribution, advertising resources and skills, marketing research, intelligence resources, and the firm's customer service capabilities, 7) NewProd III showed that many companies were particularly deficient in the way they handled the marketing side of projects. Products that targeted more attractive markets were more successful, 8) market attractiveness, and finally 9) the competitive situation and top management support (Cooper, 1993).

According to Cooper (1993), these lessons are exploited in the SG approach. They constitute a "blueprint" or "process template" for management of NPD leading to success. The effects on performance are several: increased success, reduced time-to-market and improved cross-functional activities within the organization.

2.2 GATES

The following section is concerned with the activities of the stages, thus providing the basis for decision-making at the gates by making information available through documentation. According to Cooper (2001), the quality of the stages is concerned with "doing projects right" (p. 213) and intimately linked to effectiveness. Effective innovation project management prioritizes quality by making as much information available as possible on market, technology and finance issues, which is reflected in the criteria that do not emphasize time. The second theme of this section focuses on "doing the right

projects" (Cooper 2001), which to Cooper (ibid.) is equivalent with the issue of efficiency. The SG approach consists in the generic form of 5 gates and the purpose of each gate is the same: to assess the quality of the project: "[…] ensuring that your business, do them right" (Cooper 2001: 213). Accordingly, gates deal with three quality issues:

a. Quality of execution: have the steps in the previous stage been executed in a quality fashion?

b. The quality of the business rationale: is the project still attractive from an economic and business standpoint?

c. The quality of the action plan (are the requested resources sound).

Gates are similar in format and consist of three basic components for quality decision-making: deliverables (basis for decision-making), evaluation of deliverables compared with criteria, and output (ibid.). Cooper (2001: 232) argues that it is a typical problem that project managers do not understand the expectations of senior management at the gates:

> […] hence they arrive at gate meetings lacking much of the information that senior management needs in order to make timely go/kill decisions. To avoid this situation, deliverables must be defined in advance for each gate. These are what the project leader and team must deliver to the next gate; they are the results of activities in the preceding stage. The list of deliverables for a gate becomes the set of objectives for the project leader and team. A standard menu of deliverables is specified for each gate. Also, at the preceding gate both the path forward and the deliverables for the next gate are decided.

Each gate has its own list of criteria to be used by the 'gatekeepers', which top-management's participants at the gates are called. The gate decision is based on these criteria that include go/kill and/or project prioritization criteria. Gate criteria include two types: must-meet and should-meet. First, must-meet criteria entail yes/no questions; a single 'no' might signal a kill decision. Checklists are based on the usual format for must-meet criteria. Second, should-meet criteria are highly desirable, but a 'no' to one

question will not kill the project. Rather, these questions score, and a point count or project score is determined; “Scoring models handle the should-meet criteria well" (Cooper 2001: 233). The criteria may be quantitative as well as qualitative. The design of the scheme for must-meet criteria or checklist questions is typically related to strategic issues, feasibility questions, and resource availabilities such as does the new product project fit the strategic direction of the business? Is its development technically feasible? Are the required resources available? A ‘no’ to these questions - for example, a lack of strategic fit – should be enough to kill the project. A gate 3 situation is illustrated in table 2.1:

Table 2.1: Documentation, criteria and output in gate 3 (Cooper 2001)

Documentation	Criteria (must meet)	Output
o User needs and wants o Competitive analysis o Market analysis o Detailed technical assessment o Concept testing o Financial/business analysis o Plans of actions	o Strategic alignment o Market Need Existence o Reasonable likelihood of technical feasibility o Product advantage o Meets environmental heals o Positive return vs. risk o No show stopper	o Go o Kill o Hold o Recycle o Cond. go

By contrast, the should-meet criteria or scoring model questions describe the relative attractiveness of the project (Cooper 2001). A negative answer in terms of a no will not kill the project with these criteria. A range of low scores may indicate an unattractive project that is not interesting enough to pursue. The gate-criteria are designed to enable gatekeepers to evaluate a project or several projects at a gate meeting. Following the presentation, the project is debated and each criterion is discussed, evaluated and rated one by one. As illustrated in figure 2.1, five different decisions can be made at a gate meeting. It is not possible to defer decisions (Cooper 2001: 233):

> Go means just that; the project is approved, and the resources, both people and money, are committed by the gatekeepers. Kill means 'terminate the project': stop all work on it, and spend no more time or money here. And don't resurrect the project under a new name in a few months!

Hold means that the project passes the gate criteria – it is a good project - but better projects are available, and at present there are no resources for the project (Cooper 2001). A Hold decision is a prioritization issue (Cooper 2001). Recycle is analogous to 'rework' on a production line. Recycle signals that the project team has failed to deliver the expected results (Cooper 2001). The third generation SG will be described in more detail in a later section, but Cooper (Cooper 1994c: 10) also introduced a type of output characterized as conditional Go decisions:

> This type of conditional decision making is contrary to today's absolute or black-and-white schemes. To make a hard-and-fast Go/Kill-decision at today's Gates means that all the needed information must be on the table. By contrast a 'conditional Go' means that 'on the basis of the partial information available, the project looks good. For now, the project is Go but the incomplete information delivered (and positive) by XYZ date. Otherwise the project will be halted on XYZ date.

Cooper describes this type of gate as 'fuzzy' (Cooper 1994c) p. 10, which will be amplified in the following section. Decisions are reached based on the criteria scores: "Progressive companies use scorecards or computer-assisted scoring at the gate meetings, so that scores can be displayed and differences debated" (Cooper 2001: 234). Must-meet criteria in Gate 3 are illustrated in table 2.2:

Table 2.2: Must-meet criteria (Cooper 2001; Cooper and others 2001)

Criteria		**Rating**
Business Strategy Fit	o Congruence o Impact	0-10
Product Competitive Advantage	o Customer benefits o Meet customer needs o Customer value for money	0-10
Market Attractiveness	o Market Size o Market Growth o Competitive Situation	0-10
Leverages of Core Competencies	o Marketing synergies o Technological synergies o Production/processing synergies	0-10
Technical Feasibility	o Size of technical gap o Technical complexity o Technical uncertainty o Demonstrated technical feasibility	0-10
Financial Reward	o Expected profitability o Return (IRR%)	0-10

	o Payback method o Time to commercial start-up	

Gatekeepers are essential as they make the go/kill decisions and decide on resource allocation. R.G. Cooper (Cooper 2001) has introduced a number of 'rules of thump', which include:

- Gatekeepers at any gate must have the authority to approve the resources required for the next stage.

- Gatekeepers must represent different functional areas within the firm - including R&D, marketing, engineering, operations, sales, purchasing, and quality assurance.

- Usually the gatekeepers change from gate to gate (Cooper 2001). Typically, the gatekeeper group at gate 1 is small, perhaps "three or four people who need not to be the most senior in the firm. Here the spending level is quite low. By Gate 3, however, where financial and resource commitments are substantial, the gatekeepers typically include more senior managers, such as the leadership team of the business" (Cooper 2001) p. 236.

- Cooper recommends some continuity of gatekeepers from gate to gate: "The composition of the evaluation group should not change totally … for example, some members of the leadership team - perhaps the heads of the marketing and R&D departments - might be at Gate 2, with the full leadership team at Gate 3" (Cooper 2001p. 236).

2.3 STAGES

Implementation of the required activities is based on three fundamental types of activities related to market, technical and financial issues, including project management activities in some stages. The initial activities of idea generation are not included in table (2.1). Cooper (2001: 154) argues that the

> …trigger for the SG process is a new idea, where technological possibilities are matched with market needs and expected market demand. A good new product idea can make or break the project.

Cooper (2001) recommends that the following activities are carried out for ideation: First, securing idea generation from top-down and bottom-up as both approaches have their place in SG. According to Cooper (ibid.), the difference appears in the extent of direction, e.g. top-down idea generation is directed more by strategic considerations than bottom-up idea generation, which often originates from day-to-day operations. Second, continue to look for disruption in the context of the customer's industry. Cooper (2001) suggests that large problems stem from major shifts in an industry, and problems are followed by big ideas. Third, the development of scenarios is also an important aspect of ideation. Scenarios should include the expected future, but also alternate scenarios. Cooper (ibid.) states that alternate scenarios help decision makers to be more "[…] sensitive to signals of change" (ibid: 160). Subsequently, it is important to identify the primary decisions faced by managers (ibid.). Use of Voice-of-Customer research will uncover new opportunities. Cooper (2001) suggests three methods to Voice-of-Customer research. An anthropological style of research, sometimes labeled "camping out" (ibid: 162). Product value analysis is an experiential method where customers interact with facets of the product and express their views, concerns, and difficulties (Cooper 2001: 163). The third method is to identify market trends and needs by making customer surveys or focus groups. Another point is to work with lead customers.

> "[I]f you work with an average customer, you'll get average ideas. But, if you identify a selected group of innovative or lead users, and work closely with them, then expect much more innovative new products" (Cooper 2001: 165).

Addressing the technology-push, Cooper (2001) has devised a particular SG model to organize ‘science-projects’. According to Cooper (2001), the SG process for technology development (SG TD) differs from the standard product-oriented process that allows much more experimentation. The output from the modified SG TD process is not a new product or a new manufacturing process, but new knowledge or capabilities that may be a platform for new products or processes. Another difference is the number of stages and gates. The SG TD process consists of three gates and two stages. The criteria are

much more strategic than financial in the traditional SG process. Cooper (2001) describes an example in which a Japanese company, TORAY CHEMICALS, uses the following criteria for evaluating their technology developments projects: degree of strategic fit and strategic importance to the corporation, ability to achieve strategic leverage, potential for reward, likelihood of technical feasibility, and likelihood of commercial success. Finally, Cooper (2001) stresses that it is important to harness the creative ability of the organization and suggests a number of ways: 1) establish a proactive idea focal point - an 'on ramp' - and work with the idea sources, 2) set up an idea bank, 3) try immersion - then harvest the ideas, 4) amplify thin ideas, 5) competitors trigger ideas, 6) trade shows are excellent sources of ideas, 7) trade publications provide ideas from around the world, 8) review patents - the universal clearinghouse, 9) suppliers are an untapped source of ideas, 10) universities are a brain trust in your backyard, 11) implement an in-house suggestion scheme, and 12) provide scouting time to promote creativity.

The first stage of preliminary investigation involves what (Cooper 2001) describes as a "quick-and-dirty" market study. The purpose is to determine whether the proposed product has any commercial prospects. The task is to find out quickly and at a minimal cost as much as possible about market size, growth, segments, customer needs and interest, and competition (ibid). Usually, this stage is completed within less than a month (ibid.). The purpose of the Preliminary Technical assessment is to establish preliminary, rough, technical and product performance objectives, undertake a very preliminary technical feasibility study and pinpoint possible technical risks. The preliminary business and financial assessment follows the preliminary, technical and market assessments. The purpose of the business assessment is to map out the strategic and competitive rationale for the project, including what (Cooper 2001) characterizes as a core competence assessment giving a preliminary assessment of whether the project requires partnering or outsourcing relationships. The financial assessment estimates expected sales, costs, and required investment.

The second stage is concerned with building the business case. This stage is the most difficult and cost generating of the predevelopment stages, and (Cooper 2001: 184) emphasizes:

> Moreover this is the critical homework stage - that makes or breaks the project.

This stage includes three main components: (1) Product and project definition, (2) project justification, and (3) the project plan. The first component should answer the "for whom" and "what" questions. At whom will the product be targeted, and exactly what will the product include in terms of benefits, features, and design requirements. The second component of the business case answers the ‘why’ question presenting arguments for investing in the project. This component includes a review of business, financial, profitability, and risk considerations. The third component features the project plan, which evaluates resources - money, hours, people, and equipment.

At the third stage, the project is *go* for development, and the business case plans are translated into concrete deliverables. The first problem is whether the final product will receive the same enthusiastic reception from potential customers as the product concept did in tests undertaken in stage 2. Technical problems may have emerged during development forcing a relaxation of certain performance requirements or an omission of features desired by customers (Cooper 2001). Thus, ongoing customer input and feedback must be maintained throughout the entire development stage. It is imperative to include a number of checks and tests in the game plan to ensure that the project is still on target as it moves forward. The key issue is: "no surprises" (ibid: 253). According to Cooper (2001), a second problem may occur because "the world does not stand still". The market may have changed partway or competitors may have introduced a similar product in the meantime. Therefore, rapid development is an imperative.

The output of stage 4 is a sample or a prototype and the product is partially proved due to the continuing customer input in stage 3. The purpose of this stage is to provide a final and total validation of the entire project with regard to the commercial product, its production and marketing. The marketing plan is an iterative process and was initiated in the first stages of SG. Most of the activities in stage 5 have been initiated in previous stages and developed further throughout the process. Stage 5 concludes the analyses and closes the iterative process.

The stage activities to be undertaken is summarized in table 2.3 where all activities can be categorized within four main activity areas: market, technical, financial, and project planning.

Table 2.3: Stage activities overview (developed from Cooper, 2001).

Overview	**Stage 1** Preliminary investigation	**Stage 2** Detailed Investigation	**Stage 3** Development	**Stage 4** Test and validation	**Stage 5** Launch
Market	Quick scoping; desk research only - preliminary market plan and product positioning.	User needs and wants study, competitive analysis (product strength), market and product analysis, and preliminary marketing plan, concept testing	Customer input required continues throughout this stage, market development; Products must be "genuine breakthrough products".	Test with customers, preferences, and trials (test of marketing mix), pre-test of market, identify the user.	Marketing plan (incl. introduction), define the target market, and formulate product strategy, marketing mix, communication, and sales force decisions.
Technical	Conceptual assessment of technical feasibility (technical risks included).	Detailed technical assessment, technical route, virtual prototype, manufacturability, production route, and capital requirements.	Intellectual property and regulatory issues (technology protection strategy), and production/operations process (supply route)		
Financial	"Sanity check", possible payback period (no spreadsheets).	Financial/business analysis, strategic assessment. NPV, IR and sensitivity analysis.	Update the detailed business and financial analysis.	Decide the data needed to estimate sales, production, stock, etc.	Situation size up, the final cost and sales of the plan including profit projections.
Project plans	A Go/Kill recommendation and action plan for stage 2 (timeline, resources, next gate).	Recommendation for project Go/Kill and detailed action plan for stage 3-5. Launch date is set.	Develop action plan for stage 4 (actions, resources, timing and milestones).		

2.4 THIRD GENERATION SG APPROACH

Companies who have successfully installed the generic process - termed the "second generation process" (Cooper 2001) - are moving toward what Cooper (2001) describes as the "third generation version" of the process (Griffin 1997a). According to Cooper, the first-generation process was a phased review process that appeared in the 1960s. It was largely engineering driven and featured laborious check-offs at each review point to ensure the successful completion of a number of key tasks. Thus, this method was more of a measurement and control methodology, designed to ensure that the project was proceeding as it should and that every facet of it was completed on time (Cooper 2001: 145):

> Today's second-generation process, as described so far in the chapter, is a step change from the phased review process of the 1960s. SG also consists of identifiable and discrete stages preceded by review points or gates. But that is where the similarities end. SG overcomes many of the objections found in the first-generation processes. SG is cross-functional, with no department owning any stage – marketing and operations are now integral parts of the process. The gates are also cross-functional, so that there is alignment of senior people on projects priorities. The process is more holistic. There is greater emphasis on the front end (up-front homework and a stronger customer input). It specifies stage activities and best practices. And it builds in parallel processing.

SG processes are perceived as "evergreen processes", i.e. constantly evolving and improving (Cooper 2001). Experienced 'Stage-Gaters' have improved their processes to emphasize efficiency, speed up an already effective second generation process and allocate development resources more efficiently. According to a PDMA survey (Griffin 1997a), almost one-half of the companies that adopted SG processes have redesigned them to include some of the elements of my third-generation process. The third-generation process is a natural evolution, once the second-generation SG process has been successfully installed in your business. It features six fundamental F's" (Cooper 2001: 145) including:

1. Flexibility: "[…] the process is not a straitjacket or a hard-and-fast set of rules. Rather, each project can be routed through the process according to its specific

level and needs. Stages can be omitted and gates combined, provided the decisions are made consciously and with a full understanding of the risks involved" (ibid., p. 145). The gate is 'fuzzy' with reference to a "fuzzy logic" where the outcome is not binary, but may involve various states in between. As a consequence, a go decision e.g. conditional on some future events may be made.

2. Fuzzy gate concept where the project can act as its own gatekeeper. Cooper (2001) makes a reference to NORTEL NETWORKS where the notion of a self-managed approach has been introduced, but the "[…] the jury is still out on this approach".

3. Fluidity: "The third-generation new product process is fluid and adaptable. Activities are not married to specific stages, but rather there are overlapping stages. Some activities, normally done in the next stage, will begin before the previous stage is completed" (ibid.).

4. Focus: "The third-generation new product process is focused, much like a funnel, where poor projects are weeded out at each gate and resources are reallocated to the best projects" (ibid: 148).

5. Facilitated: Cooper (2001) recommends using a project manager or other organizational facilities. Particularly, in large companies the process manager's position must be full-time.

6. Forever Green: SG processes are constantly renewed, redesigned, and improved as user companies gain experience from the approach. Some of the general improvements that businesses have made include the five F's listed above. Other companies have adjusted their SG processes to suit their specific needs. Cooper (2001) argues that the first step is to strive for a basic and effective new product process incorporating only some of the elements (the F's). Cooper (2001: 150) uses the metaphor of an automobile, where it is necessary to learn to drive first and follow all the rules and "[…] with experience, the professional driver does

some things automatically: and he learns when certain rules can be broken without additional risk in order to speed up the driving".

7. The seventh F is fallibility and represents a possible negative consequence. The third-generation process with flexibility, fluidity "and fuzzy gates introduces much more discretion to project leaders, teams, and senior managers". "The new process is more delicate, sophisticated, and sensitive, and thus it requires a more experienced, professional management approach. Using the automobile drive analogy, with more discretion over the rules and with increased speed, comes an increased risk of disaster" (ibid.).

The significant difference between the second and third generation is the gates that can be described as[12]:

Figure 2.2: Third generation gates (developed from Rosenau 1996 p. 8)

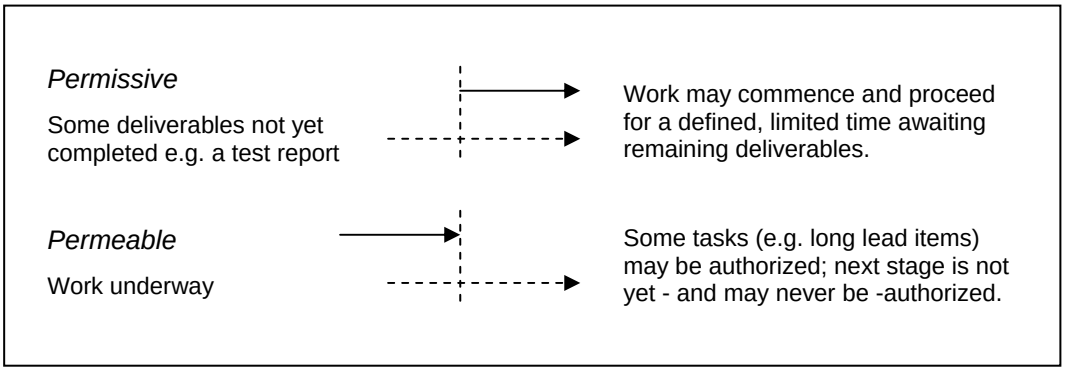


Figure 2.2 illustrates two types of the "conditional go" decision type introduced with the third generation SG approach.

[12] See also Krishnan and others (1997) where the limitations of concurrent engineering were examined with respect to overlapping stages.

2.5 CONCLUSION

SG is a conceptual model for managing the NPD process. According to the normative literature, it is a facilitating management tool to keep the risk associated with new product development to a minimum by enforcing decisions through predefined criteria at review gates and breaking the whole product process from idea to launch into five small stages to guide the concurrent information-generating activities in the cross-functional project team. However, the model is much more elaborate in the description of how to undertake the decision-setting (Gate reviews) than in the description of the activities required in the stages, where Cooper and Kleinschmidt emphasize the control of the output and at the gates focus on the process of input, computing and a predefined output type.

The early work is focused on the stages and their performance, but later in the research the focus changes to include the gate reviews. However, the coordination between the stages and the gates is of paramount importance to performance, and despite the relaxation reflected in the so-called ‘F’s in his latter work, Cooper et al (2002a; 2000b) has recently insisted that the stage must not overlap the decision-setting thus abandoning a critical property included in the third generation. The risk is that cost generating activities that should have been stopped are continued. However, some of the requirements have been relaxed, but the third generation SG approach has by no means been conceptualized to the same extent as the second generation even though 12 percent of all US companies apply a third generation process (Griffin 1997).

The activities required at each stage are described and to some extent normatively elaborated in terms of how to conduct the activities. But Cooper’s concern is that the activities are actually carried out without omitting any; the success of the project is linked to whether all activities have been performed. Thus, the SG approach described here can be characterized a management technique, which is to be studied by analyzing how the SG approach becomes a management technology through the perspective of appropriateness (to be presented in chapter four). The solution to bring improved performance (efficiency, effectiveness and reduced time-to-market) might not be as direct as assumed by Cooper (et al.).

But before continuing this line of enquiry, the next chapter will address the issues raised by the criticizing literature, which is categorized into four main issue followed by sources investigation into decision-making and PD.

CHAPTER THREE

Issues raised by the previous literature on the Stage-Gate approach

The purpose of this chapter is to present a number of critical voices in recent research, who have addressed potential limitations and problems in the SG approach, which roughly can be divided into the following areas: idea generation, intensity, and stages. Other sources have also been identified (De Brentani 2001; Walwyn and others 2002; Davis 2002; Barrow 2001; Radnor and Noke 2002), but they do not focus directly on the SG approach. The aim of this chapter is to describe the literature[13] in the three areas explicitly concerned with the SG approach, including literature on decision-making and management control literature, in order to present how other research has treated the SG approach.

3.1 IDEA GENERATION

Since the appearance of the SG approach in Cooper and Kleinschmidt's version (see chapter two), Cooper (2001) has added a 'discovery' phase (stage zero) to secure appearance of ideas to be fed into the SG approach. Smith and others (1999), Shaw and

[13] The literature has been identified by searching the ABI Inform, Elsevier, and Business Source Primer databases with "stage-gate" as the search string. There was no difference when searching in two separate words or with a hyphen.

others (2000), Hughes and Chafin 1996, Stevens and others (1999) and Perel (2002) have all criticized the SG approach with respect to creativity.

Smith et al (1999) argue that the "fuzzy front end" (p. 15) is defined poorly and constitutes an area where companies that have successfully implemented a SG approach might optimize due to an increase in the quality of new ideas. Smith and others (ibid.) refer to a benchmarking study claiming that out of 3,000 unwritten ideas, only 125 written ideas emerge for stage gate development. Out of these, only one will become a commercial success, which brings an emphasis on the front end and the design of "an organizational process" to manage the inventiveness in the first stages of the SG approach by decoupling the first stage from the rest of the approach. Research by Shaw et al (2000) indicates that out of 100 ideas entering the first stage, only 13 will be commercialized successfully. Hughes and Chafin (1996) suggest that an increased emphasis on product development as an iterative process with a focus on customer value, continuous learning and building consensus among the project team members is a better alternative than the SG approach since these issues have not been raised as a particular concern (see chapter two). Rather than building a decision-model with a weighted sum score for predicting the success of a new idea as suggested by Cooper (2001), the authors suggest a model that will work as a consensus facilitator allowing team members to see how closely they agree (Hughes and Chafin 1996). The 'linearity' of the SG approach must be reduced by allowing what Stevens et al (1999: 458) describe as "leaps of creativity & branching". Therefore, they suggest incorporating some of the same non-linear thoughts on the PD process and select innovation people for the early stages of the SG approach teaching the project team business discipline. In this way, the ideas will have a breakthrough character reducing the problem that only one out of 3,000 ideas will prevail before the first gate review. In addition:

> Innovation is an iterative process and forcing it into a linear mold offers senior management too many tempting opportunities to demonstrate the lack of courage by killing ideas (Perel 2002).

Contrary to these scholars, Buggie (2002) supports the SG approach by claiming that fuzziness is <u>at</u> the front end and not that the front end of the SG approach is fuzzy. Furthermore, Buggie (ibid: 11) argues that the SG approach is a conventional project-

management process incorporating milestones as it proceeds, which might indicate that the criticism raised by Smith and others (1999), Shaw and others (2000), Hughes and Chafin (1996), Stevens and others (1999) and Perel (2002) to some extent is out of context compared with the motives behind the design of the SG approach. The SG approach is an administrative system for innovation rather than a system designed for creativity and idea production.

3.2 RIGIDITY

The second area of rigidity addresses compliance with procedure and is a central issue in the SG approach. The 'inventors', Cooper and Kleinschmidt (see chapter two for the origin of the SG approach), emphasized that companies had to conduct their "homework" assuring that activities had not been skipped and objective decision-making would be carried out. Interestingly, Shaw et al. (2000), who developed a revised model based of the SG approach motivated by a desire to reduce development time and resources, also argue that if the SG approach is employed rigidly and more for "its own sake", the result may be an actual increase in the development lead-time. Ottosson (1996) addresses coordination (whether to allow overlapping stages) and argues that if projects have to wait at each gate until all tasks or activities have been carried out, it is difficult to start working on another stage before the previous one has been completed. Such a procedure will result in time delays and inefficient use of the company's human resources. This concern has been addressed by the third generation SG (Cooper 2001), which relaxes the need for complying with the procedure before moving into the next phase. Rosenau (1996) has presented two types of these gates (see figure 2.2). Curtis and Ellis (1998) argue that the key benefit of the SG approach is its ability to involve general (top) management in the decision-making - especially at the early stages. Jenkins et al. (1997a; 1997b) address the concern about rigidity by stating that:

> These methodologies do have some potential weaknesses that management must address. As has been stated earlier these procedures should be seen as guidelines and if an overly rigid set of rules is applied to product development, responsibility may actually be taken away from the core team. If this is allowed to happen the desired effects of empowering the team, and allow-

> ing them to develop the process will not be achieved. It is thus important to remember that phases can, and should be overlapped in places. If tasks are allowed to queue at phase review points, time to market may actually be increased (Jenkins et al 1997a: 391).

Jenkins et al (1997) argue that if the formal and structured approach is not applied as a 'guideline' but an imperative, the project team might be demotivated and the projects might be queuing before the gate reviews. Perel (2002: 16) uses the terminology from a "straight-jacket" to describe the SG approach arguing that it will impede promising projects and "[…] prolong the agony of losers". Finally, O'Connor (1994) argues that many companies have been asking for a PD process with overlapping phases.

Cooper (1994) has presented a "conditional go" decision output type that to some extent permits overlapping stages (third generation SG approach). Flexibility in application of the SG approach has been introduced by applying various number of gates based on an evaluation of the risk-level associated with each project: a full scale model for large, high risk projects (five gates), a fast track process for lower risk projects (three gates) and finally a significant customer request process with two gates. However, in the most recent work by (Cooper et al. 2002b: 45), the third generation SG model is not mentioned and the authors maintain the earlier requirement for:

> "[…] tough Go/Kill decisions are built into your new-product process, where all products are carefully scrutinized, and weak ones really killed".

In sum, the application of formal and structured approaches affects the innovation process and appears to be an unsettled issue in the literature on the SG approach. In their most recent work, Cooper et al. (2002a; 200b) maintain that projects should not be allowed to proceed before a formal approval, and therefore overlapping stages must not occur. Thus, application of the SG approach is a central theme when the approach is employed in an organizational praxis as a management technology. Since the application affects the innovation process in several ways, further research is needed.

3.3 STAGES

Stages and decision-making are closely related to rigidity (Anderson 1996; Phillips and others 1999; Rochford and Rudelius 1997; Stevens et al. 1999). Anderson (1996) mentions particularly the SG approach in the second approach as a Phased Product Development (PPD)-approach to PD characterized by segmenting the PD-process into a continuum of phases or stages. To complete a development phase, a checklist of "exit criteria" must be met and approved by a Phase Review Board. In PPD, risk is managed by allocating development funds based on completing each phase of development successfully. In view of what Anderson (1996) characterizes as Integrated Product Development (IPD), PPD is activity oriented (phase structured) whereas IPD is information and decision oriented. IPD focuses on intense communication and information gathering among team members, which allows development to move swiftly using partial information. This information use is blurring structured-phased development (Anderson 1996). In IPD (ibid: 33), project teams are empowered to be responsible for project concepts, resources and delivery making it possible to overlap and integrate development activities. Thus,

> "[…] the focal point of IPD perceives development as an invisible information and decision-making process rather than a tangible compartmentalization of building block activities along a product maturity curve".

According to Anderson (1996), the third-generation SG approach is in line with IPD and the second-generation SG approach is in line with PPD. Anderson (1996) suggests that PPD provides a disciplined system for managing product development by ensuring that steps are not skipped, "quality stays high" and technical and marketing risks are controlled by senior management. The risks are managed by allocating development funds based on the successful completion of each phase. Projects do not take on a life of their own and must prove again and again that they are winners. PPD focuses on gaining early market information and underwrites the screening of winners from losers in the product pipeline. This ensures a market-driven process rather than a technically driven one (ibid.). Through the control procedures of the review board, PPD also provides opportunities for senior functional managers on all products in the pipeline. Ac-

cording to Anderson (1996: 31), IPD is founded in the history of developing military aircrafts at the LOCKHEED Corporation:

> Lockheed's Skunk Works started in a large rented, and remotely located circus tent. But rather than accenting separate autonomous units today's modified team model knits development projects into a company's existing structure. Although a team assumes responsibility for new product delivery, it remains a part of the texture of the company even if it locates in a remote area. The modified architecture is usually called Concurrent Engineering, Simultaneous Engineering, or IPD.

Senior Management outlines a broad concept challenge that becomes the basis for a specific product development agreement or what Anderson (1996) describes as a contract between the project team and senior management. The contract specifies cost, quality, schedule and other "negotiated goals to be met by the team" (p. 31). The IPD team is multifunctional and led by a respected project manager with responsibility for project resources and development decisions. The team consists of a small number of core members collocated in one area with additional time-shared experts (Anderson 1996). The team establishes the development path using what Anderson (1996) describes as:

> "Concurrent and overlapping development practices that accent early planning and decision making. The focus is on intense communication and information gathering among team members. This allows development to move swiftly using partial information, thus blurring structured phases of development. To keep the team honest, metrics are identified to track results in aiding the team and senior management" (Anderson 1996: 31-32).

Anderson (1996) supports the notion of an IPD process where the project team is empowered. The project is not managed through a SG approach, but the team has a designated budget and is decoupled from departmental relationships to ensure the information flow. Information intensity and empowerment enable a dismissal of the SG functionality to the effect that stages as a notion are dismissed.

The study by Phillips and others (1999: 290) examined the SG approaches of six large firms based on a definition of stage gate as:

> […] a framework, which is applied to the company's product development process. The framework aids the process and enables the efficient and effective movement of a new product from idea to launch".

The authors regard the SG approach as a high-level representation for product development. The method applied by Phillips et al. (1999) was to develop a basic SG approach as a control measure to contrast and compare each firm's specific stage gate approach individually. The control approach included four stages: preliminary concept development (stage one), design and development (stage two), validation (stage three) and in-service product support (stage four)[14]. Phillips et al (1999) conclude that the SG approaches share the same objective of executing projects efficiently and effectively, but the number of phases employed by the six firms range from four to ten. However, each organization appears to follow the "[…] typical stages of development" (p. 291). The difference appears in the number and title of phases into which organizations divide their individual processes suggesting a classification of SG between low and high phased processes.

The underlying organization of the firm has a significant influence on the choice of SG configuration. Organizations where each phase in the SG approach only includes a few stages have cross-functional teams involved throughout the life of the project. In comparison, organizations with high-phased processes need to enforce reviews into the overall Stage-Gate process to cope with a functional orientation to development. KODAK, e.g., has a broad scope of businesses, is functionally organized and only applies cross-functional advisory groups on special issues (Phillips et al. 1999). A key competitive dimension for KODAK is time to market with a very close customer-orientation. Therefore, the company emphasizes the initial stage of development where all customer needs are identified (Phillips et al 1999). Thus, the initial concept development stage is divided into two phases: customer mission and technical demonstration subdivided by an additional review. The same behavior is observed with the validation phase, which is divided into three phases or 'sub-stages' with additional 'sub-reviews' "[…] to obtain tighter control" (Phillips et al 1999).

[14] The authors use Cooper (1990) as a source to establish a four-stage approach. However, Cooper addresses a five-stage approach in line with the description in the previous chapter. The contradiction has no significant influence on the discussion and the validity of the findings by Phillips et al. (1999).

Rochford and Rudelius (1997) have investigated completed new product projects processed by an SG approach in the medical products industry with a particular emphasis on the comparison between new-to-the-world products and product modifications in terms of perceived importance of twelve PD stages by R&D, manufacturing, and marketing departments. Apparently, there are variations in the use of specific PD stages:

> […] the firms use the PD stages more often for new-to-the-world products than for product modifications, and "high-success products" utilize the PD stages more often than "low-success products.

Based on the early work of Cooper (1990) and the study made by Booz, Allan and Hamilton, Rochford and Rudelius (1997) have used a theoretical derived thirteen stage model of the PD process focusing on the twelve stages preceding the last stage: commercialization. Compared to the generic SG approach (described in chapter two), the parallel activities made in each stage have been turned into a stage of its own by the authors. However, they are not distinct on the implications of this particular stage gate in terms of e.g. costs and what appears to be an extended lead-time. Based on the approach to PD, the study investigates four kinds of variables. The method is a questionnaire mailed to 215 firms with a response rate of 36%. The survey presents a number of managerial implications based on the findings.

First, the relation of product innovativeness to stage importance is disclosed including a distinction between product modifications and new-to-the-world innovativeness suggesting that the stages of the PD-process are more important for new-to-the-world products than for product modifications. The danger of skipping some of the stages may be critical – especially in the medical devices industry where even product modifications may require significant R&D and product testing (Rochford and Rudelius 1997). Cooper (2001) suggests that a fast-track version of the SG approach can be applied to smaller projects with low risk, e.g. line extensions, product improvements, and modifications, which appear to be supported by Rochford and Rudelius' (1997) research. For new-to-the world and product modification projects, the stages of idea generation, product development, and in-house testing are crucial and equally important. The respondents had to weight the perceived importance on a scale ranging from one (not important) to five (critically important), and the above mentioned stages were the only ones to

score more than four (very important). Rochford and Rudelius (ibid.) also investigated what different departments perceive as important and disclose that idea generation, product development, and in-house testing once again are perceived as the most important stages regardless of the department in question. The greatest difference between the four departments R&D, marketing/sales, manufacturing and top-management is how they perceive the importance of the preliminary technical analysis and market testing stages. In general, marketing/sales considers preliminary technical analysis, product development, and in-house product testing to be almost as important as R&D. However, the reverse only applies to preliminary market analysis. The conclusion indicates that R&D need to value marketing-related stages in the PD-process. Third, the link between perceived importance and whether a specific stage actually has been performed were also investigated. The study discloses a number of findings (Rochford and Rudelius 1997: 77):

> […] 100% of the respondents reported their firms used the idea generation and product development stages for their new-to-the-world products. In contrast, marketing-oriented stages (preliminary market analysis, market study, and market testing) were used far less often for product modifications: 60% of the preliminary market analysis stage, 51% for the market study stages, and only 39% for the market testing stage.

O'Connor (1994) has analyzed how to accelerate implementation by exploring the issues and challenges of implementing a SG approach. O'Connor (ibid.) made a simple regression of the percentage implemented and time-dedicated data, which suggested that complete implementation may take over six years. Also, for companies with similar practices as those observed in the benchmarking forum, five years may be the norm for achieving full (70%-80% complete and benefits accrued) implementation of an PD process.

> "Another insight that the regression analysis suggests is that negative results may accrue during the first six months or so of implementation" (p. 184). Through an analysis of the dialogue and bundling the common concerns and actions, three key components of implementation emerge:
>
> 1. Managing the organization's perceptions/expectations of and commitment to the process

> 2. Developing flexibility and adaptability as a balance to the discipline and thoroughness of the process
> 3. Causing frequent and productive dialogue between cross-functional teams and cross-functional top management" (O'Connor, 1994: 184).

The research by Rochford and Rudelius (1997) also disclose that no two processes are identical; each firm creates its own customized version by emphasizing different elements and activities, but there are also remarkable similarities. Specific activities, timing of gate reviews, assignment of team members, who participate in gate reviews, who lead development teams, the specific role of sponsors' differ among the processes. The number of gates in the six processes ranges from four to seven and gate activities differ somewhat for each of the processes. For instance, screening of projects, normally an initial gate activity, differs in each participating company. One firm maintained a database of previously reviewed new product ideas. The new-ideas database included product descriptions, analyses of the ideas, and the ultimate outcome of each idea. It enabled quick references to previous activities on specific ideas with the result that individual senior managers and teams did not have to 'recreate the wheel' in screening decisions. Screening at an initial gate in other firms includes variations on top management's intuitive assessment; weighed evaluation of fit, market attractiveness, product advantage, priority ranking of concepts, and identification of killer variables. Activities within stages also differ. For example, one firm did not create or involve multifunctional teams in gate activities until the third stage of development. It is extremely expensive to get teams together, because products are developed and launched globally. This means that the activities in stages one and two and the business case analysis are done in functional departments. The global multifunctional team comes together electronically when the business case has been reviewed and accepted by senior management sitting in review at gate three (Anderson, 1996). Finally, Anderson (1996) suggests:

> Another discussion theme was that of assuring potential contributors that the process is flexible and adaptable. This could be seen in how the processes were promoted to their organizations. For example, each firm gave names to their processes, which included phrases such as 'development process', 'management system', 'innovation process', 'concept development', and 'development model'. None included the phrase "Stage-Gate". This purposeful omission underscores a common desire to position each process as flexible and situational, not rigid and bureaucratic.

Anderson (1996) abandoned the PPD (or stage functionality) because the approach tends to impede the information flow within the team. Therefore, he suggests empowering the team with decision-making authority and a budget based on a contract. However, the stage gate functionality is maintained by 1) Rochford and Rudelius (1997) who have identified the relationship between skipping stages and performance, but also suggest applying a reduced model when the business risk is perceived to be low, 2) Phillips et al (1999) who found that the key to the number of stages is cross-organizational information flows. Consequently, companies with several departments should apply more stages to secure information, and 3) O'Connor (1994) who has focused on the complexity of implementation claiming that flexibility must be built into the design of the approach. Stages are closely related to rigidity. The three authors above maintain the need for stage functionality, but one scholar (Anderson, 1996) suggests abandoning the notion of stages due to a fundamental difference in the level of empowerment. Anderson (1996) suggests that his perception of an IPD approach is based on leadership whereas the others basically regard stage functionality as management control.

3.5 MANAGEMENT CONTROL AND STRATEGY

Simons (1987) has investigated the relationship between business strategy and accounting based control systems. The latter is defined as

> […] formalized procedures and systems that use information to maintain or alter patterns in organizational activity.

Anderson (1996) suggests that the SG approach is a control system that also can be identified in Simons' (1987) definition since the SG approach is a formalized and structured approach based on information that must be documented before each gate review meeting. The purpose of the SG approach is normatively to govern activities into standardized activities with respect to gates and stages. As such, the SG approach can be regarded as a control system.

Simons (1987) has drawn on a large number of previous studies, which have attempted to test the Burn & Stalker's (ibid.) conclusion that unstructured, organic organi-

zations with minimal formal controls are best suited to a strategy of innovation. In Simons' (1987) perspective, the results of these studies are inconclusive. In an attempt to reconcile these differences, Miller & Friesen's (Simons 1987) research reveals that control in relation to the strategy of the firm is critical to understand the relationship between control and innovation. The key dimension of the Miles & Snow typology is the rate at which the organization changes its products or markets. On this basis, they identify three successful, generic strategies, which they label prospector, defender, and analyzer. Simon developed a H_0 hypothesis claiming that control systems attributes do not differ between prospector and defender firms because each strategy requires a particular management control system. The hypothesis was rejected partly due to the following data (the table below) describing the correlation between ROI and attributes of the control system. The numbers suggest that prospectors pursing a value adding strategy through innovation are using control systems more successfully than defenders. The difference is even more pronounced when the results are decomposed into company size.

Davila (2000) has elaborated on these studies based on a research design including case studies and surveys by drawing on Galbraith's uncertainty concept (Galbraith 1977) and examining the drives of management control systems in PD. Information variables on customers, product designs, time, costs, resources and profitability in a management control systems were examined. The findings show that there is a positive and significant coefficient for the design of the management control system and cost information, but the correlation is -0.225 for time. This might indicate that a decrease in development time is not always valid with respect to the company's competitive advantage. This aspect is also underlined by Cooper (2001) who focuses on quality, which might decrease development time for the projects' portfolios due to early canceling of unprofitable projects producing free resources for other profitable projects.

Table 3.1: Correlation between ROI and attributes of the control system (Simons 1987)

Attributes control system	Prospectors*	Defenders*
Tight budget goals	0.47	0.25
External scanning	-0.08	0.10
Results monitoring	0.23	0.06
Cost control	-0.20	0.02
Forecast data	0.27	0.02
Goals related to output	0.32	0.06
Reporting frequency	0.14	0.15
Formula-based bonus remuneration	0.03	0.24
Tailored control systems	-0.36	-0.04
Control system changeability	0.02	-0.16
Industry dynamism	0.37	-0.42

* the numbers refer to the correlation coefficient between attributes of a control system and ROI, for instance the number 0.47 indicates a strong correlation between return on investment and to the extent the company investigated secured and evaluated the goals set with the budget.

Bonner and others (2002) have made a survey to examine the design of management control systems in PD such as stage-gate and QFD. The survey identifies statistical support claiming that formal process control can become too detailed, which stifles the creativity and hinders the project teams' ability to make the adjustments needed early in the process. But the survey could not identify any support for the hypothesis that the degree of output control is positively related to performance in contrast to the Simons' findings (1987).

The SG approach can be aligned with a management control system, and its relevance for firms pursuing the most innovative strategies can be established although the literature differs on some issues. Initially, the purpose of the SG approach has been to accelerate time-to-market and increase efficiency in the development work by securing quality. This notion seems to be supported by literature, but the design and use of these systems are highly relevant to the performance of the development project.

3.5 DECISION-MAKING ON PD

Literature has raised the issue of overlapping stages as a crucial concern in management of the PD process since rational decision-making is an imperative and projects that prove unprofitable should be stopped. Therefore, it seems expedient to include some of the studies focusing on the SG approach as well as decision-making in PD in general. The literature identified[15] includes the following sources:

Olson and Bakke (2001) followed the implementation process of a Lead User method in an IT firm. The method was abandoned for a number of reasons although the lead-user derived product concepts had been successfully implemented. Management explained that it was personnel turnover and lack of time that made them return to the original product development process, which was more technological driven. Also, the firm was performing well, which added to the conception that a lead-user method was "nice to have" rather than "necessary". The authors indicate that the ambiguity may be related to customers' lack of precision in expressing their desires and preferences for current and new product concepts. However, the ambiguity was reduced in the case of the lead-user approach resulting in a number of very specific product suggestions from customers specifically selected due to their advanced product knowledge. The customers' competence level reduced the "translation" problems from customer inputs to the language used by the technical development people. According to the authors, a new reward system should have been implemented as well as the lead-user method.

Calantone and others (1999) addressed decision support models for screening product ideas in the 'fuzzy front end' (see above). Calantone et al. (1999) illustrated a particular model (AHP: Analytic Hierarchy Process) by applying a new product screening decision. The AHP aids the decision-situation by means of a support model and will ideally "automate" the decision-process replacing Cooper's (2001) requirements to disclose subjective evaluation through the Likert-scale and the zero to ten points (see chapter two).

[15] The inquiry was based on a search in a number of selected journals including Accounting, Organization and Society (0 results), European Accounting Review (0 results), Administrative Science Quarterly (0 results), Management Science (4 results), and Journal of Product Innovation Management (3 results). The search string framed was 'Decision and Product Development' within a time frame ranging from January 1999 to April 2003.

Mullins and others (1999) examined risk and decision-making disclosing a number of findings on the selection of people for the project. They showed that the role of the individuals' previous experiences and whether survival or outperforming competitors motivated their goals had an influence on the decisions made. Thus, decisions are not only analytical or rational, they also exert an influence on learning.

Loch and Kavadias (2002) focused on dynamic portfolio selection of PD programs based on a programming model. The unit of analysis was not the single project, but a strategic program associated with an entire product line. According to the authors, resource allocation can be varied continuously at that level because individual projects are small relative to the program, which allows a marginal benefit analysis instead of combinatorial optimization. The aim of this decision model is to provide decision-makers with a "rule of thumb" indicating that the managerial decision-making perspective is a rule-based model. The construction of the model is an attempt to gather information based on an incomplete view of the world and in a sense an attempt to rationalize on the basis of limited information and rules (uncertainty).

Krishnan and Bhattacharya (2002) addressed the selection of the right technologies for new products with an element of uncertainty. The authors formulated a mathematical model of a firm facing two options: 1) a proven technology that is known to be viable and 2) a prospective technology that offers superior price to performance results, but whose viability is not a fully certain outcome. To reduce the impact of technology uncertainty, the authors proposed two approaches to design flexibility, termed parallel path and sufficient design, allowing concurrent development of the firm's products while validating the technology. The managerial implication is to formulate a number of conditions for when to freeze the product design depending on the technological uncertainty. The authors assumed that information is limited and departed from the same point of view as (Loch and Kavadias 2002) by formulating a decision-set that managers can use to decide on the design of the PD approach.

Ulrich and Ellison (1999) examined how a firm confronted with developing a new product chooses either to design new components or to select components already available. They called the situation for the design-select decision and argued that decisions are greatly influenced by customer requirements and core capabilities of the firm. Even though the approach is analytical in nature, the authors suggested that a number of

elements should be included in the decision on whether to make or buy components, and in that sense the decision type can be seen as both analytical and a rule-based.

Krishnan and Ulrich (2001) reviewed more than 200 papers focused on decision-making in product development. The papers were categorized according to decisions made within the context of a single project or decisions made by a firm to establish an organizational context and plan development projects. They explicitly departed from the bounded rationality perspective subscribing to the point of view that an organization manages uncertainty through information processing (Krishnan and Ulrich 2001).

However, this small literature review does not make the distinction suggested by Krishnan and Ulrich (2001) nor does it subscribe to only one particular perspective on decision-making. The literature review does not identify papers according to decisions in PD concerned with the anarchical, political or analytical decision types. The number of reviewed journals is much larger than the number of journals included in this small literature review, but the papers included here are more recent. Krishnan and Ulrich (2001: 3) argue that:

> The decision perspective helps us get a glimpse inside the 'black box' of product development without being concerned about how these decisions happens.

The literature is concerned with developing systems to support substitute decision-making that appears to be influenced by uncertainty. Information gathering may reduce uncertainty, which makes rational decision-making feasible in PD. However, Olson and Bakke's (2001) study disclosed a situation, in which a firm abandoned an approach to manage the PD process where the preferences of customers were made visible, but characterized as ambiguous. However, the ambiguity could be handled, but the firm resumed the previous inside-out strategy based on technology.

Generally, the literature suggests further research by opening the 'black box". In particular, attention should be focused on the decision-making functionality, which also was seen as a significant feature in the SG approach by the literature in the previous sections. In addition, there is a need for analyzing the relationship between formal and structured approaches and ambiguity, which has been identified as ubiquitous in PD (Martin and Meyerson 1988; McCaskey 1982).

3.6 CONCLUSION

The purpose of this chapter was to present a number of critical voices in recent research, who have addressed potential limitations and problems in the SG approach. These can roughly be divided into the following areas: idea generation, intensity, and stages, management control and strategy and decision-making on PD. These voices are summarized in the table below:

Table 3.2: Limitations and problems in the SG approach

Issues	Discussion in the literature
The SG approach as a tool for idea generation	The SG approach impedes idea generation in the front end by being fuzzy whereas other sources claim that fuzziness is *at* the front end. The benefit of the SG is the actual killing of ideas as a procedure for innovation.
Compliance with the SG approach (the issue of rigidity)	The literature is undecided whether to allow for project work to continue without formal approval (the coupling between gates and stages).
The division of the PD process into stages	Closely related to rigidity (see above) is whether project teams should be empowered to make their own decisions and avoid the requirement for formal approval (and decisions in general). The discussion on whether to have a procedure in place with stage and gate functionality remains an open issue.
The SG approach as management control	Main body of the literature points to a positive relationship between performance and formal and structured approaches as the SG approach, but does not explain why that is.
Decision-making on PD	Only limited literature on how decision *happens* and assuming ambiguity. Main part of literature is concerned with decision-making support systems.

A study with an organizational focus on how the SG approach is applied within the organization (as a management *technology*) appears to be a valid attempt to add more insights into the workings of the SG approach as a formal and structured approach although several performance issue remain open as well. The ‘black box’ should be opened, particularly in decision-making where some authors suggest more enquiries into how decisions are made in a practice surrounding innovation and PD.

CHAPTER FOUR

The Stage-Gate approach as rules: instrumentality and appropriateness

The purpose of this chapter is to establish a meta-theoretical framework for the empirical analysis that is set out in the following chapters. The critical voices that we met in the literature review of the previous chapter took ‘rigidity’ as an issue of contention (Shaw et al 2000; Ottosson 1996; Jenkins et al 1997a; 1997b), suggesting that formal and structured methods of innovation may become too ‘bureaucratic’ when employed in an organizational context (Clark and Wheelwright 1992; Hamel 2002). This criticism of the Stage-Gate approach indicates that investigating rules might offer one way of explaining how formal and structured approaches interrelate with the organization, helping to develop a better understanding of the problem originally identified in the introduction to this study, i.e. how the rules in Stage-Gate becomes a management technology. Thus, the chapter will discuss views on organizational workings with respect to rules, taking the discussion of Stage-Gate one step further than the issues presented previously.

According to Giddens (1984), we may, for example, look at rules as formalized prescriptions. In this way, four dualities are relevant to any social analysis: 1) intensive and shallow, 2) tacit and discursive, 3) informal and formalized, 4) weakly sanctioned and strongly sanctioned. As social structures consist of rules and resources, they constitute the means by which the medium acts. As a consequence, structure is both enabling and constraining, but not deterministic. Structure is also constructed within the actor and not outside the actor.

March (1994) has elaborated a notion of appropriateness, which he had already sketched in 1963 (Cyert and March 1992), where appropriateness is taken as being constructed by rules. Although March (1992) and Giddens (1984) share similar views on behavior as a social construction, March (1994) differentiates his analysis by looking at structure external to the individual or the organization. As this study will focus on the interaction between the system (the structure) and behavior as a way of investigating the effects of the system on the organization, this perspective seems the more suitable approach to adopt here. Moreover, as the study also sets out to analyze rules defined as formal rules (i.e. those documented on paper or electronic rules) rather than norms or cultural roles, it does not take recourse to Giddens (1994) who would have been a more obvious candidate in this instance. The exclusion of informal rules does not, however, undervalue the importance of such rules. Instead, formal and written rules have been selected because they can be distinctly identified, and consequently the behavior surrounding the formal rules can be profitably investigated.

Any notion of rules invariably begins with Max Weber (March et al. 2001), who regarded rules as the defining characteristic of a bureaucracy (Weber 1968). Within this perspective, behavior is intimately linked to rules to the extent that behavior can be predicted or that an organization in general adopts a systematic approach to its activities. This logic can also be identified in the writings of Cooper (e.g. 2001, see chapter two), who advocates an organizational standardization of activities. However, more recent organizational theories have indicated an additional perspective to rules where behavior is *influenced* by rules, but does not necessarily conform to them (Cyert and March 1992; March 1994; March et al. 2001). Here, the individual or organization is assumed to ask 'who am I, and what would a person (or organization) do in a situation like this?' In other words 'What is appropriate?' According to the perspective of appropriateness, the normative Stage-Gate approach described in chapter two is subject to a 'filter' and, in general, becomes a behavioral issue when we attempt to understand the approach as a form of management technology in an organizational practice.

The framework of analysis adopted here is based on these two perspectives, and will be described and discussed in the following sections. The first section examines the perspective of *instrumental (rule-following)*, based on the writings of Weber (1968) and Cyert and March (1992), and includes a discussion of its relationship with the Stage-

Gate approach which was set out in chapter two. The second section then examines what has been labeled *appropriateness*, drawing on the writings of March (1994) and his collaborators (March et al 2001). Each section (and indeed perspective) also serves as a platform for formulating a number of research questions that will be explored in more detail in the empirical analyses of the next chapter.

4.1 INSTRUMENTALITY

Instrumentality is the first of the two perspectives to be discussed and refers to the notion of human actions as they conform to rules. Our discussion of the Stage-Gate approach and rules starts by outlining the characteristics of the Weberian-bureaucracy. A comparison between the Stage-Gate approach and this kind of bureaucracy is then made and is followed by a section addressing administrative rules. On the back of this, a number of research questions will be formulated.

4.1.1 The Weberian-bureaucracy

Weber (1968, 1972) originally made the link between rules, bureaucratization and what he perceived as 'modernity', tracing: "The modern bureaucracy to a rationalization process accompanying the development of capitalist economies" (March et al. 2001: 9). The prevalence of rules distinguished formal organizations from intimate interactions, and Weber (1968, 1972) saw rules as the defining characteristic of an ideal bureaucracy. As will be seen below, at least six of the nine characteristics he delineated as characteristics of a bureaucracy relate directly to rules and rule-following behavior, these include the following features:

(1) "The principle of fixed and official jurisdictional areas, which are generally ordered by rules, that is, by laws and administrative regulations" (Weber 1968: 196).
(2) "The regular activities required for the purposes of the bureaucratically governed structure are distributed in a fixed way as official duties" (ibid.).

(3) "The authority to give the commands required for the discharge of these duties is distributed in a stable way and is strictly delimited by rules concerning the coercive means, physical, sacerdotal, or otherwise, which may be placed at the disposal of officials" (ibid.).

(4) "Methodical provision is made for the regular and continuous fulfillment of these duties and for the execution of the corresponding rights; only persons who have the generally regulated qualifications to serve are employed. In public and lawful government these three elements constitute 'bureaucratic authority'. In private economic domination, they constitute bureaucratic 'management'" (ibid.).

(5) "The principles of office hierarchy and of levels of graded authority mean a firmly ordered system of super- and subordination in which there is a supervision of the lower offices by the higher one" (ibid.: 197).

(6) "The management of the modern office is based upon written documents ('the files'), which are preserved in their original or draught form."

(7) "Office management, at least all specialized office management – and such management is distinctly modern – usually presupposes thorough and expert training" (ibid.: 198).

(8) "When the office is fully developed, official activity demands the full working capacity of the official, irrespective of the fact that his obligatory time in the bureau may be firmly delimited" (ibid.).

(9) "The management of the office follows general rules, which are more or less stable, more or less exhaustive, and which can be learned. Knowledge of these rules represents a technical learning, which the officials possess. It involves jurisprudence, or administrative or business management. The reduction of modern office management to rules is deeply embedded in its very nature" (Weber 1968: 198).

Thus, the *ideal* form of bureaucracy focuses on structure and activities, functional areas, management (employee sanctions), knowledge and learning, line of command, regulation of decision-making and rules used to make objective decisions. Rules are therefore the primary characteristic of bureaucracy, as March et al (2001) have also suggested.

4.1.2 The SG approach and bureaucracy

There appears to be a number of similarities between the theories relating to the operation of a bureaucracy and the theories presented in the SG approach (see chapter two). While bureaucracy was originally designed to help regulate office-work and not directly for the purposes of PD,[16] it may nevertheless be argued that phased-based approaches to innovation are in fact an attempt to make PD manageable precisely by applying structures and rules to the process. In addition, the SG system represents a set of prescriptions, guidelines and procedures, i.e. a whole set of rules on how to conduct PD processes and activities. In this way, the SG approach represents one of the main characteristics of bureaucracy, namely that it is based on the design, application and modification of rules.

The *ideals* of Cooper (2001) and Weber (1968) are summarized and compared in table 4.1 below with respect to their objectives, interaction and outcome. Both ideals strive for the objective discharge of business. When interacting with the organization, activities are standardized and behavior is determined by rules, which makes it possible, for instance, to comply with time constraints and achieve precision in decision-making.

Table 4.1: The bureaucracy vs. the Stage-Gate approach

	Bureaucracy	**Stage-Gate**
Objectives	o bureaucratic authority o objective discharge of business according to calculable rules and 'without regard to persons' o administrative structure for both superior and staff, stability and predictability o specify role obligations, clarity and hierarchical concerns	o disciplining system for innovation through standardization o establish a high level of quality in product development processes
Interaction	o fixed and official jurisdic-	o orchestrate information (also

[16] Weber (1968) assumes that 'regular activities' are a precondition for bureaucracy, which might merely be a methodological side-comment if the SG approach was completely aligned with bureaucracy and not merely a matter of *sharing* similarities. However, Jaworski and others (1993) indicate that low task complexity is not necessarily associated with – what they describe as – the bureaucratic system. Moreover, the low control system is associated with routines.

	tional areas ordered by rules (administrative regulation) o stable distribution of authority to give commands (delimited by rules) o a firmly ordered system of super- and subordination (hierarchical) o thorough and expert training (knowledge of rules represents a special technical learning) o management of the office follows general rules, which are more or less stable, more or less exhaustive	cross-functional) and secure documentation o standardized activities including a standardized common format for decision setting o standardized format for evaluation including predefined criteria and outputs
Outcome	o speed of operations o precision o unambiguity o knowledge of files o continuity o discretion o unity o strict subordination o reduction of friction o reduction of material and personal costs	o effectiveness o efficiency o time-to-market o commercial success with new products o decisions more ‘objective’

4.1.3 The SG approach as administrative rules

Arguably, the Stage-Gate approach (SG approach) shares certain similarities with a bureaucracy, and as a consequence enables its translation into a set of rules that can in turn be aligned with the categorization of administrative rules. In this way, Cyert and March (1992) investigate the role of management control and rules, and apply four types of administrative rules to their analysis of the role of explicit standard operating procedures (SOP). These are: information handling rules; records and reports; planning; and task performance rules; and are set out below in more detail.

(1) *Information handling rules*: These rules define the firm as a communication system, emphasizing the distribution and condensation of external or internal information, and paying attention to the characteristics of information leaving the organization. Rules on information handling can also be identified in the SG approach where the emphasis is

placed on cross-functional information generation, assimilation of information as a project progresses, as well as documentation based on the criteria used for deciding whether a project should continue or not. Cyert and March (1992) focus in particular on two aspects of information flows: routing rules and filtering rules. According to them, routing addresses "[…] who will communicate to whom about what" (Cyert and March 1992: 129), which is regulated in the SG approach, for instance through the rule which governs that a project manger must not communicate with the decision-makers at the gate meeting in order to reduce any 'political' influence. Cyert and March (1992) are also concerned with filtering rules and argue that bias is omnipresent in organizations, and, as a consequence, that some information is unreliable. More particularly, "one of the ways in which the organization adapts to the unreliability of information is by devising procedures for making decisions without attending to apparently relevant information" (Cyert and March 1992: 130).

(2) *Records and reporting rules*: Reporting and records are explicit in the SG approach, where information on the criteria on which to decide a project is reported as an input to decision-making. It is therefore also implicitly part of the SG approach because of the requirement to report the decision as an output. On a more detailed level, these rules are present in financial activities (see table 2.1, chapter two) where a number of reports on financial considerations must be made prior to each gate review. The details ensure that information is available for more detailed reporting on the project.

(3) *Plans and planning rules*: This rule type is also a component in standard operation procedures (Cyert and March 1992) and has been identified by Cooper (2001) as the business case that must be formulated in the second stage and updated in subsequent stages together with the successive project plans, presumably formulated for each (following) stage. The business case formulation is part of the 'must' and 'should meet' criteria in the gate meeting, which in Cyert and March's (1992) terminology are termed 'planning rules'.

(4) *Task performance rule*: This specific type of rule is concerned with the activities that have to be undertaken. Cyert and March (1992) suggest that even as complex an

activity as decision-making can be reduced to a ‘simple’ problem with a minimum of uncertainty, which is also the purpose of the SG approach (chapter two). The SG approach is designed to reduce uncertainty through the standardization of tasks (see table 4.1, above) that have to be performed both at the gates and in the stages and by the division of decision-making into a number of distinct decision occasions. The task performance rules include *both* gate and stage activities.

The task performance rules for the stages have already been described in table 2.3 above, where the detailed tasks or activities to be performed are described for each stage. However, the rules are not set out on a detailed and operational level for individual tasks. Rather, they are general task performance rules indicating, for instance, that the market activities need to be carried out in stage 4: “Test with customers, preferences, and trials, pretest of market and identify the user” (Cooper 2001). The task performance rules are of paramount importance to Cooper (ibid.) since management control through standardization is the primary mechanism used to control instances of poor quality. Cooper (2001) identified the omission of task performance as a reason why many companies in the 1980s and early 1990s failed to achieve product success.

The gates can also be seen as a set of activities that need to be performed in order to disclose consensus on the evaluation of the project, by matching the evaluation criteria of the project with the criteria types ‘must’ and ‘should meet’. According to March (1994), two theories of choice are evident in rational decision-making: the standard theory of choice (STC) and the theory of limited rationality. STC embraces a vision of rationality in which actions are seen to be derived from expected consequences and the preferencing of these consequences. STC assumes an actor is in possession of full information. The theory of limited rationality, on the other hand, questions this assumption of a ‘perfect world’ but rather starts from the perception that the world is imperfect and further information may thus be needed to increase the precision of decision-making. In contrast to the notion of ‘ambiguity’ (March, 1994), these two approaches assume an order to the world where preferences are stable, which in turn enables rationality, albeit of a limited scope. Within the vision of a limited rationality, choices arise as a result of a deliberate, consequential and management-based decision process, and, according to March (1999), they must answer four basic analytical questions:

(1) What actions are possible?
(2) What will the future consequences of each alternative be? (In the most elaborate model of rationality, the probability distribution of consequences of each alternative is known.)
(3) How valuable are the consequences associated with each alternative to the decision-maker?
(4) How to choose between the alternatives, considering the value of their consequences (decision rule)?

The fundamental idea of limited rationality is that it is impossible to know everything at any given time, owing to an element of uncertainty. As a consequence, decision-making will be based on incomplete information about alternatives (1) and their consequences (2). The real world is only understood imperfectly and not all the information about consequences and alternatives is known in the decision-situation. Information is constrained and must be discovered through a process of discovery (March 1999), which is translated by Cooper (2001) into sequential decision-making functionality. Each project is therefore expected to invest in information up to the point at which the marginally expected cost of retrieving information equals the marginally expected return. In other words, if a piece of information will not affect the choice, it is not worth acquiring (March 1994). Some of the reasons for this approach are discussed by March and Feldman (1981), who address the assumptions of information underlying limited rationality. As a consequence of rationality, they suggest that information in this paradigm should be gathered prior to decision-making and in line with the specific needs of a project, provided the marginal return in improving decisions exceeds the marginal cost. Thus, only relevant information will be gathered.

The idea of limited rationality is built into the SG approach as a standard operating procedure. Cyert and March (1992) argue that the standard operating procedures provide the organization with a level of stability, which will consequently influence the organization, including its decision-making process. The Stage-Gate approach breaks down the problem of uncertainty in consequentiality of PD into a number of sequential steps. Thus, the gates have to apply the documented information prior to the meeting, undertake a consensus disclosure through a 10-point Likert scale (chapter two) and

make a decision of a particular decision-type. Even though Cooper was initially concerned with the stages, as was shown in chapter two, he quickly began to address decision-making as a central issue of creating product success. Cooper (2001) focused on the making of rational decisions which, like Weber (1968), was concerned with objective decision-making as way of avoiding arbitrariness. He suggested that task performance rules encompass decision-making at the gates, through what Weber (1968) described as 'calculable rules'. In this way, it is assumed that the two normative sets of rules in a bureaucracy, and the Stage-Gate approach, are attempts to establish rules that also regulate consequentiality in decision-making activities, in terms of programming decision-making based on the distinction between programmed and non-programmed decisions (Simon et al 1954). A traditional technique of programming decision-making is standard operating procedures (ibid.).

Another central type of performance rules regulates what Cyert and March describe as "coordinative mechanisms" (1992: 123). A specific variety of planning rules regulates the relationship between stages and gates and can be seen as task performance rules on a more generic level than the specified task performance rules set out earlier in table 2.3. Although the coordination rules are by definition not a distinct type of rule, they are nevertheless singled out to emphasize one of the central mechanisms of the SG approach. Coordination in the second generation of the SG approach regulates the level of separation in the sense that gate-activities should not be continued, but rather await the decision to be made in the subsequent decision setting. However, in the third generation, new rules have emerged and have relaxed this distinct segregation (coordination rules) to the extent that stage activities are allowed to continue even though a decision has not been reached.

Table 4.2: The SG approach aligned with the rules of the standard operating procedure

Standard operating procedure	The SG approach
Task performance rules (4)[17]	o Stage activities according to a standardized format o Gate activities according to a standardized format o Gate keeper activities required to be undertaken o Coordinative mechanism (whether stages must overlap)
Information and reporting rules (1 and 2)	o Project managers produce information to be used in gates o The information production is determined by the activities taking place in stages o The information must be reported (documented) to the decision makers o The reporting format follows the stages that must include marketing, production (technical issues) and finance
Plans and planning rules (3)	o Business case formulation o Performance criteria (should and must meet) o Project plans (including dates)

To summarize, the SG approach can be aligned as an explicit standard operating procedure (SOP) containing three types of administrative rules, which reduce decision-making to a matter of rule-following. This is in line with Cyert and March (1992) and their attempt to develop a set of decision rules for regulating decision-making on price and output determination in a retail department store (see table 4.2 above). The ideal stage-gate approach is translated into a set of rules where deliberate and consequential decision-making and other activities, such as reporting and information, are ideally reduced to following a set of rules. Behavior must be subdued and aligned with the rules and is therefore the first of the two perspectives denoted as *instrumentality*.

4.1.4 Instrumentality and research questions

As outlined above, bureaucracies are described by Weber as being defined by nine characteristics, six of which are related to rules on consequential behavior (1968). Rules are

[17] The numbers refers to the sections above on the types of rules defined by Cyert and March (1992).

such a primary characteristic that Weber (1968) regards them as so embedded in a bureaucracy that office management can in fact be reduced to rules. A number of similarities between the ideal bureaucracy and the Stage-Gate approach can thus be identified precisely because of their mutual emphasis on rule-following. It has been argued that rule-following is necessary to avoid inefficiency in the PD process (Cooper 2001). This then raises the question: *what are the rules in PD within the instrumental rule-following perspective?*

Chapter two indicated that the normative system could be adapted to the individual company in terms of number of stages, criteria to be used at the gates, and flexible rules (third generation SG). More recently, Cooper et al. (2002a; 2002b) have abandoned the flexibility in the SG approach by claiming that the PD process cannot be decoupled from the administrative system with flexible gates where activities are not allowed to continue until a decision has been reached at the gates. This in turn raises the questions: *how do the rules in PD compare to the normative system with respect to gates, stages, and information/document-tation?*

4.2 APPROPRIATENESS[18]

Cyert and March indicate in the epilogue to a *Behavioral Theory of the Firm* that the theories of consequentiality "underestimate" (1992: 230) an alternative theory to rational choice, i.e. the logic of appropriateness. They suggest that rules have an effect on the four questions of rational choice outlined above. It is therefore possible to devise a rule-model for a certain price/output decision-making situation that affects the four questions of rational choice in such a manner that can consequentiality be programmed into a set of ideal rules which also organize behavior with respect to the gates (decision-making). In the ideal Weberian-bureaucracy (Weber 1968), the organization is 'de-humanized'. Here, Weber's notion of 'calculable rules' is seen as condensing

[18] March claims that both the perspectives of rule-following (consequentiality and appropriateness) are required: "Empirical observations of decisions provide ample examples of behaviors that are hard to understand without attention to both perspectives, and neither (at least in its present incarnation) explains enough of the phenomena to claim exclusive rights to truth" (1999: 102).

consequentiality into a set of rules that is followed by the organizational members.[19] It is an issue that is not open for debate. Behavior should be subdued. This perspective was labeled *rule-following*.

March argues that: "[...] rule-following is portrayed as unthinking and automatic" and deviations will be treated as deviations from reason. However, he also uses the word "rule-following" to describe "[…] rule following in the name of appropriateness" (1994: 100). March thus advances appropriateness as a perspective in which identity is *not* taken to be inferior to rule-following and is, consequently, not as 'straight-forward' as it is assumed to be in the perspective set out above. Instead, he argues that it is rather *based* on rules (March et al. 2001). Within this perspective, individuals or organizations are assumed to ask the following three questions:

(1) The question of recognition: What kind of situation is this?
(2) The question of identity: What kind of person am I, or what kind or organization is this?
(3) The mobilized rule depends on the match between 1) and 2): What does a person like me or an organization like this do in a situation like this?

March argues that the process is not "random, arbitrary, or trivial" but a "systematic, reasoning, and often quite complicated" (1994: 58) process that makes the behavior of individuals and organizations more arbitrary and difficult to predict. "Rules involve … three constructions" (1994: 6). Rules are negotiated and interpreted and consequently subject to change as indicated by the description of rules in the previous chapter. March has thus introduced two levels of analysis: the individual and organizational. The Stage-Gate approach, however, also focuses on group-activities, particularly at the gate-meetings. March suggests that a study of decision-making within the perspective of appropriateness leads to a number of questions, including "How are situations interpreted

[19] "[C]alculable rules are connected to given ends" (Glegg 1995: 16) which suggests that Weber's perception of rationality has certain aspects in common with the consequentiality and logic of means-ends relationships. However, the instrumental perception of bureaucracy might be supplemented: "Instead of the spread of the bureaucracy being due solely to its instrumental efficiency, according to Weber, it could be correct to point to the cultural conditions of "rationalization" as the appropriate explanation. Such "cultural" explanation points to the institutionalization of value as the overarching factor in interpreting the rise of particular types of organization. The iron cage is a cultural construct not a rational construct" (1995: 27).

and recognized?", "How are organizational identities defined?", and "How is the match between situations and identities made?" (1994: 59). Although he applies the word 'rule-following' to both 'automatic' rule-following and rule-following from the perspective of appropriateness, the term 'rule-based' is used to describe the theory of appropriateness because actions do not automatically follow rules. This is in line with the most recent terminology adopted by March et al. (2001).

On the organizational level, organizational rules define what it means to an appropriate decision-maker.

> Formal and information organizational rules are woven into, utilize, and help define organizational identities and roles. Tasks are organized around sets of skills, responsibilities, and rules that define a role. Roles and their associated rules coordinate and control organizational activities (March 1994: 60-61).

However, March also emphasizes that rule-based behavior is influenced by uncertainty and that "Situations, identities, and rules can all be ambiguous" (1994: 61). In addition, "They are processes of reasoned action, but they are quite different from the processes of rational analysis" (ibid.). On the level of the individual action:

> An identity is a conception of self-organized into rules for matching action to situations. When Don Quixote says 'I know who I am' …, he claims a self-organized around the identity of 'knight-errant' (March 1994: 61).

Socially-defined identities are templates for individual identities in three senses. First, they define the essential nature of being a project manager or perhaps even a dentist:

> Recognizing a dentist involves knowing how dentists behave and associating observed behavior with that role. Being a dentist involves knowing how dentists behave and acting accordingly (ibid.: 64).

Second, social identities are templates in the sense of contracts, where

> … an individual agrees to behave in a way consistent with socially defined identity in order to gain certain compensation (ibid.).

The third sense is concerned with the assertion of morality,

> … accepted by individuals and society as what is good, moral, and true. An individual "internalizes" an identity, accepting and pursuing it even without the presence of external incentives or sanctions (ibid.: 65).

March goes on to argue that the relationship between providing incentives for following rules associated with identities and their internalization is complicated:

> On the one hand, there is a strong tendency for individuals (and organizations) to accept identities that are easy or rewarding to perform – that confirm their competences … people are more likely to internalize roles and rules that they fulfill effectively more than those that they do not (ibid.: 65-66).

To substantiate this, he takes the case of top-level executives who have experienced their own competence in decision-making and have, consequently, tended to internalize the role of decision-maker. Thus:

> They are likely to think of themselves as decision-makers. They act appropriately as decision-makers because they have come to believe that the proper way is not only a way to gain social approval but also a way to conform to their own standards (ibid: 66).

However, individuals who have failed in decision-making are less likely to internalize the role of decision-maker.

> As a result, experienced, successful decision-makers become socially more reliable in their decision-making, and inexperienced, unsuccessful decision-makers become less reliable (ibid.: 66).

Although the reward structure influences the internalization of an identity, it is not a rewarded identity that will be internalized. Internalized identities are likely to be imagined where external incentives are weak, whereas strong external threats or dramatic events can be used to explain behavior without the need for internal commitment (March 1994). However,

> … even when an interpretation is accepted, its ultimate stability depends on experiential confirmation, so interpretations that are totally unrealistic will be eroded by subsequent disconfirmation (ibid.: 67).

On the issue of internalization and identities, March (1994) summarizes:

> Identities are socially constructed contracts, motives, and cognitions that connect to organizational rule structures. And this fine tapestry of obligation controls much of what is called decision-making (ibid.: 67-68).

Attention is important in this perspective, because some decisions might yield a number of relevant identities and rules (March 1994). March illustrates this aspect with the example of a decision-maker who is reminded of his role as a citizen and consequently may act differently than if (s)he had been reminded of his/her role as a family-member. As a consequence, the potentially relevant rules are not evoked. Four psychological mechanisms (March 1994) explain how rules and identities are perceived in various situations: 1) Experiential learning: individuals learn to evoke identities in a situation by experiencing the rewards and punishments of past experiences; positive experiences are more likely to evoke an identity; 2) "… central aspects of the self are more likely to be evoked more frequently and maintained more consistently than others" (ibid.: 70), which suggests that individuals with single categories, for instance where the central categorizing feature is its competitive nature, are less dependent on the process of evoking rules and identities; 3) identities and rules that have recently been evoked are more likely to be evoked again; 4) the social context of others is also more likely to influence which rules and identities are evoked. To illustrate this, March (1994) provides the example of a redhead in a crowd who is more likely to focus on hair-color. As he argues:

> formal organizations play important parts in organizing the application of identities and rules to situations. Organizations shape individual action both by providing the content of identities and rules and by providing cues for invoking them (ibid.: 70).

Thus, the term 'use' relates to shaping appropriate individual action. 'Use' is richer than the 'automatic' (March 1994) action required by the individual in the rule-following perspective. Instead, it becomes a behavioral question rather than the more closed 'black box'-perception of 'just following' rules within the previous perspective. Formal rules

constitute a model for appropriate behavior, on the basis of which project managers or decision-makers can imitate, emulate or learn rules, thus:

> Rules of appropriate behavior are supplied with concrete meaning through elaboration and clarification within an organization (March 1994: 72).

In addition to using rules through a model of appropriate behavior, organizations can also be perceived as "writers of scripts and providers of cues and prompts" (ibid.: 72) where identities are highlighted through language and by landscaping where the formal locations are constructed as a reminder of the appropriateness of formal behavior (March 1994). Experience with rules also has an influence on appropriateness:

> Experience with pursuing an identity produces learning, by which the rules of identity are changed. The experiences are managed to stabilize a consistent set of identities within any given organization (ibid.: 73).

March discusses violations of formal rules:

> Most of the time behavior follows rules. At the same time, it is hard to imagine a social system without violations of rules. Rules are overlooked or ignored (ibid.: 73)

March focuses on two issues particularly: First, where individuals are simply unaware of the rules because of complex situations, and where a new ruler or rules can be made ambiguous due to political compromises. Nevertheless, rules may also be inconsistent with other rules, thus producing deviations, or inconsistent with other procedures, such as deadlines. These situations are often unintentional. However, rule violation may also be intentional, as March illustrates:

> Many are deliberate, conscious violations of known rules. Rule making and rule enforcing sometimes involve different coalitions. They address different interests and require different mobilization patterns (1994: 74).

The forces that are asked to implement rules may differ from the ones that have made the rule in the first place (March 1994), for instance, top management may have devised a set of rules that has to be implemented at the project management level. *Second*, viola-

tions are more likely to occur when the rules are rigid and cannot be changed easily, just as rules are more likely to be violated when the violation is associated with performance measures, in which it makes good sense to ignore the rules. As March says:

> rules cannot fit every situation, and there is a need to "fine-tune" them to meet the demands of the variable environment. Knowing when to bend a rule is one of the hallmarks of an experienced decision-maker. Tolerance for rule violation is a form of delegation to individuals who have a more refined capability for accomplishing the intent of the rules in a special case. Organization also allows variation in interpreting rules in order to experiment with what they might come to mean (2004: 75).

4.2.1 Appropriateness and research questions

As mentioned at the outset, appropriateness introduces a 'filter' between rules and actions in the rule-following perspective, thereby challenging the instrumentality of rules. This 'de-humanization' that occurs in the ideal bureaucracy implies that actions conform to rules 'without any questions being asked'. In comparison, the 'filter' makes formal rules imply interaction with three questions of identity, identifying the situation and defining what proper behavior is in the situation in which the actor finds himself. Thus, behavior is not as predictable as Weber (1968) argues; despite the advantages he assumes this would bring to the ideal bureaucracy.

The theory of appropriateness suggests that rules are therefore a question of application based on the identity of the actor and recognition of the situation. Application itself was addressed in the previous chapter, which showed that part of the criticism leveled at the Stage-Gate process of an organization focuses on the issue of 'rigidity'. Rigidity seeks to address problems of compliance with procedure and is identified as a central issue of the literature on Stage-Gate which has been outlined previously. In this way, Shaw et al (2000) have suggested that a rigid employment of the SG approach might influence the development lead-time of a project by actually increasing it. Ottosson (1996) is similarly concerned with issues of inefficiency since an innovation project might first have to wait for the top management to discuss the project at a gate. Jenkins et al (1997a; 1997b) also question rigidity at gates and specifically argue that the Stage-Gate process should be regarded as a set of guidelines rather than "an overly rigid set of rules" (1997b: 391). Given these criticisms, it would be instructive to explore the interaction between the formal administrative rules and the organization to identify whether

the rule-following perspective produces the effects on the PD-organization that are promised by Cooper (see table 4.2), including predictability. Such an exploration would also address the questions of 'rigidity' and 'bureaucratic issues' raised by Clark and Wheelwright (1992) and Hamel (2000), respectively. Within this perspective, rules are perceived as an instrument to control behavior by 'programming', but bearing in mind the issue appropriateness and rule-deviation that have been outlined above, it would be pertinent to ask the question: *how exactly are rules applied appropriately to the PD process?*

Weber (1968) asserted that the rationale of a bureaucracy demands that rules must be followed with obedience. This point of view applies to the SG system too. In order to generate the most efficient process from idea to launch, individual behavior must be subdued. The peculiarity of modern culture, more specifically its technical and economic basis, demands this calculability of results (Weber 1968). The more perfectly developed a bureaucracy is, the more it is 'dehumanized', thus eliminating all purely personal, irrational and emotional elements that escape calculation:

> "Je mehr sie sich entmenschlich[en], je vollkommener" (Weber 1972: 563).

Ideally, rules and regulations offer a rational decision-making procedure based on 'pure' calculations through which effects can be achieved. But rule 'following' is also a behavioral issue, which raises the further question: *if formal procedures affect the innovation process, do they lead to the effects predicted by Cooper or Weber – or other effects identified on the basis of appropriateness?*

CHAPTER FIVE

The instrumental perspective on rule application

The objective of this chapter is to investigate the nature of rules in product development (PD), looking at what kind of rules can be identified, how they are developed with respect to attributes of elaborateness and exhaustiveness, and what problems they are intended to solve. The previous chapter compared the SG approach to an ideal bureaucracy, based on a number of similarities that could be identified and which allowed the SG approach to be translated into a system of rules in an organizational context. It was, however, seen that two perspectives were in fact prevalent on how rules are linked to actions through rule-following: the instrumental perspective, which assumes actions are programmed, and the behavioral perspective, which assumes that actions are subject to 'a filter' resulting from a construction of appropriateness. This chapter now takes the first of these perspectives as its point of departure, seeking to investigate a number of research questions that are based on the instrumental perspective in order to identify the exact nature of rules in PD, how they can be best characterized, and comparing them to the normative system that was set out in chapter two.

This chapter has a two-fold structure. First, it takes a multiple-case study of five companies, as set out in Yin (2003), analyzes them and subjects them to a cross-case analysis based on the three research questions ascertained in the previous chapters. Second, a single company is then selected for more detailed analysis with respect to the individual rule-system design of the SG approach and compared to the normative system described previously. By way of conclusion, I then discuss these findings within the

broader framework of literature on the SG approach that was identified and analyzed in chapter three.

5.1 RESEARCH QUESTIONS – MULTIPLE-CASE ANALYSIS

The starting point of our multiple-case analysis is a set of three research questions, which have been framed on the basis of the study so far. These are:

(1) The SG approach has been classified as a model which bears comparison with an ideal bureaucracy. One of the most important pillars of any bureaucracy is rules, and, as a consequence, the SG approach can be regarded as a system for PD. As was seen in the previous chapter, Weber (1968) focused on office work and activities that can be standardized. The pertinence of his thinking in this context is that he explicitly focuses on rules, rather than on whole bureaucracies. For Weber, rules can be characterized in terms of exhaustiveness, which is here interpreted as compliance with the normative system. As Cyert and March note with regard to standard operating procedures: "Choice and control within an organization depend on the *elaboration* of standard operating procedures" (1992: 133, emphasis added). This therefore raises the question: *what actually are the rules in PD and how they can be characterized with respect to exhaustiveness and elaborateness?*

(2) The condition of stability was also a concern for Weber (1968). Griffin et al. (1997), however, characterize SG approaches on a 'sophisticated level' and argue for instance that a company requires competence in a second generation SG approach before it can "move" in version, i.e. towards the third generation approach, which they perceive as the most sophisticated version of the SG approach (see chapter two). It can therefore be asked whether *the formal procedures for PD do actually provide the process with stability and predictability.*

(3) Weber (1968) asserts that the rationale of instrumentality demands that rules must be followed obediently. This point of view applies to the SG system too. In order to generate the most efficient process from project idea to launch, individual behavior needs to be submissive. The peculiarities of modern culture, more specifically its technical and economic basis, demand this calculability of results (Weber 1968). The more perfectly developed a bureaucracy is, the more it is 'dehumanized', all purely personal, irrational and emotional attributes being eliminated that are not amenable to calculation. Weber sums this attitude up in the aphorism: "Je mehr sie sich entmenschlich[en], je vollkommener" (Weber 1972: 563). Rules and regulations thus offer a rational decision-making procedure based on 'pure' calculation. This leads us to ask: *what effects of rules can be identified on the PD process?*

5.2 CASE-COMPANIES

PAINT specializes in producing paint for protective purposes, particularly for windmills and shipping companies. The company headquarters is located in Denmark, with a centralized R&D function, but has four laboratories in various other countries to establish proximity to achieve local market adaptation (product modification). The company employs 3,000 people worldwide and has sales offices in 40 countries, with production facilities in 20 of these. PAINT is one of the top five companies in the industry and is in the process of changing from a follower innovation strategy to a more proactive strategy. In 1999, it initiated the implementation of a SG process and the dissolution of R&D. R&D was to be henceforth divided into a long-range technology department, with responsibility for feeding SG with product ideas to take the company toward to the position of market leader, and a short-range R&D department, which was placed under sales and marketing. The SG approach was made noticeable through the introduction of handbooks, mouse pads, posters, etc. Those interviewed for the purposes of the present study include the R&D Manager and a Product Manager from the primary division (marine).

MEDICO produces devices for a range of medical treatment. The company is organized into six divisions according to the type of medical ailment to be treated, with development departments in each division. The company operates globally with a workforce of 5,000 employees. There is no product development in subsidiary companies and all four divisional development departments are located in Corporate Headquarters, Denmark. MEDICO is a market leader in its industry and applies a prospector strategy for innovation with extensive user-involvement in R&D, which is why each employee in R&D works closely with two selected users. Each year there is a seminar with 200 selected users and customers which aims to generate ideas for new products and to test products in the PD process. MEDICO is currently experiencing high organic growth but also through a self-imposed acquisition-strategy. In 2002, it won an award for being the most innovative company in Denmark. Moreover, it implemented a SG process in 1996/97 which was subsequently modified in 1999 and 2002. The implementation of the latest changes in the SG approach was made visible through the introduction of a company intranet but also through initiating an extensive training program. The respondents to our data gathering include a Project Manager from one of the divisions as well as a Group- and Project Manager from the primary division.

MACHINERY is a global production company with its headquarters and a centralized R&D department located in Denmark. The company employees more than 10,000 people and is organized into three business areas. MACHINERY is a market-leading company focusing on value-adding through paying due account to long durability and environmental concern. The company had already employed a SG approach in 1992/1993 which has been subject to changes in 1995 and 1999 in combination with major strategic reorientation of the company. As with MEDICO, the SG approach was made visible through the introduction of an intranet and training courses. Furthermore, a small department was established with specific responsibility for updating the process, and in general ensures learning and assimilation of new procedural inputs. The company has won many awards, including the European Quality Prize for ‘Leadership and Constancy of Purpose’ from the European Foundation for Quality Management.[20] In this company, the interview respondents crossed three functions of R&D: a Development

[20] Additional reading: http://www.efqm.org/

Process Manager of the SG approach, a Senior Project Manager, and a Product Engineering Manager.

INGREDIENTS employs 2,000 people worldwide and was recently bought by its most dominant competitor, a large American producer of ingredients for the food industry. The product range includes pectin and gum. Thus, the new company has two PD centers: one in the US and one in Denmark. Unfortunately, it was only possible to interview the R&D Manager in this company, who was naturally influenced by the change in the situation. Experiences with the SG approach were nevertheless perceived to be valid for the investigation as most of the changes took place before the takeover. The SG approach was originally initiated in 1995/1996 and changed in 2000. It manages PD-projects as well as projects for production process improvements which lead to operational improvement rather than new products within the SG approach.

PLASTIC was established in 1992/1993 through a merger of competing companies and is now a subsidiary of three large companies in the oil industry. PLASTIC is a market leader and employees a competitive strategy focusing on value-adding through innovation in plastic properties and customer services. The company employees 5,000 people and approximately 500 in R&D, which is formally organized into a central R&D function owning its own long-range projects but also supports product development in seven business units that focus on production plants and markets served respectively. The R&D organization is geographically located in five countries. All types of innovation projects, including technology development, product development projects and production process improvement, are managed within the SG approach, which was initiated in 1995/1996. Recently, a new version of the SG approach was implemented (January 1st, 2003) with emphasis on portfolio management functionality and the responsibility of the SG approach being placed under a new function of the portfolio manager.

5.3 CROSS-CASE ANALYSIS

The section is organized in accordance with the research questions set out in the first section (5.1).

1) What are the rules in PD and how can they be characterized?

An SG-influenced approach has been introduced in all of the five companies under investigation here. In three of the five companies with an SG-influenced PD process, a distinction between technology planning and PD processes is discernible, as is suggested by Smith et al. (1999) and Cooper (2001). This is particularly the case with respect to the specific version of SG, SG TD employed (see chapter two), although on occasion new PD projects are actually influenced by decisions made within the technology planning processes. PLASTIC runs technology planning and management of technology projects via the SG, but has a particular decision-making forum for what they characterize as 'long range projects'. With all the companies investigated, decision-making with PD consequence is *also* carried out outside the SG model. An electronic template is available for each stage and gate in MACHINERY, contrary to PAINT, which has only provided the employees with a written manual and has no processes to secure rules for best practice.

Table 5.1: Describing rules in PD

	PAINT	**MEDICO**	**MACHIN-ERY**	**INGREI-DENTS**	**PLASTIC**
What are the formal rules for PD?	SG-influenced model	SG-influenced model + technology planning + other plans	SG-influenced model + technology scanning process	SG-influenced	SG-influenced for all types of innovation projects
How are rules made noticeable in the organization?	Handbooks, mouse pads, posters, etc.	Intranet and extensive training program	Intranet + courses and via gate-driven process	By a manager for project-processes + information	Intranet, 'road shows', and 'super-users'

In order to better understand the rules in PD, the notions of elaboration and exhaustiveness are introduced. Here, exhaustiveness is understood to constitute completeness with

respect to the system described in the normative SG approach (see chapter two). In other words, it seeks to answer the question: do the rules cover all prescribed areas or is their scope wider? For instance, the normative system covers stages, information (and documentation), and gates, as well as the rules identified in organizational practice. These all need to cover these basic functionalities on the general level of exhaustiveness. Three levels of exhaustiveness are defined: 1) Very exhaustive: In this case, the scope is broader than the SG approach originally prescribes, for example, through additional rules on new areas or topics. In other words, the business case should always be confirmed and supplemented with data from both the marketing and the accounting departments before it is presented; 2) Normal: This covers the areas prescribed by the SG approach and which fulfill the requirements formulated by SG; 3) Less than normal: This has a narrower scope than the SG approach prescribes, but does not require that the business case should be developed and presented as a requirement for proceeding to the next stage. In all of this, the rules can be more or less elaborate, which is merely the expression of the level of detail contained in the rules. To illustrate this, one rule of the Stage-Gate approach involves the need to produce a financial calculation, but a number of elaborated 'sub rules' can frame the calculation by requiring figures for, amongst other things, expected market share and development costs. In some examples this can be achieved via an electronic template made available through a company's intranet. Three levels of elaborateness are defined here: 1) Extra elaborate: This case has more details than the SG approach prescribes, for example, through the addition of further rules to the requirements set for developing the business case; 2) Normal: This situation entails the level of detail that the SG prescribes, fulfilling the requirements formulated by SG; and 3) Less than normal: This case has a lower level of detail than the SG approach prescribes, for instance, through requiring that only rudimentary information on the business case is presented at the gate meeting.

Both the degree of exhaustiveness and elaboration vary among the case companies. MACHINERY has a department for securing best practice rules in innovation and each functional area continually contributes to the process. An example of this is the financial department's design of a spreadsheet for carrying out product calculations. INGREDIENTS has replaced a very elaborate model with a much simpler checklist. PLASTIC has moved from a less elaborate model to a normal elaborate model and then

more exhaustive, for example, by instigating the inclusion of the portfolio-management functionality of the SG model, which constitutes an advance on the earlier version. One cross-case observation that can be drawn at this stage is that companies with elaborate rules also tend to develop more exhaustive rules. As one senior project manager from the MACHINERY firm states: “Rules seem to be added, not removed”.

Companies with more exhaustive rules seem to utilize the intranet frequently as a means of communicating the rules throughout the organizations, providing templates and examples. On the other hand, companies with extensive rules tend to spend large amounts of their resources on training project- and product-managers, also in the SG approach.

Table 5.2: Rules in case companies on two dimensions

Exhaus-tive/Elaborate	*Very elaborate*	*Normal*	*Less than normal*
Very Exhaustive	**MEDICO MACHINERY**	**PLASTIC**	
Normal			
Less than normal		**PAINT INGREDIENTS**	

2) Do formal and structured procedures for PD actually provide the process with stability and predictability?

The SG approach was originally introduced into the companies some 5-10 years ago, and has typically undergone one or two major revisions or changes since its introduction. Rules can therefore be said to be not stable if studied over a longer period (say 10 years), although periods between revisions obviously represent a level of stability. The question of stability is nevertheless also related to the question of how rules are applied. This is indicated by the data, which suggests that there is a difference between formal rules and the usage of rules in all the cases, as will be analyzed in more detail in the following chapter.

Table 5.3: Stability and change in case companies

	PAINT	MEDICO	MACHINERY	INGREI-DENTS	PLASTIC
When originally initiated?	1999	1996/97	1992/93	1995/96	1995/1996
Significant changes	N/A	1999 and 2002	1995 and 1999	2000	2003
Version of the SG approach adopted?	Facilitated Stage Gate	Third generation Stage Gate	Third generation Stage Gate	Facilitated Stage Gate	Facilitated Stage Gate
Rules stable – medium time perspective	Yes	Yes	Yes	Yes	Yes
Rules stable – long time perspective	N/A	No	No	No	No
Does the PD process provide stability and predictability through rules?	PD is structured and still market driven and "we can show that we are doing the right things now"	Rules establish common ground for internal situations and particularly the relationship between team and management	The PD-process is making the organization more 'sure' of what it does and why	The PD process ensures that central issues are processed	PD process is providing decision-makers with an 'overview' and in general portfolio functionality. Now the projects can be perceived an entity with a total NPV.

Griffin (1997) has examined the types of processes in PD and identified that approximately 12 percent of production companies apply no process type at all, 22 percent apply an informal process type, and 6 percent apply a functional sequential process type. The remaining 60 percent apply a version of the Stage-Gate approach, which was further separated into three process types: 'Stage Gate' (24 percent), 'facilitated Stage Gate' (19 percent), and 'third generation Stage Gate' (17 percent).[21] The distinction between functional, sequential and Stage Gate versions is that the latter are cross-

[21] All numbers in percentage terms refer to production companies and have been read of figure 1 (Griffin 1997: particularly 440).

functional. The distinctions between the versions of the SG approach are not defined other than:

> Over half the firms which adopted stage gate […] processes have moved from a basic process to more sophisticated versions with formal process ownership and facilitation (18.5 percent of the total) or third generation process with more flexible gates and stage structured (15 percent). Third generation processes match the complexity and difficulty of the project […]. The PD process owners who 'own' facilitated process are instrumental in aiding teams in effectively following and completing the requirements for each stage of the process and prove a means to retain and diffuse corporate learning across projects and over time (Griffin et al. 1997).

PAINT is in its first version of SG, but has sought to establish a clear ownership of the process from the outset (R&D manager). It has also been instrumental in providing the project team with handbooks and even mouse pads. PLASTIC on the other hand is in the process of evolving from the second version to the third generation of the SG approach and has added more exhaustiveness through with the introduction of portfolio management rules. On the downside, however, it has for instance not provided its staff with any training in the latest approaches. Teams have therefore attempted to work cross-functionally but have found it difficult to get the latest information through formal channels of cross-functionality. In addition, this approach has only been facilitated to a limited degree. MEDICO and MACHINERY are both in the process of introducing greater flexibility, training and putting greater emphasis on organizational learning in the SG approach. Both fit into the third generation approach although the MACHINERY is further down the road to third generation than MEDICO. Finally, INGREDIENTS attempted to adopt the third generation approach as its first version with a process owner, contractual agreement.[22] However, it did not provide sufficient training for its staff as this version was eventually abandoned in favour of a facilitated version of the SG approach. Griffin et al (1997) have identified that companies tend to 'move up' in version in direction of the third generation approach, but as argued has been argued by Cooper (2001), rules first require competence before the shift to a more sophisticated level.

[22] Similar to Integrated Product Development (IPD) described in chapter thee, Anderson (1996).

The companies under investigation therefore appear to have very different sets of rules in PD. As has been seen, not all companies are 'ready' for the adoption of a whole set of rules and all companies with a formalized PD approach tend to apply the rules differently. Two of the five companies appear to relax the demand for rule-following as the company gains competence in the rules. Cooper (2001) argues that as a company gains competence it tends to move towards a higher level of generation, which has also been observed by Griffin who states that "PD processes continue to evolve and become more sophisticated" (1997a: 429).

However, sophistication or flexibility is not achieved through flexible gates with dependent decisions sanctioning the launch of a project where stage activities are not completed, as has been suggested by Cooper et al. (2002b). This rather occurs through the introduction of loosely-structured stages and the application of a number of gates according to the perceived risk of the project. The existence of flexible gates, which allow a project to continue regardless of whether all activities are carried out or not, are not part of the findings of this study. This suggests that the characteristics of the third generation SG approach must be found at the level of model applied according to project size and the degree of relaxed rule-following within the stages. As the company gains competence with the rules and chooses to relax the demand for rule-following in the stages, and as the company seeks to maintain this demand through gates, the role of gates comes more and more into focus. Moreover, with increasing rule-relaxation companies tend to simultaneously increase the number of rules both in terms of exhaustiveness and degree of elaboration, which in some cases is the result of a deliberate process. This can be seen with MACHINERY where a whole department was designated the responsibility of process facilitation and improving the SG approach.

It would appear that two out of the five companies with the SG-influenced model for conducting PD processes have gained sufficient experience to change the rule-system significantly within a time-frame of 2-3 years; the rules being subject to changes resulting from both internal and external factors. Unsurprisingly, however, a relationship between the rules and the organizational context can also be identified. Strategic (market perception) or managerial driven rule development seems to take place frequently, as was found by Zhou (1993) in quite another context. The companies all seem to have addressed a number of widely diverging and broader organizational issues regarding the

design and application of rules in PD. Companies that are moving into new markets, orienting themselves globally or placing greater focusing on customer and sales-integration into PD-processes all seem to develop extensive rules with respect to these developments, and are often eager to use the rules for creating a common language of communication on such issues within the organization. They may also focus on the application of special subsets of rules that are deemed helpful in addressing wider organizational issues (which are, of course, related to the PD activities). This is also often expressed when companies relate their experiences with regard to the advantages that can be had by adopting the SG model.

As is the case with all companies, rules have been introduced within the last ten years and have typically been modified twice since their introduction. Modifications can, however, be more or less extensive, but at least three companies have invested substantial resources in updating, amending or extending the rules on a regular basis and in a structured way. The rules tend to be stable if looked at within a period of a few years, but are invariably modified over the long term. Therefore, in answer to Weber's proposition that rules are required to be stable (1968), it may be said that the answer is 'yes' and 'no', depending on the timeframe in question. To be fair, however, it should be noted that Weber was not unaware of instability and states, as can be seen from the following:

> Business management throughout rests on increasing precision, steadiness, and, above all the speed of operations … The extraordinary increase in the speed by which public announcements, as well as economic and political facts, are transmitted exerts a steady and sharp pressure in the direction of speeding up the tempo of administrative reaction towards various situations. The optimum of such reaction time is normally attained only by a strictly bureaucratic organization (Weber 1968: 215).

In the case of INGREDIENTS, the modifications have been significant since the requirements for use of the rules has been relaxed extensively. The question then arises whether this change was the result of a managerial decision, which had already been implemented by the PD projects in the company or whether as result of the daily working practices of the team members? No evidence supports either of these propositions.

Finally, with the exception of PLASTIC, all companies have made a distinction between a reduced- or full-scale application of the rules, depending on the level of ex-

pected investment and the business risk involved. For example, MACHINERY established a new rule to apply a full-scale PD process only when the project requires an investment of more than €700,000. It could therefore be argued that this new rule was a response to what must have appeared a problem to many of the companies in the case study, namely whether they should apply a full-scale model to each project under development. Here, Rochford and Rudelius (1997) have identified a useful distinction between what they label 'new-to-the-world' and 'product modifications'. Their research has indicated that 'high-success' products tend to utilize the PD stages more often than 'low success' products, independent of whether they address new-to-the-world products or product modifications. From the companies under investigation here, however, no evidence disclosed whether the states or gates were skipped, apart from those of low-risk projects which were often cases of product modification rather than new products.

3) What effects can be identified with regard to rule application in the PD process?

In all of the companies under investigation, the status of PD and the attention paid to it by top-management is high. (In the case of PLASTIC, however, only divisional managers participate in the gate review meetings, not members of the executive committee, which is nevertheless not perceived as a problem by any of the participants.) Each of the companies under review has experienced a range of benefits from the introduction of the SG model, which are primarily associated with the effects brought about by the requirements of rules on documentation and explicit decision-making on PD.

In all of the five companies, various organizational issues seem to have been 'solved' through the introduction of rules in PD, which was suggested to be a function of rules by March (1994) and March et al. (2001). PAINT, for instance, needed to generate greater focus on calculations regarding the business potential of its many product development and product modification projects. MEDICO needed to place more focus on ensuring commitment within the organization and across countries and units. As MACHINERY had a number of projects and ideas working simultaneously, the introduction of the SG approach helped provide it with rules for documentation and decision-making. INGREDIENTS needed to improve cooperation and develop a common language, whereas PLASTIC needed to establish an 'overview' of the range of projects it was undertaking, and subsequently a reduction, which was eventually solved by rules of

decision authority diminishing the project managers' responsibilities. Nevertheless, this is not to claim that all these complex problems disappeared as a result of implementing the latest version of rules in these organizations, merely that the use of rules is thought of, and often discussed in terms of having a positive effect on the problems at hand.

The reduction of friction and political processes that is brought about by the introduction of rules is one of the central advantages to have been identified by Weber (1968). All five cases of SG rules indicate that there has been a reduction in these factors, even though political issues, described as 'lobbying', seem to be prevalent in PLASTIC. Here, 'lobbying' was associated with a lack of objective decision-making and instances of pre-approval with the portfolio manager which the formal rules permitted. As one respondent discloses:

> … a year or two ago one person started to promote the idea [that in] the new plants we were using a catalyst without any evidence that it worked, for example, not even at the pilot stage … and especially not in our demonstration production unit.… Now they are building a €200 million plant or they are proposing that it is okay that we will use this catalyst – without any evidence [that it works].

These issues are summarized in the table below.

Table 5.4: The instrumental effects of rules on the PD process

	PAINT	MEDICO	MACHINERY	INGREDI-ENTS	PLASTIC
What is the status of PD activities?	There is much more focus on PD recently.	Top management attention. Progress is monitored and "we serve the sales companies"	High	High	High – 'R' feels that more attention is devoted to 'D', which contrasts with 'R', which is not (just) a 'cost-spender'.
Are organizational issues and problems solved by the rules?	Focus on the business potential.	Commitment across the organization.	Several.	Cross functional and cross organizational cooperation - and creating a common language.	Too many projects are reduced through modified rules and the portfolio and total value has become a managerial concern.
Has there been a reduction in friction and political processes through rules?	'Random' decisions on which projects to approve is reduced.	The PD-process functions as a sorting process	Problems with new markets are resolved through modified rules.	Before: Projects initiated by individual managers producing problems. Now: Mandatory cooperation.	Formally the problems with friction are solved, but 'lobbying' prevails and is in general perceived as a problem.

5.4 RULES IN PLASTIC

The PLASTIC firm has been selected for further investigation for several reasons. First, the company had previously applied a version of the SG approach in which the project managers were empowered to make decisions on the project, but has since reverted to a facilitated SG approach rather than the third generation Stage-Gate approach. Second, it is the only company under investigation in which where the rules have been analyzed as very exhaustive and subject to normal elaborateness (see table 5.2).

The second part of this chapter is therefore a single-case analysis of PLASTIC, which is structured as follows: In the first section, the rules of PLASTIC are presented, followed by a comparison of these rules with the normative rules in the generic SG ap-

proach (as described in chapter two). Finally, the literature on the SG approach (presented in chapter three) is discussed in relation to the rule-system of PLASTIC, and the findings of the analysis are compared.

PLASTIC's main products are polyolefin – plastic raw materials consisting of polyethylene (PE) and polypropylene (PP). The turnover in 2002 was €3,514 million, which generated an operating profit of €85 million. The firm employs 5,000 people and produces approximately 3.5 million tons of PE and PP each year. Polyolefin is a plastic which increasingly can be substituted for many conventional materials due to innovation in its properties and performance. The primary customers of its products are plastic manufactures which convert the company's products into everyday products – from food packaging and construction material through household goods to car and aircraft components.

The production of plastics is a process industry and the manufacturing process of PE and PP starts with the distillation of crude oil. Most of the substances in crude oil contain hydrocarbons. The molecular weights of the substances in crude oil vary, which enables a distillation of different fractions (or monomers) through heating and subsequent cooling in a refinery. Each fraction is a mixture of hydrocarbon chains, which differ in terms of the size and structure of their molecules. One particular fraction is Naphtha, which in its gaseous form is the feedstock in the production process of the plastic firm. No chemical transformation has taken place after distillation in the refinery, which, nevertheless, is required in order to make more practicable products with different melting and boiling points and chemical properties.

Chemical transformation is initiated in a reactor where the fractions are transformed into products through a cracking process which breaks the naphtha down into smaller hydrocarbon molecules such as the gases ethylene and propylene (olefins). The plastic firm has five crackers (some in joint venture) geographically placed throughout Europe and the Middle East. The transformation continues in a chemical reaction called polymerization, where a large number of individual molecules are linked together to form polymer chains, such as PE and PP. In this reaction, the double binding of the carbon molecules in, for example, ethylene are broken and the electron released from this goes on to form two single-bindings in which the open binding becomes coupled with another ethylene-molecule with an open binding, and where ethylene goes on to form a

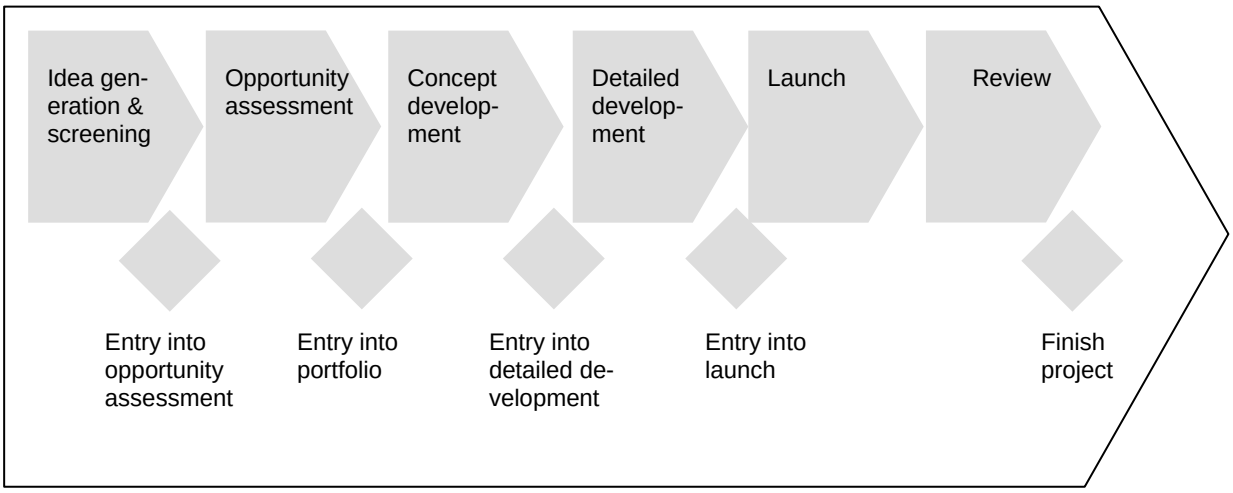
chain of polymer: polypropylene. The output of the plastic firm, namely polymers PE and PP, takes the form of granulates, which are transported as bulk or by truck to the customers. PLASTIC has seven polymerization plants. The design of the assets in the plants has an influence on the properties of olefins and each particular plant is designed to operate under certain conditions with special catalyst systems to make its own product mix. The polymerization production process is complex when a new product is required, because a new additive that has thus far not been tested – or even in some cases has been tested – can contaminate the production process and subsequently the next product.

The company is structured in five areas including a polyolefin business group, technology and projects (including R&D), operations and procurement, hydrocarbons group and business support. The largest area is the polyolefin business group, consisting of primarily eight business units of which five are organized according to markets served, two according to assets (PE) and (PP) and one as a support function. Each business unit is a profit center. Approximately 500 people work within R&D. The company has 57 projects in the portfolio and seven long range projects (Quarter 3, 2003). Innovation projects can be owned by R&D and are primarily concerned with catalyst research in the cracking process, which often has a ten-year development time. In Quarter 3, 2003, seven long range projects were owned by the R&D department. The five business units managed 47 projects in Quarter 3, 2003 concerned with product development. This is normally a development issue which centers on additives to the polymer in the polymerization process with the aim to control product properties. The procedure can be illustrated by, for example, a common experience in the household, when cling-film sometimes becomes difficult to separate when applying it in the kitchen – this is often a cause of the quality or the level of ‘slipperiness’ which depends on the types of additives mixed in the polymer, which in turn depends on the price. Asset (PE and PP) also owns 10 innovation projects (Quarter 10, 2003) that often address issues of production process investment and innovation in the fundamental production technologies of the company. This influences both the cracking and polymerization process. The building of a new test plant is also one of these projects.

All innovation projects are organized in line with the SG approach, which has been in existence in the company since 1995/1996. In 2003, the process was changed from

the first version, PD & I, to what the company describes as the 'new innovation process' (IP). The value of the portfolio is €241 million (Quarter 3, 2003) measured as the sum of a net present value (NPV) multiplied by the likelihood of success for each innovation project; a project team normally include 6 or 7 people. The SG approach of PLASTIC includes six stages and five gates and shares a high number of similarities with the stages of the normative SG approach (see chapter two). It is, however, influenced by the peculiarities of the process industry. Issues of comparison will be investigated later when attempting to answer the two analytical questions at the outset of this chapter. For the present, this approach is illustrated in the figure below:

Figure 5.1: PLASTIC Stage-gate approach (source PLASTIC; redrawn from evidence material due to technical difficulties with scanning).



The decision-making authority of a project largely depends on the project type. Long-range projects (which are normally concerned with catalyst development) must be decided by a technology council, as opposed to a portfolio management meeting (PFMM) where decisions on the portfolio are taken. The R&D department, asset PE and PP, and business units, can all recommend projects to the technology council. Business units, asset PE and PP, and manufacturing can propose projects to the portfolio. The decision-makers of the PFMM are the General Manager of the two asset clusters (who are the Chairmen of the meetings, and as a consequence revolve), PE and PP. However, questions concerning resources must be agreed together with the portfolio manager. Conflicts that cannot be resolved by the General Managers are put before an Executive Vice

President of Research and Technology who does not participate in PFMM, unlike the technology council the executive vice president of technology and projects do however participate.

The PFMM-forum also includes (besides the General Managers PE and PP) one production team leader, the portfolio manager, the VPs of each business unit, the VP of R&D, and one senior scientist (appointed by the General Manager). The progress of the project is monitored according to a checklist in which eight deliverables must be met, including strategic fit, market plan, business case, killer variables, milestone solution, project plan, HSE/FTO (production possibility, environmental – and safety issues) and resources (source: formal IP material). All projects in concept development, detailed development and launch are part of the portfolio, see figure 5.1 above.

Innovation activities (allowing for 20 percent of the time) can also take place outside the portfolio as a separate 'activity', but must be made part of the portfolio when pilot plant runs and/or upscale runs in 'commercial plant outside the current operating window' is required, or when catalyst or process research is required outside the opportunity assessment work. This type of activity has been observed when entering the portfolio with a project status of concept development, which is formally the skipping business assessment stage.

The PFMM-meetings are dislocated in time from the innovation projects. This is because the PFMM takes place on a quarterly basis but then covers all innovation projects in the portfolio at one go. According to the formal rules, a PFMM is also possible each month but this has so far not been carried. It is also possible to approve provisional entries into the portfolio by the portfolio manager, if resources are available and the criteria set out above are met. The PFMM-meetings are required to make decisions on single projects and on the portfolio-level of decision-making, including setting priorities between the individual projects; the former includes decisions as to whether a project should be kept in the portfolio at all or discontinued "as a result of a stage review" (source: PLASTIC). Portfolio decisions include prioritization of projects to maximize cash-flow over time, and to decide on

… an optimal mix of projects with respect to strategy (risk, business mix)
… balance resources and define cut-off points between projects for which

resources are available and projects for which resources are no longer available (source: PLASTIC).

The gate activities (PFMM) that are required to be carried out are illustrated in table 5.4 below and described in more detail in chapter six, where the extent of rule application is analyzed:

Table 5.5: Formal gate rules (source: PLASTIC)

Rule area	Formal gate rules
Agenda	o Status of current portfolio and its implications o Existing projects at major stage gates o New projects at major stage gates o Implication of long-range projects o Recommended portfolio implications and alternatives
Decision	o New portfolio o Project managers o Resolve all outstanding legal/HSE/IPR issues
Portfolio	o Prioritize projects to maximize cash flow over time o Decide on optimal mix o Balance resources and define cut-off point between projects for which resources are available and projects for which no longer any resources are viable o Quarterly o Monthly

The company employs a database particularly for its innovation purposes, where the project data is stored in the form of a project description, and where resources allocated and cost follow-ups are registered. This particular innovation enables links to another archival database where documents in the form of reports are stored, for example in the form of a business case and market plan. Consequently, the databases should ideally be able to provide a formal a ‘snapshot’ of the progress of an innovation project at any point in time.

The responsibility for updating information has been designated to the assessment leader (vice presidents) in the first two stages (idea generation and business assessment) and the project manager in the subsequent stages. The assessment leader is therefore responsible for documenting project ideas, using an ‘idea communicator’ which is simply a Word document, and, in the second stage, for securing information in the form of a project description, including a business case, and HSE-check registered in the inno-

vation database, as well as links in the archive-database. In the subsequent phases (stages), the project manager assumes responsibility for documenting a market- and launch-plan as well as a project plan. The documentation must be updated "continually" and "checked at least in milestone review" (formal IP material). One example of increasing elaboration in the PLASTIC firm is the introduction of the innovation database and the formal templates to be filled out.

The detailed requirements to be registered generally fall into four categories of rules. First, information on the project including objectives, target objectives and the selected technology platform (pop-down menu) is to be registered. Second, 'Project Assessment Metrics' are required to be filled out, including the probability of success (which is calculated as an average between market and technical probability of success), the estimated NPV of the project (business case), and finally the estimated cost. Third, the project is to be documented with the business case, market plan, killer variables, and project plan (including end date). Finally, the innovation tasks are to be described in operational terms and the formal stage and status of the project on a continual basis.

The production of information to be registered and documented takes place in the stage activities of the PLASTIC firm, where each stage formally has a number of objectives and required actions that are to be undertaken. As suggested above, the rules have not only been made more elaborate as part of this latest Stage-Gate version, but also more exhaustive by the portfolio management functionality. Portfolio management has introduced a division of activities in the stage-activities in terms of pre-portfolio activities that are the responsibility of a business unit or R&D, and, when the idea is developed to the extent that the use of the test-plant is required, the project must be made part of the portfolio. The pre-portfolio activities are illustrated in table 5.6 below.

Table 5.6: Formal rules of pre-portfolio (source: PLASTIC)

Stage	Objectives	Actions
Idea generation and screening	o Acquire broadest set of ideas – connect to customer needs o Take action on all ideas aligned with innovation objectives within a robust process o Measure and reward good	o Broadly communicate innovation objectives, aligned with business strategy o Assign ideas to innovation objectives – enhance, enrich and structure ideas

	ideas	o Separate potential activities vs. potential projects o Communicate outcome of idea evaluation to all involved
Opportunity assessment	o Assess commercial and technical feasibility of ideas o Identify ideas with largest business potential o Prepare necessary information for first portfolio decision incl. business case and project plan through launch	o Conduct an initial proof of concept and get sign-off from a senior scientist o Prepare business case, assess strategic fit, competitive advantage and risks o Develop project plan, identity critical path and killer variables o Decide which opportunities to forward to portfolio decision or to discontinue o Identify critical resources and check availability

The first stages in the pre-portfolio phase are idea generation and screening and opportunity assessment, whereas the portfolio stages are subsequently concerned with development and post-development, including concept development, detailed development, launch and review (see figure 5.1). The formal system of the PLASTIC firm shares similarities with the normative system, which will be discussed in greater detail below, but for the time being it is interesting to note that the focus on customer and economic rationality is one similarity between the two normative rule systems.

The portfolio responsibility includes transfer to line-management but also that of capturing lessons from the specific development project. The stages include concept development, detailed development, launch and review. The objectives to be fulfilled and the activities required to be carried out are thus listed in the table below:

Table 5.7: Formal rules of portfolio (source: PLASTIC)

Stage	Objectives	Actions
Concept development[23]	o Demonstrate value creation potential for customer and Borealis o Proof of concept on bench and pilot scale prepare for detailed development	o Test and prove technical feasibility on bench and pilot scale o Identify upscale plant, determine recipe and process conditions o Adapt market and competitive assessment – use pilot material for tests with customers as appropriate o Obtain sign-off from manufacturing for upscale
Detailed development[24]	o Demonstrate value creation for customer and Borealis o Proof of concept at commercial scale o Prepare for launch	o Scale up to commercial plant o Test and approve and material/process with key customer; start pre-marketing activities o Resolve all understanding legal/HSE/IPR issues o Prepare all necessary material for launch o Obtain sign off from commercial and plan manager for launch
Launch	o Fast and successful penetration of the market o Successfully manage transition of product/process from project team to line organization	o Provide technical support with new grade to customers o Execute launch according to plan (timing, sales volume and margins by customer) o Hand over to line organization
Review	o Enable knowledge building and learning from completed and terminated projects o Support learning for decision makers, project managers and team members	o Conduct review session within portfolio decision meeting o Project managers write final report and present project outcomes and key learning's to decision forum o Decision makers review decision made over course of the project o Root cause analysis for project success/failure

The rules employed by PLASTIC have been described to the extent that they have been made available to the investigator. It must, however, be recognized that acquiring knowledge in this area has generally proved difficult due to the fact that competence in

[23] This stage has formally been subdivided into two stages: bench scale and pilot scale which refer to the physical development of the plastic. The stages are divided by an 'interim milestone review' to be run by the steering committee of the project.

[24] This stage has formally been subdivided in plant scale and market test requiring that a market test cannot be undertaken before the product has run through the plant. Again, the 'interim milestone review' must be run by the steering committee.

the rules is not sufficiently developed amongst many of the respondents and that formal training has so far not been undertaken. This applies at both vice president and project management level. Thus, the description of rules provided above draws heavily on the formal literature and print-outs that were made available to the investigator during a start-up meeting at corporate headquarters. No access was possible to the databases.

5.5 COMPARISON OF NORMATIVE SYSTEMS

Similarities as well as differences can be identified between the normative system as described in chapter two and the normative system that was designed by PLASTIC and presented in the section above, particularly with respect to gates, stages, and information/documentation. The latter forms the link between gates and stages.

Gates: The system described in chapter two prescribes a standard of evaluation for an individual project that is undertaken according to the criteria with which the project has to comply. The criteria are similar even though the distinction between – what was described in chapter two as – should-meet and must meet criteria could not be identified in PLASTIC. As was outlined in chapter two, the two timelines of gate review meetings each quarter and the progress of an individual project were not identified as possibilities by the normative system set out by Cooper and Kleinschmidt (see chapter two). The normative gates that are defined by these authors are two-fold: first, the project must comply with the must-meet criterion and, second, the should-meet criterion should also be fulfilled where comparison between the projects is undertaken according to a 10-point Likert-scale (Cooper, 2001) to be evaluated by each participant in the meeting. The requirement for making portfolio-based decisions is therefore not developed to the same extent in PLASTIC as was the case with the normative system set out in chapter two. The purpose of the should-meet criterion is to establish a standard of comparison between the different projects in the portfolio and the purpose of the Likert-scale is to disclose the level of agreement that is reached among the gate review participants, and which was a central issue to Cooper and Kleinschmidt (see chapter two). Project managers are excluded from the gate review meetings to secure ‘objectivity’, which was identified as a requirement by Cooper (2001), and top-management, at least at the level

of the executive committee, do not participate in the gate review meetings (PFMM) either. This, however, is required by the normative system described in chapter two.

Stages: In stage one, the activities of PLASTIC are more focused on the communication of ideas and not so much on idea generation itself, as was suggested by the initial stage of this investigation and proposed by Cooper (2001). Idea production, however, needed to be more market focused, which is why BUs needed to formulate innovation objectives as part of the new innovation process for PLASTIC. Stage two follows a similar pattern, but here the project management of the rule system requires that the project manager must submit an end date when entering the portfolio that is, ideally, not subject to change as the project develops. Stage two in the normative system set out by Cooper and Kleinschmidt (cf. the detailed investigation) has been integrated into stage two of PLASTIC. Stage three also pursues a similar development, particularly with the requirement of greater contact to the customers early in the process. PLASTIC proves the exception here as it has divided this stage into two sub-stages. Stage four in the normative system requires product testing with customers, including trials and pre-tests in the marketplace, whereas PLASTIC rather sets its requirements on up-scaling to commercial plant testing and approval of material with the customer. This stage has also been divided into two sub-stages. The sub-stages are further divided by a sub-gate to be managed by the steering committee. Moreover, PLASTIC has added an extra stage after launch, namely the ‘review phase’, which has been added to emphasize learning and secure the delivery of the project to the line organization.

PLASTIC manages technology development projects, process improvement projects, and product development projects within the SG approach, whereas projects with an expected NPV of less than €2 million (often product modifications) are governed by the respective departments of the project owners without the involvement of portfolio management. This might introduce a resource problem since product development projects will naturally also compete for resources. Cooper (2001) recommends a lighter version of the SG approach to manage low-risk projects, like product modifications, for companies where competence has been developed, but does nevertheless recommends a version of SG which is focused on technology development (SG TD).

Information and documentation is facilitated through a number of databases, which ideally enable constant control of the content and development of projects together with

monthly reporting of costs to SAP and hours to the hour-reporting system (SSP). The database is also designed to facilitate communication between project team members who can often be geographically dispersed, such as when a project in Finland can be managed by a project manager in another European country. Cooper (2001) does not elaborate too much on the topics of information and documentation, but merely assumes that all information is documented and made available to the members of the gate review. This is done in order to secure 'objective' decision-making and also so that information is shared cross-functionally as well as among the project team members.

In conclusion, it can be seen that the nature of the two normative systems is indeed similar in terms of their attempts to install economic rationality (consequentiality) by separating the innovation process into a number of gate reviews and stages. Interestingly, no formal rules at PLASTIC require project managers to stop working while awaiting the decision of the PFMM. This is an additional difference between the two systems.

5.6 ANALYZING RULES IN PLASTIC

The change in the SG approach at PLASTIC resulted from problems that occurred as the number of projects continually increased and the sense that the executive committee had thus lost the overview. In the previous rule-system, PD&I, project managers were authorized to make decisions on their own projects and business units decided the total number of new projects that were to be undertaken. Nevertheless, the project managers have been deprived of this authority. As one respondent states:

> … in a way the power of the project manager is not as big any more; earlier we basically had the right to make many decisions on the project concept, and now, in the innovation process, the decision level has moved up. We are basically more coordinators than decision-makers (project manager).

Anderson (1996) suggested that within what he described as IPD, project managers should be empowered to make decisions on a project based on a contractual agreement. This was attempted at INGREDIENTS, but the number of projects increased, which was in itself ascribed to the authority of project managers to make decisions. Keeping to

the terminology of Anderson (1996) the second generation SG approach can be said to be more a management control system than an innovation system.

On the project level, exhaustiveness was increased through the introduction of information and documentation rules which project managers required were continually updated. The portfolio management functionality, on the other hand, was subsumed under the responsibility of a designated portfolio manager who reported to two Asset General Managers. The main responsibility of these General Managers is the operation of the plants at PLASTIC. The functionality of the SG approach is to make 'objective' decisions based on sufficient project information and documentation. The elaborateness of documentation and information rules corresponds to the requirements for making portfolio decisions even though PLASTIC does not have any rules for reaching should meet criteria which support portfolio decision-making by comparing the relative attractiveness of projects against other projects.

Phillips et al. (1999) argue that the number of stages depends on the strategy of the company and the peculiarities of organization which prevail at any given company. PLASTIC has set itself the goal of becoming more of a prospector with a focus on customers and value adding. According to Phillips et al. (1999), this strategy requires the subdivision of the first stages in the SG approach at PLASTIC as customer needs are identified particularly in these stages. KODAK is mentioned as an example of a company which has adopted this process design as a result of greater customer-orientation. This design can, however, not be applied to PLASTIC, which is more focused on securing quality in the concept and detailed development of the product. Sub-stages are associated by Phillips et al. (1999) with tighter control, which in the case of PLASTIC is placed on concept and detailed development. Phillips et al. (1999) further suggest that high-phased companies like PLASTIC (eight stages) need to enforce reviews as part of the overall process in order to cope with the broad scope of business strategy. The business scope of PLASTIC, however, is not broad, at least not to the same extent as KODAK. However, the geographical locations of its units are widely dispersed, particularly between sales- and marketing and R&D, which appear to the rationale for devising sub-stages in the first place rather than as a result of overall corporate strategy issues.

Rochford and Rudelius (1997) suggest that the number of stages can vary in accordance with the risk of the project. In addition, Cooper (2001) suggests a fast track ver-

sion for smaller projects as advisable. In PLASTIC, a rule has been added only to address projects with an expected NPV over €2 million in the SG approach. This is the only example of a rule which has been made in order to create flexibility whereas all other types of projects, including product modification, are managed by the business units and thus outside portfolio management.

5.7 CONCLUSION

Taking PLASTIC as a case study, rules influenced by the SG approach have been identified in an organizational practice. Not only can the rule systems be characterized in terms of elaborateness, as suggested by Cyert and March (1992), but also with respect to exhaustiveness (Weber 1968). The degree of exhaustiveness and elaborateness varies among the companies. Rules are stable in the short run, but generally change between 2 and 3 times over a 10-year time-frame. Competence in rules seems to be an imperative when companies are in the process of moving to a higher generation SG, but a retroactive movement has also been identified among the case studies. The issue of competence indicates that the organizational response to rules requires a perspective of appropriateness to understand the use of rules in an organizational practice. The companies with the 'highest' attitude towards PD appear to be companies with the greatest reduction in friction and political processes, which further emphasizes the perspective of appropriateness when understanding the manageability of PD, since organizational identity seems to be central to understanding the link between rules and actions. Moreover, SG rules in PD are interconnected with other rules and problems outside PD.

The comparison between the normative systems described in chapter two and the system of PLASTIC revealed a degree of similarity between the two systems, even though some differences could also be identified. As was seen, the goal of the PLASTIC rule-system was to produce objective decision-making in the gates 'fueled' by information produced in the stages and documented prior to the gate meeting. In this sense, the rule-system of PLASTIC is an attempt to install rational behavior (consequentality) in PD. However, the findings in the cross-case analysis further substantiate the need for understanding how rules are actually used.

CHAPTER SIX

The appropriateness perspective: using rules in five case companies

The purpose of this chapter is to analyze rule-application in relation to the five companies under examination. As we saw in the previous chapter, the perspective of rule-following assumes that actions conform to a rule (instrumentality) and, as a consequence, tend to neglect accounts of identity or any situational interpretation of the circumstances in which actors find themselves.

The perspective of appropriateness challenges the instrumental perspective of rules – how rules are applied therefore becomes a central issue since they cannot be programmed (or even automatically predicted). Building on the previous chapter, this section seeks to analyze the multiple-case studies as a whole before turning to the single-case analyses in the following chapters. In the following case study, observation is then included as a relevant data-gathering technique.

The starting point of this chapter, however, is the framing of two research questions, which provide an organizing device for the subsequent analysis in the following two sections. In doing so, the chapter refers particularly to rule-application with respect to the five companies before offering a preliminary conclusion of the argument so far.

6.1 RESEARCH QUESTIONS

The analysis outlined above leads directly to the approach adopted here. In exploring this approach, we are guided by two research questions which implicitly determine the structure of this chapter. These questions are formulated as follows:

(1) The concept of appropriateness challenges actions which are said to conform to rules by claming that actions are a result not only of rules themselves, but also issues of identity and interpretation of the situation in which the respective actor or organization finds itself. As March (1994:61) notes:

> To say that individuals and organizations follow rules and identities, however, is not to say that their behavior is always easily predicted. Rule-based behavior is freighted with uncertainty. Situations, identities, and rules can all be ambiguous.

As a consequence, actions cannot be assumed to conform solely to rules. This raises the question: *how are rules actually applied to PD – in strict accordance with bureaucratic mechanisms or rather in a relaxed way through the construction of appropriateness?*

(2) Moreover, the interaction of rules with the organization itself first needs to be understood in order to evaluate whether the application of the rules is actually different from that which is assumed by the instrumental perspective. Arguing from the perspective of appropriateness, it may thus be questioned whether *rules influence organizational identity, require competence, and, additionally, whether the rules are a response to problems other than those assumed by the normative rule-system as outlined in chapter two?*

6.2 RULE APPLICATION IN PRODUCT DEVELOPMENT

Rules are not applied to all PD activities. All five companies under consideration here make a distinction between a reduced or full-scale application of rules depending on the expected investment and the risk to business involved. MACHINERY, for example, only applies a full-scale PD process when the PD project requires an investment of more than €700,000, whereas the PLASTIC firm does so only when the expected NPV is above €2 million.

From four out of the five firms under examination, it is not mandatory to use all the rules. In this way, PLASTIC formally demands that all rules are followed, but rule-deviations are not sanctioned. The PAINT company, on the other hand, rather places its focus on stages, the preparation of documents and the preparation of the business case – as is the case with the INGREDIENT company. Generally, there seems to be a discernible focus on preparing documentation for the gate meetings, as required by the formal (and normative) rules. The INGREDIENT company seems to apply the SG approach when organizational cooperation between the different PD centers is essential and/or needed. The general attitude towards the rule systems for PD in the five companies is summarized in the table below.

Table 6.1: General attitudes of SG rule-based systems in the five case studies

General Attitude	*"They are of great help – they provide structure to the process and secure good decisions."*	*"Rules exist – but we use them as needed."*	*"They play an insignificant role; important decision-makers and other decision forums determine what happens in the PD process."*	*"We considered introducing rules – but do not consider them to be important."*
Firm	PAINT PLASTIC	INGREDIENTS MACHINERY MEDICO		

From the empirical analysis, PAINT seems to prefer sticking to the rules. One explanation for this may lie in the fact that the company is new to the world of SG rules and is

therefore still in the process of learning. Similarly, PLASTIC sticks to the rules as a consequence of its experience in the delegation of decision-making authority, which has led to the generation of too many projects (more than 200) and the feeling that the top management has lost the 'overview' of these projects. A new version of the SG approach, however, was implemented at the beginning of 2003, when formal decision-making was re-introduced. In the other three companies, respondents generally found rules helpful to the extent that they provided structure and tended to secure good decisions, providing that their application was a discretionary matter and not mandatory. Moreover, the general picture of rules in the PD process was that they work as a 'guide' or 'framework', which suggests that rules are applied according to the specifics of a situation. As two respondents had it: "You can choose independently what to include in the stages" (senior project manager) and "rules can be challenged" (project manager).

Furthermore, three out of the five companies had already attempted to establish mandatory rule-following, but the experience had merely resulted in the companies reducing their requirements (with the exception of PLASTIC), particularly for rule-following in the instrumental understanding, and instead the form of a 'checklist'. As one respondent explained his experience with regard to the use of detailed documentation: "the extensive use of manuals is too tight and bureaucratic" (Development Manager).

Discretionary application also appears to apply especially to activities between decisions (gates). Again, the PLASTIC firm is an exception here, as it outwardly maintains the formality of rules while not sanctioning their breakage. In this case, for example, while the performance of the project managers is officially monitored via the company intranet, a project may still be formally approved even though a business plan for the project had not even been uploaded.

Gates seem to have an important role in the structuring of the PD processes, with gate three (before development) and gate five (before launch) particularly being kept completely formal through the participation of executive management or divisional management. In this way, MEDICO has replaced gate one with decisions related to the budgeting process, where divisional managers allocate resources to the PD project only if the project complies with the required criteria.

PLASTIC is a market leader and employs a competitive strategy which focuses on value added and at the same time on production costs because of heavy production fa-

cilities. Consequently, it applies an expected NPV as the economic criteria for taking account of sales and costs. INGREDIENT is also a process industry. Both types of company therefore include process improvements which are to be managed through the PD process and are influenced by the SG approach. PAINT, on the other hand, is also a process industry but is currently in a process of transition from a follower to a proactive prospector strategy. In the past, it produced products which were based on by-passing patents, but is now attempting to focus its attention on more proactive projects with a 'new-to-the world' element. As a consequence, R&D has been relocated under sales and marketing, which thereby re-focuses interest on the business potential. Finally, MEDICO and MACHINERY are also both market leaders in their respective industries, but have placed their focus on costs because their price-strategy had already been determined prior to the respective project work on product development and the fact that costs were set from the outset of the project development.

All the companies under investigation are in the process of trying to establish an economically viable rationality, in the instrumental sense, even though they are aware that the initial calculation (in gate one) is rough and uncertain. Nevertheless, all of the companies are developing these calculations further as the product development projects progress. The requirements for financial calculation appear to be mandatory with no possibility for choosing freely, except when management chooses to support 'a high-risk project', a 'strategic' project or a 'symbolic project' to legitimize other decisions. The latter case can be evidenced by PLASTIC where a particular project was approved despite the fact that it was below the €2 million-rule. In this case, the decision was justified by the need to support an earlier decision to build a new plant which was to produce the product resulting from the development project.

Rule-following is rather relaxed when it accords with the complete set of SG rules. None of the companies investigated here are particularly strict when it comes to demanding that the whole set of rules must be applied (although PLASTIC appears to be the exception) even if they have invested large amounts of resources in developing and updating, including training on, the rules. This does not mean that PLASTIC has softened its requirements for following formal rules, rather that all the rules are not followed in an organizational practice. There is ample room for context specific interpretations and modifications to the rules; thus, the SG approaches, when implemented, do

not amount to a whole bureaucracy in the strictest Weberian-sense. For Weber (1968, 1972), rule-following was not an open question or a discretionary matter even though he recognized that rules could be learned. Nevertheless, the bureaucratic mechanism could be identified to a certain extent. In fact, the PD processes *are* influenced by the particular SG approach that has been selected, especially with regard to documentation and the kind of argumentation adopted at the gate meetings (Gate reviews). The gate meetings thus come into focus if the development, design and application of rules in PR, is to be further investigated. Consequently, if the company relaxes rule-following at the stages, the question arises as to the quality of decision-making that is taking place at the gate meeting, owing to the lack of information. No evidence supports this, which raises a further dilemma as to how some of the bureaucratic advantages that are claimed to be experienced by the organization can in fact be accomplished if the rules are violated, even to a limited degree?

The empirical data supports the notion that PD is made manageable through an application of rules to the process at hand, e.g. to rules for calculating the justification of projects or rules regarding user involvement and decision-making. Even if the rules are applied in different ways, and to different degrees, companies with SG approaches find that the PD process is heavily influenced by some form of requirement for preparing a business case or business model for new products, or also for presenting calculations on expected costs or expected future profits. The introduction of various models and templates that arises through introducing and utilizing the SG approach for preparing these calculations and documents for the SG meetings seems, in fact, to be one of the major impacts that this approach has had on the cases under study, and as was predicted by Weber (1968).

The introduction of rules seems to influence the PD process by placing greater focus on calculation, thus moving the PD decisions into the ‘open’ decision arena, and – according to a number of interviewed actors – reducing the influence of ‘people’ and politics on the

Table 6.2: Summary of rule-application at the organizational level

	PAINT	MEDICO	MACHIN-ERY	INGREDI-ENT	PLASTIC
Rules applied on all PD activities?	No.	No.	No.	No. SG used when organizational cooperation is needed.	No.
Is it mandatory to use all the rules?	No. Focus stages on preparing documentation and business case.	No. Focus on stages and documentation, but linked with many planning activities.	No. Applied differently across the organization. Decision points important.	No. Focus on preparing case and to justify the project. Gate-contracts for each stage.	Formally yes, but rule-deviation is not sanctioned.
Are the PD processes structured according to formal rules?	PD is becoming more structured.	To a high degree – PD activities are related to various plans and planning activities.	Formalized and structured – but there is room for high-risk projects. Success rate of 70% is the target.	To some extent – and increasingly more.	PD and technology planning is becoming more structured.
Are 'written' rules and rule following important in PD?	Rules serve as a 'guide' to activities between gates.	Rules for activities act as a 'compass' or 'time-table'.	Rules for PD are a 'framework'.	Experienced that extensive use of manuals etc. is too 'confining' and 'bureaucratic'.	Rule-following by project managers is monitored but not sanctioned.
Are there formal gate-meetings?	Yes.	Yes. Gates can be replaced by other meetings.	Yes.	Yes – difficult to get the process working.	Yes – but gate meetings for technology planning is separate.
Is PD influenced by calculations?	Yes – business potential.	Yes – focus on costs.	Yes – costs and market potential.	Yes – profit from projects.	Yes – focus expected NPV.
Are PD projects budgeted?	No project budgets.	Project managers becoming more focused on planning, budgets, and coordination (vis-à-vis departments).	Yes, negotiate about resources, PD costs, business evaluation, and payback period.	Budget issues are the line manager's responsibility.	Yes monthly updated in terms of costs and time consumption.

PD processes themselves. In this way, rules do actually fulfill another major objective identified by Weber (1968), namely that of removing the 'personal' from the decision arena and introducing 'objective criteria' to decision-making. The data gathered here indicate that at least two of the companies under investigation think that the SG model is helpful, provide structure to the process and facilitate decision-making. At the same time, the data indicate that while rules do exist, they are often applied as needed. The five companies that adopted the SG approach with regard to the PD process are more or less structured according to the SG rules and their application. That being said, the degree of structure varies greatly among the respective cases. This is summarized below.

Returning to the first research question, which asked how rules are applied to PD, it can therefore be concluded that rules are not followed mandatorily nor do actions directly conform to the rules. Moreover, although the analysis suggests that the gates are kept formal, rule-following in stages is rather more relaxed and tends to be couched rather in terms of appropriateness.

6.3 INTERACTION BETWEEN RULES AND THE ORGANIZATION

No respondents expressed any particular problems with implementation, as is addressed in the work of O'Connor (1994). In particular, his observation that it can take up to six years for an SG approach to work cannot be supported by the analysis here. That being said, INGREDIENTS actually experienced the need to relax the demand for rule-following, as O'Connor (1994) predicted when he argued that a key component in implementation was the need to develop flexibility as a counterbalance to the discipline and thoroughness of the SG model. As the cases show, there are situations where rule-following is more or less mandatory but the activities and processes between gate meetings are more loosely structured and only narrowly related to rule-following.

In fact, the five companies under investigation here have all undergone some major shift in their organizational focus or in the priorities set by the management. PAINT, for instance, has moved into new markets in an effort to become truly global. As a consequence, it still needs to integrate more production facilities and geographical markets. Top management has become more involved in the innovation process, and there is

more focus on customer and sales company involvement, as is the case in MEDICO and MACHINERY. The identity of the organization therefore seems to be influenced by the formal rules, and the rules in turn are influenced by company strategy in terms of its relationship with the environment.

The relationship between the organizational identity and the formal rules for working in the companies can, however, represent a challenge, as is the case of PAINT where, to quote one actor:

> [S]ome technicians regard the rules as purely bureaucratic. Others want boxes and rules for everything, for example, on responsibility, and that is not possible – unfortunately (R&D manager).

In MEDICO a distinction between senior project managers and new managers is established by their access to extensive training activities within the company. In the MACHINERY firm, on the other hand, there is a classical clash between the identity of production and the PD teams. Here there is

> …an old culture in the company. There has never been a great distance between idea and action in the company. Things had to go fast, and there has not always been any discipline (in PD) processes. … [for instance, when] electronics wants more formal rules than machine people.

In sum, identity can be influenced by formal rules, but it can still be ambiguous and sometimes even contradictory. The identity of groups within the organization seems, nevertheless, to be further influenced by the general level of education of such groups, which suggests that rule-following is in fact a construction reflective of education. Some groups want more rules whereas others want fewer, which means that homogeneity is not an effect of rules, although the organization's identity is influenced as a consequence.

Rules are established in response to a variety of problems. For instance, PAINT wanted more integration of the project teams and clearer project definitions, whereas MACHINERY wanted better coordination between the market segments, the latter nevertheless being accomplished through a separating R&D into two new different depart-

ments.[25] With INGREIDENTS one important comment that was made was that the formal rules influenced the identity of the company to the extent that a common language was established. PLASTIC experienced problems as a consequence of developing too many projects and thus decided to modify the rules, depriving project managers of their decision-making authority, generating more market-related ideas and ideally to better integrate R&D.

Some organizational identities seem to be more susceptible to formal rules than others. This was the case with INGREDIENTS which had to adapt from a more elaborate ('bureaucratic') model to a simple form of checklist. Rule implementation was softened because of its incompatibility with the organizational identity, which could in turn explain such policies as the lack of training programs within the company and the top-down decision to implement the SG approach.

Rules can also be learned – which is evidenced by the findings in all companies – but organizations need to build competences in using them. Where a training program was not offered to do this, it was usually grounded in the perception that the rules were too 'bureaucratic'. Moreover, the learning process has to be conscientious since at least three of the companies have more extensive rules than are actually required in the PD processes. For example, MEDICO has an extensive formal training program. In the training program, the SG approach is presented and actually gives newcomers the impression that they have to apply *all* the rules in their projects. In turn, this introduces large amounts of documentation into the PD process. Trainees have to learn the difference between formal rules and the 'necessary' formal rules needed to comply with the demands and requirements, or in other words, they have to learn the difference between 'nice-to-have' and 'need-to-have' rules. March et al. (2001) argue that competences can be built into the process of using rules (as is in fact illustrated by the data here), but that rules do not necessarily solve all problems.

[25] For further reading on this specific company, see Christiansen et al. (2003). The break-up of research (R) and development (D) was a managerial intervention aimed at increasing manageability by reducing technological ambiguity in product development. This was in order to resolve some of the problems earlier identified in R.

Table 6.3: The interaction between rules and the organization

	Major changes in organizational focus?	***Rules and organizational working?***	***Rules and organizational culture***
PAINT	More market-oriented and more collaboration, top management involvement	Too many projects started with the same people. Challenge "to get the project, the project team and the project definition".	Some technicians regard the rules as purely bureaucratic. But "some engineers love boxes. They want clear definitions of relationships. That's not possible – unfortunately"
MEDICO	More market-oriented – involving customers earlier.	The six divisions and the sales companies are not always involved in Gate 3 decisions. Top management is involved in PD.	Divisional focus versus central planning – but several planning processes criss-cross the organization
MACHINERY	Three market segments defined – early customer and market involvement and analysis.	The question of coordinating three market segments is solved through a division of PD and separation between 'R' and 'D'.	Production units versus PD. "Old culture – not far between idea and actions. Things had to go fast, and there has not always been a discipline (in PD processes)." "Electronics' wants more formal rules than machine people".
INGREDIENTS	New owner – important to get the process to work across the whole organization and between all levels.	PD needs to be coordinated between two PD organizations – SG creates a common language with guidelines.	After change form extensive handbook to a guideline and checklist – much more positive comments.
PLASTIC	More focus on environmental issues and more market-driven idea generation (and innovation).	Portfolio-perspective is important and will solve the uncontrollable number of new projects	The merger of the four companies is not physical and organizational. The magnitude of the production plant impedes the integration of the company in many ways, but the local culture seems to have been diminished through frequent job rotation.

PLASTIC, for instance, is struggling to influence behavior and make action conform to the formal rules, but does not, nevertheless, seem to have provided any training pro-

grams to achieve this. Before implementing the new version of the stage-gate approach, down-sizing (Hamel 2000) through the so-called MATT-program (outlined in chapter five) had already been undertaken. The consequent reduction in the number of people employed in R&D, somewhere in the order of approximately 30 percent, naturally generated a negative attitude towards the new rule-system amongst some of the respondents. This is summarized in table 6.3.

The second research question set out at the beginning of this chapter sought to frame an analysis of the interaction between rules and an organization. It was argued that identity is influenced by rules but that identity is nevertheless not homogenous. Instead, the interaction between rules and organization is subject to a filter, which is determined by identity. This suggests that actions cannot automatically be linked to the formal rules provided by the design of the SG approach within each company. Rules can, however, be learned which suggests that the attitude towards the rules is an important factor when attempting to manage the PD process through the adoption of formal rules. Strategic problems also need to be solved. Here, the approach has been motivated by the theories of Cooper (as analyzed in chapter two), who emphasizes the need for companies to be more market focused.

6.4 CONCLUSION

Summarizing the above, when rules are applied to PD activities, it becomes clear from an analysis of the organizational level that their application varies among rules governing gates, information and documentation, and stages. In the five case studies, emphasis seems to be placed on preparing and documenting the Gate Reviews, which are kept formal, whereas rule-following in stages tends to be a discretionary matter with respect to the project managers. Amongst some project managers, it is even a hallmark of the more experienced to break the rules, which suggests that their identification with the company is not homogenous. Moreover, the rules in some situations do not cover all eventualities since projects are by their nature unique and therefore do not lend themselves to the generalized character of the SG rules. In other words, rules are generic and situations specific (March, 1994).

Rules are generated not only in response to problems of innovation but also issues of strategy, particularly in concerns with respect to the relation of the organization to its environment. As suggested by March et al (2001), rules are interconnected and new rules that respond to problems created by the environment affect the formal rule-system of innovation. 'Rule-following' is further interrelated with the organizational identity, which along with other factors (including training), leads to the construction of an attitude as to whether it is appropriate to 'follow' the rules or not. March (1994) emphasizes that appropriateness is a rational process, but another form of rationality than the analytical (see chapter four). Thus, rule-breaking can in some situations make more sense to the organization, as part of its formation of a sense of appropriateness than 'just' following the rules. March (1994) also suggests that formal rules are socialized, which in turn raises the question whether new rules can in fact compete with old rules (norms). This is one of the limitations consciously placed on the present study, which attempts to focus on explicit rules only.

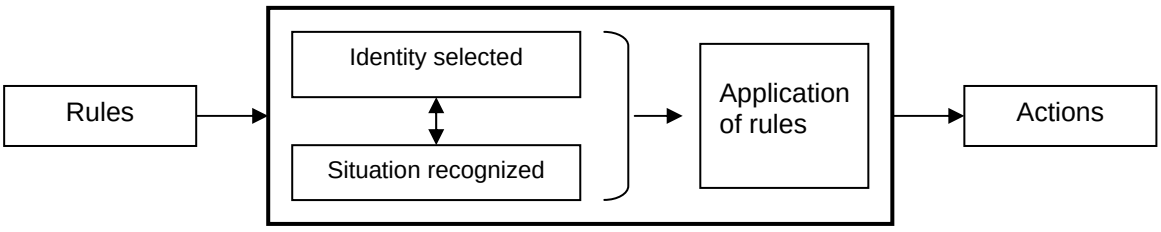
Thus, rule-following becomes a question of constructing a sense of appropriateness rather than merely automated actions which are programmed by rules (Simons, 1954). This in turn suggests the need for a more in-depth analysis of how rules are actually constructed, situations interpreted and identities associated with rules. Moreover, more analysis is needed not only in investigating the variance in the Stage Gate components but also as to why some rules are broken and others followed. From the above, the companies appear to insist on keeping the gates formal, which further suggests that an examination of these gates is required in order to identify whether rule-following in this instance is also rather relaxed.

CHAPTER SEVEN

The appropriateness perspective: using rules in PLASTIC

This chapter sets out to investigate how rules are used in PLASTIC from the perspective of appropriateness. The previous chapter analyzed appropriateness on an organizational level and, through cross case-analysis, identified a number of important findings. PLASTIC was then selected for further analysis. How rules are used in this case will be is investigated below by applying the theory of appropriateness as outlined in chapter four. Here, it will be remembered that appropriateness is constructed according to the following schema:

Figure 7.1: Constructing appropriateness.[26]



[26]This model is developed on the basis of March et al. (2001: 22) and inspired by March's earlier work (1994). The boxed area is added to the model adopted by March et al. (2001) in order to emphasize the theory of appropriateness and the 'filter' which is conspicuous in the behavior of actors between the sphere of rules and actions. Appropriateness is discussed in more detail in chapter eight where additional variables are added.

The formal rules of PLASTIC prescribe what it means to be, say, a proper decision-maker or a project manager, but whether these rules call forth the actions(s) actually intended by the rule(s) crucially depends on how issues of identity are defined as well as the specific situational circumstances in which the rules are used. This can sometimes result in rule-deviation or the use of the rule(s) being regarded as a duty, and thus lacking any internal commitment, particularly where external coercion is a motive (March 1994). As a consequence, rule-competition, rule-ambiguity, multiple identities, ambiguous situations, and ignorance can all result in rule-deviation (ibid.). With this in mind, the first part of this chapter analyzes the extent that rule-following and rule-deviation occurs in PLASTIC with respect to gates, information (and documentation), and stages. A second section then focuses on analyzing a gate meeting in more detail, looking at the decision-situation as defined by the formal rules. As with previous chapters, each of the following sections is guided by a number of key research questions.

7.1 RESEARCH QUESTIONS

Previous chapters investigated the broad framework of the theory of appropriateness and identified a number of conceptual and practical questions. These questions are further analyzed in the following chapter as applied to PLASTIC. In exploring these issues, two broad questions guide our analysis.

(1) The previous chapter suggested that rule application varied among PD activities, with gate reviews in particular being kept formal. Observation, however, was not part of the data gathering technique in the previous chapter, which suggests that discretion might be exercised with respect to rule-following – also in gates – but not detected through, say, interviews. This arises because post-rationalization can sometimes occur among respondents (March 1994). In this chapter, therefore, observation is specifically added as a data-gathering technique in order to answer the question: *to what extent are rules used in the PD activities of PLASTIC?*

(2) According to Weber (1968), rules and regulations offer a rational decision-making process which is based on 'pure' calculation effected through calculable rules. The previous chapter, however, indicated that the identity of the project manager was crucial in explaining whether a rule was evoked or not. Moreover, rule-following between gates was seen to be generally lenient when compared to the actions that the formal rules actually prescribed. As a result, the kind of objective decision-making predicted by the instrumental perspective was seen to be an illusion since information is not produced in the stages. The theory of appropriateness, on the other hand, represents an alternative rationale to 'rule-following', one where identity and the interpretation of a specific situation are regarded as central under ambiguity. Thus, the overarching question may be asked: *how are rules actually used with respect to decision-making (in the gate meeting)?* This can in turn be broken down into further relevant sub-questions:

a. *Does the color-rule system (monitoring time-delay) compete with other rules?* Rule competition becomes conspicuous when actors use rules (March 1994). This aspect is therefore analyzed in two further sub-sections. The first investigates projects that are addressed at the gate meeting (PFMM-meeting in PLASTIC-terminology) according to the rules that prescribe how projects are to be selected when shifting stages. It also looks at the color-rule system, which is designed to monitor delays to the end-date which is approved when the project enters the portfolio. The second section then analyses projects which are addressed according to other rules or problems not so far solved by existing rules.

b. *How is the criterion of manufacturability*[27] *constructed within the gate meeting and can competition among criteria rules be identified?* Here, an analysis of two projects is undertaken with respect to the interpretation and construction of appropriateness of this particular criterion.

[27] Manufacturability is the most common discussed criterion (appendix J: projects no. 47, 30, 23, 28, 8, and 32).

c. *What is the role of calculations under ambiguity?* Calculations constitute yet another calculable rule (within the terminology of instrumental rule-following) and are observed to be raised at gate-meetings. This section examines whether calculations are also subject to interpretation and whether post-facto information gathering can indeed be identified as a form of legitimizing decisions, as was suggested by March and Feldman (1981).

These questions are examined in the following and the chapter is organized accordingly. Thus, the first section analyzes the extent of rule-following that can be observed in the case under review, whereas the second section seeks to examine the gate meeting in view of the four supporting questions set out above. Analysis of the first supporting question in section (a) is, however, further divided in two separate sections. The chapter concludes by providing answers to the two main research questions stated at the outset.

7.2 EXTENT OF RULE USAGE

In the following, the analysis of the extent of rule usage is undertaken with respect to three factors: 1) gates; 2) information (and documentation); and 3) stages.

7.2.1 Gate rules

The formal gate-rules of PLASTIC are described in chapter five (see table 5.4 above) and fall into three rule-areas: agenda, decision and portfolio decision. Whether these rules are followed in all projects is examined by looking at the September PFMM and illustrated in table 7.1 below. From this, it can be seen, for instance, that an analysis of the rule ‘existing projects at major stage gates’ reveals that three projects are not addressed in the gate meeting. This rule is therefore marked with a ‘no’ in the table.

Table 7.1: Summary of the application of gate rules

Gate Rules		**Applied?***
Agenda	Status of current portfolio and its implications	Yes
	Existing projects at major stage gates	No
	New projects at major stage gates	Yes
	Implication of long-range projects	No
	Recommended portfolio implications and alternatives	No
Decision	New portfolio	Yes
	Project managers	No
	Resolve all outstanding legal/HSE/IPR issues	Yes
Portfolio Decision	Prioritize projects to maximize cash flow over time	No
	Decide on optimal mix	No
	Balance resources and define cut-off point between projects for which resources are available and projects for which resources are no longer viable	No
	Quarterly	Yes
	Monthly	No

* Yes or no indicates whether the rule has been applied to all projects

Agenda: In the September PFMM, two out of five normative rules concerning the 'agenda' were used, three rules were not applied. The 'status of the current portfolio-rule' and its implications were discussed in terms of the expected NPV, and the value of the portfolio was generally identified as a concern, particularly by the portfolio manager and the chairman of the meeting. The state-gating rule of 'existing projects at major stage gates' was also used to the extent that all projects which were in the process of moving into new stages were addressed at the meeting – with the exception of projects no. 12, 29, and 67 (see appendix J). As a consequence, the rules were not applied to all projects, but did nevertheless have a substantial influence on which projects were addressed. 'New projects at major Stage Gate' were addressed and formalized, for instance, as all new projects were preliminarily approved prior to entering the portfolio so as to avoid delays. One peculiarity of PLASTIC is that all projects are addressed at the quarterly meetings, thus being detached from progress reporting on individual projects which might require intermediate decisions. As will be discussed below, in one instance a new project was seen to enter the portfolio although it was already in the detailed de-

velopment-stage (stage 4).[28] The 'implications of long-range projects'-rule is not applied, although in some cases the possibility of a spin-off project was discussed. This rule is designed, since the set of rules in the SG approach rules also cover decision-making undertaken by the Technology Council.[29]'Portfolio implications' was addressed as part of the discussion on status, in terms of expected NPV-value, which is a main concern. Alternatives were, however, not discussed since none was actually presented at the meeting. As a consequence, no prioritization was undertaken in this regard during the PFMM. All new projects were approved and the pool of active projects in the portfolio was not questioned, especially regarding their justification or attractiveness compared to other more profitable projects. Decision: The 'new portfolio'-rule was used as it was addressed as a matter of concern and concern by the participants. 'All outstanding legal/HSE/IPR' issues were not resolved during the meetings. For instance, an analysis of the documentation rules indicate that, on average, only 34 percent of the projects have been able to resolve this issue (this will be analyzed further in the forthcoming section). An analysis of the information and documentation in the gate meeting indicates that several projects were formally without a 'project manager' (cf. figure 7.2 below). Portfolio decision: Here, one rule is followed, namely that of the quarterly meetings, whereas none of the other rules – 'prioritize projects to maximize cash-flow over time', 'decide an optimal mix', 'balance resource and define cut-off points', 'monthly meetings' – was used during the gate review meeting being observed (September PFMM).

In the previous chapter, the examination of the organizational level suggested that gates were kept formal. An analysis of PLASTIC, however, reveals that rules are also applied leniently with respect to gates (on the vice president level) with 38 percent of the rules being applied and 62 percent not. In particular, rules governing portfolio decision-making are not used. Sixteen projects (excluding new projects, see appendix J) were at a major SG, although three of them were not addressed (projects no. 12, 29, 67, see appendix J).

[28] According to the normative system (described in chapter five), the project should in fact have entered the portfolio at the concept development stage.
[29] For information on the Technology Council, see chapter five. This decision situation was not observed.

7.2.2 Information (and documentation) rules

In this section, the use of information and documentation rules is investigated. PLASTIC is particularly concerned with the 'quality' of rule-following in the area of information and documentation rules. While rule deviations are monitored, they are nevertheless not sanctioned – as was emphasized by the portfolio managers. Still, what is characterized as Quality Information (QI) is measured for each project and will be made available as from the November meeting, albeit in measures. Figures for the September PFMM were not made available, and could therefore not be employed in this study. The results for rule-deviation that could be obtained are illustrated in figure 7.2 below, where 100 percent indicates that all projects have formally applied all the rules. In the case of PLASTIC, these rules have been broken down into five rule-areas.

The first area, basics, is characterized as information on innovation objectives. On average, rule-deviation in this area is 59 percent, which indicates that definition and responsibility for this area seems to be a low priority for the project managers (see figure 7.2, in particular, no documentation has been made available (URL for further reading).

The second area, innovation database, is concerned with information on the project itself. Here, average rule-deviation is only 11 percent – this is a rule-area that can be followed easily by the project managers. No access was permitted to the database for the purposes of this study, but respondents ensured the investigator that these types of rules took the form of a drop-down menu. Thus 'Technology Platform', for instance, provides a choice between three technologies which are assumed to be the main technologies of the company. Figure 7.2, however, indicates that approximately 60 percent of projects have not been assigned. Instead, a chairman steering committee takes care of day-to-day operations and evaluates the sub-stages (milestones) within the detailed development-stage. Moreover, all projects appear to have uploaded an end date, since rule-deviation is zero percent in this respect.

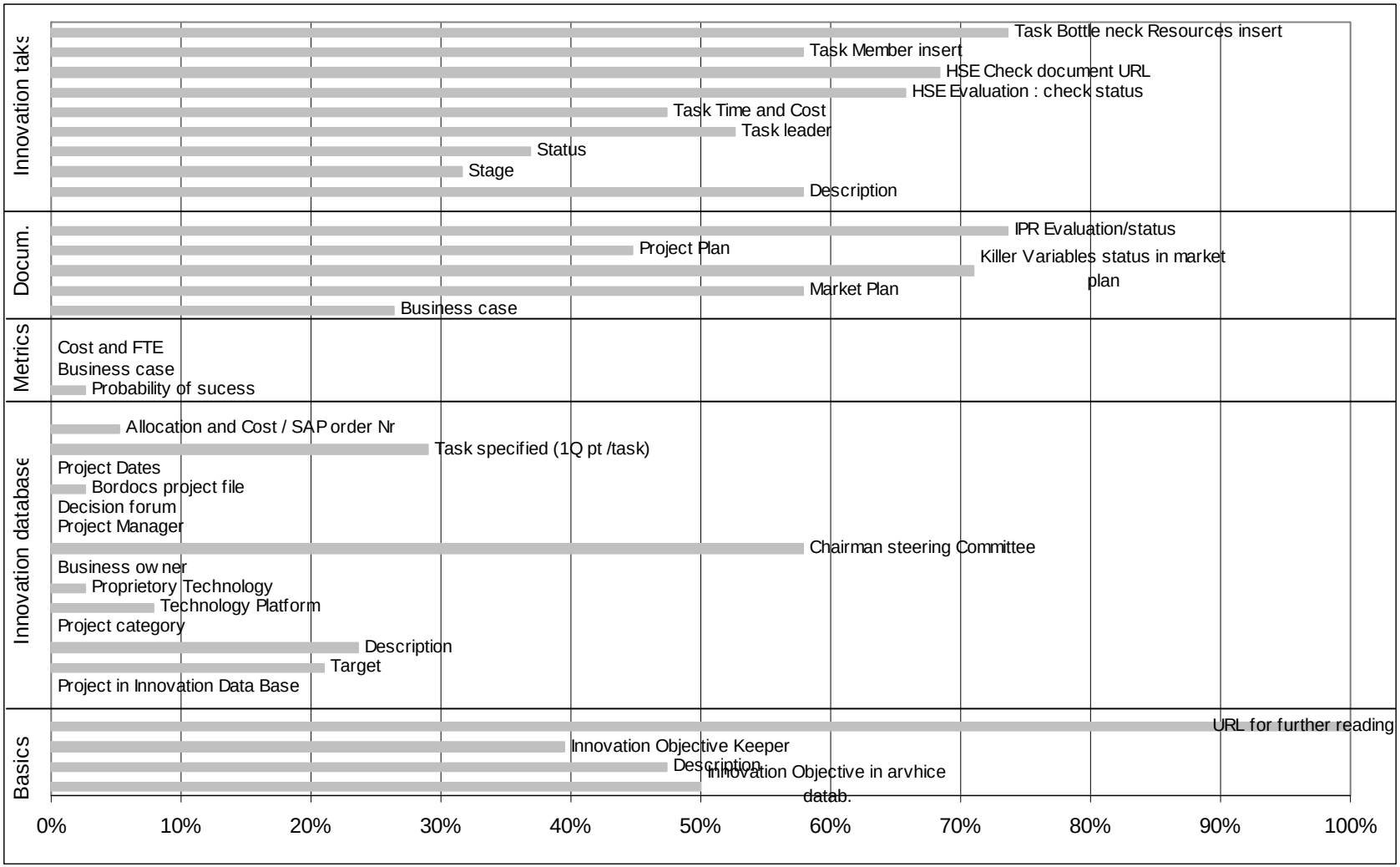
The third area, project assessment metrics, indicates whether the business case has been made (including expected NPV), the probability of success calculated (based on the business case), and whether cost and environmental issues (FTE) have been considered. Again, this appears to have been uploaded since the average rule-deviation is one percent. Of the five areas, this type of rule is most often applied to the project.

The fourth area, project documentation, concerns which project documentation has been entered into the various information systems. The average rule-deviation here is 55 percent, which suggests that the documentation cannot be made available to the vice presidents in the portfolio management meetings (e.g. September PFMM) in more than half the projects. As a consequence, they are not able to examine the figures adequately and validate the expected NPV of each project. Furthermore, portfolio management rules were not mobilized in the gates (except for one, see table 7.1), which related to rule-deviation of documentation rules. In more than half the projects, it is impossible to discuss the project in detail and thus compare them than any other means except metrics, which is nevertheless followed by the project managers.

The fifth area is denoted by PLASTIC as innovation tasks and indicates, amongst other things, that the tasks to be undertaken have been defined for approximately 40 percent of the projects. By contrast, more than 70 percent of the projects have not documented the killer variable, which is to be formulated by the project managers, and more than 70 percent have not dealt with bottle-neck resources. The latter calls attention to the fact that the lack of mobilization in portfolio management rules does not solve resource allocation issues between projects.

Average rule-deviation amounts to 33 percent; consequently, rule-following lies at 67 percent. These figures correspond to the situation described by gate rule application (see section 7.1.1). How easy it is to follow a rule, however, largely depends on when rules are actually used. Apparently, it is possible in the case under review for a project manager to suggest that the business case has been made without uploading the market plan, which is ideally part of the calculation in the business case. Moreover, rule-deviation varies among the business units, which could suggest that leadership styles influence rule-following, as was pointed out by the new portfolio manager when asked about this kind of variation.

Figure 7.2: Rule-deviation, information and documentation rules. Grey area indicates rule-deviation (source: PLASTIC).



The QI-level for projects nos. 22, 23, 24, and 47 (green projects) and nos. 4, 9, 33, 36 (red projects) are shown in appendix I (see also appendix J). In project 4, rules are applied 58 percent of the time, but none of the documentation rules has been followed. The project is instead tested with a strategic customer and then taken forward. As can be seen from appendix J, the duration of discussion on this amounted to a mere 30 seconds. Rules are applied 63 percent of the time in project 9. Here, discussions centered on the evolution of how the project could be applied to a market, yet, as the data in appendix J suggests, the market plan has nevertheless not been documented, including killing variables. The same situation can be identified with projects 33 and 36, where market plans and killer variables have also not been documented. In addition, environmental rules have not been followed in the red projects. The average rule-following ration for red projects amounts to approximately 70 percent and 93 percent for green projects. Projects 22 and 24 were deemed inappropriate for discussion at the September PFMM (these will be discussed below). However, while the vice president, who 'owns' projects no. 22 and 24, attempted to comply with portfolio management rules, and despite the fact that there was a high degree of information and documentation rule-following in this case, he was not able to initiate a discussion on these projects. Project 23 was in stage gate (appendix J), but the issue of manufacturability was raised in the discussion which rather instigated an argument on economic viability (more specifically, lower production costs). This highlights the point made earlier, that even though the project complied with (almost) all information and documentation rules, the economic benefits and criteria of manufacturability still proved a point of debate among the vice presidents at the gate meeting. The same line of reasoning applies to project 47. On average, 33 percent of rules are deviated from, which consequently means that in 67 percent of cases are the information and documentation rules followed. Rules were deviated from to the greatest extent in project documentation and innovation tasks, particularly in red projects. Here, rule-deviation was most dominant, suggesting that it was inappropriate to upload inconclusive documentation for the use of participants at the September PFMM.

Projects 22 and 24, which displayed almost total rule-following, were nevertheless not discussed despite their high level of rule-compliance. This was most likely due to the fact that they were concern with deviation than rule-following at the vice president-level. A

template has been designed for the vice president to be used when presenting a project, which indicates that his participation in decision-making does not, however, rely on the information and documentation which is made available through the databases. (This template is reproduced in appendix E.)

Respondents at the vice president-level suggested that they were not using the information available to them through the database, as was also substantiated through observation of the September PFMM. This has implications for management, particularly the project managers, as can be seen from the following dialogue between the investigator and a vice president of a business unit:

> Vice president: "[…] really going [into] the details? [speals very low] This we didn't do at all"
>
> Investigator: "What do you think about the information available?"
>
> Vice president: "I have the feeling that [the archive database] is very well documented but, to be honest, I don't use it frequently. The information is available [but] it is not used"
>
> Investigator: "Because?"
>
> Vice president "I don't know why [not] – maybe it is a question of time, maybe it's a question of going into the system, maybe it's not such a convenient system, and these kind of things – but it's available. Information on innovation is available in PLASTIC; summarized in [the archival database] we can find it, no problem. The question is what [21.30] and draw your conclusions out of it, before you go into the meeting"
>
> Investigator: "If you don't use [it] that much – maybe the people that you work with, will not use it that much [either]?"
>
> Vice president: "Exactly – project managers enter information into [the archival database], but more out of duty than as to use it as a tool".

The impression made by some project mangers is that the information is there to be used to discuss a project at the gate review meeting. The two time-lines between the gate review meeting and the project progress meeting, however, tended to create problems, as was mentioned by several project managers who argued, for instance, that a test-run or pilot cam-

paign had not, in some cases, been finalized prior to the meeting. The project managers also stated this as a reason why these should be involved personally in the gate review meeting, where they would prefer to present and be present during discussion of 'their' project.

Documentation is ideally updated prior to a gate review meeting or a meeting of the steering council (at project management level) between sub-stages and, as a consequence, the most recent information is invariably not available in the archival database at *any* point in time. Moreover, as costs are reported monthly and a project manager recommends that decisions are based on the slide that vice presidents fill out prior to the meeting (appendix E), this information is necessarily not gleaned from the available databases. Furthermore, while the databases (including the innovation database) were developed to facilitate information flow between members of the project team, who are geographically spread across Europe and the Persian Gulf, the information is very often based on what is provided by the persons who are participating in a meeting. Thus, if marketing is not participating in the meetings for any reason, information on a possible change in customer preferences will not be communicated in a timely manner. As one participant confirms: "… you normally don't get the information very fast … if the right people are not present, then it's a problem" (project manager).

In conclusion, one part of a project manager's identity is established through the realization of information and documentation rules, and consequently the actions that are generated through following these rules. However, with *some* project managers this was carried out as a 'duty' rather than through a sense of commitment, particularly since some project managers were unaware of decisions that had been made on the basis of the databases in the gate meeting. Owing to this lack of decision-making in order to establish priorities between projects, the resource problem tended to be pushed downwards to the project management level and even other levels. For example, the manager of the test plan had to set prioritization without any criteria for doing so, or even in some cases according to the dictates of the project manager who 'shouted the loudest'. New rules have, however, been added to solve these problems in the test plant. Nevertheless, no respondent was able to explain these rules when prompted, due to their high complexity and a lack of competence in using them.

7.2.3 Stage rules

A similar analysis is undertaken with respect to the usage of stage rules. The design of the SG approach of PLASTIC consists of six stages (see figure 5.1, chapter five). Each stage is analyzed with respect to the extent of rule-following as with gates and information rules. Stage 1 and 2 represent the pre-portfolio activities that are required to be carried out, whereas stages 3 to 6 are undertaken within the portfolio itself.

Table 7.2: Summarizing the application of stage rules

Stage	Formal rules	Applied?*
Stage 1	Communicate innovation objectives	No
	Assign ideas to innovation objectives – enhance, enrich and structure ideas	No
	Separate potential activities vs. potential projects	No
	Communicate outcome of idea evaluation to all involved	No
Stage 2	Conduct initial proof of concept and get sign-off from a senior scientist	Yes
	Prepare business case, assess strategic fit, competitive advantage and risks	No
	Develop project plan, identify critical path	No
	Identify killer variables	No
	Decide which opportunities to forward to portfolio decision or to discontinue	Yes
	Identify critical resources and check availability	No
Stage 3	Test and prove technical feasibility on bench and pilot scale	Yes
	Identify upscale-plant, determine recipe and process conditions	Yes
	Adapt market and competitive assessment – use pilot material for tests with customers as appropriate	No
	Obtain sign-off from manufacturing for upscale	No
Stage 4	Scale up to commercial plant	Yes
	Test and approve material/process with key customer; start pre-marketing activities	Yes
	Resolve all outstanding legal/HSE/IPR issues	No
	Obtain sign off from commercial and plant manager for launch	Yes
Stage 5	Provide technical support with new grades to customers	Yes
	Execute launch according to plan	Yes
	Hand over to line organization	Yes
Stage 6	Conduct review session with portfolio decision meeting	No
	Project managers write final report and present project key learning's to decision forum	No
	Decision makers review decisions made over course of the project	No
	Root cause analysis for project success/failure	No

* Yes or no indicates whether the rule has been applied to all projects

The first rule to be followed in stage 1 is the communication of innovation objectives. Approximately one year after the formal start of the new set of rules, the HRM-organization in R&D undertook a road-show to market the new IP (new set of rules) and the innovation databases and, in particular, the innovation objectives to be described through these databases. Access to the databases has been limited, but observation of one of these road-show sessions at the company headquarters suggested that some innovation objectives had been made available in the innovation database. That being said, it seems to be that the organization has not taken any notice of its own objectives, which were ideally designed to guide the generation of new ideas. When quizzed about this, one respondent replied: “No not really, because the system [addressing the front end] is not really working as it should” (portfolio manager).

The innovation objectives were criticized by one respondent for being too detailed, and also as constituting more a project proposal rather than a vision for creativity. Generally, idea evaluation and discussion are an informal process where the idea-owner tests the idea through discussion with colleagues and subsequently registers it in an idea bank should it not meet approval amongst the pool of colleagues. Presumably, in acknowledgement of the general character of deposited ideas, the idea bank does not appear to play a significant role in PLASTIC despite the fact that the management put emphasis on the utility of this tool in the first stage of the innovation process. It can therefore not be characterized as being properly communicated and motivated. Examining the information rules suggests that innovation objectives was one of the rules that was not followed by the red projects. One project manager, for example, stated that the responsibility for formulating innovation objectives for ongoing projects also remained unclear. In this case, he had to approach the portfolio manager for help in re-formulating the innovation objective of his project, which was formulated so broadly that it could apply to almost any of the projects in the business unit. When combined with the extent of rule usage in information and documentation rules, the general impression arises that the project objective is often formulated subsequent to the initiation of the project. As one respondent stated:

> Yes. It has been carried out, but also that is something that is – I mean, it is not yet as clear for people as it should be, because many of the projects that we had earlier are now being continued in the new [way], so it was not done. Actually it should have been done, also to those [projects], but it was done in a very – let us say – [cursory] way, because the project was already there (project manager).

The argument that rule deviation is more frequent amongst old[30] projects was also put forward by the new portfolio manager and explicitly stated in the formal report of the September PFMM. That being said, while a new project – project 74 – which was discussed in September had demonstrated a degree of rule-following that amounted to 59 percent, widespread rule-deviation particularly with regard to documentation rules, including market plan, could also be identified amongst new projects as well as those that already existed. The separation of 'potential activities' and 'potential projects' is supposed to be an formal activity, and one business unit thus felt justified in copying the portfolio rules and applying them to formal decision-meeting in this respect, as the following exchange demonstrates:

> Investigator: "And this also takes place on the business unit level … "
>
> Vice president: "Yes, yes, yes. The information – no, the innovation process – is this general innovation project meeting across [PLASTIC]. But this is only what we call in category one. For category two, three and four we have our own business unit project meetings".
>
> Investigator: "And do you also work in these meetings with, say, criteria?"
>
> Vice president: "Yeah, yeah. For idea generation we use the same template as for the overall innovation process. And for new product development and for activities we have a very simple template, designed by ourselves, of one- and-a-half pages where we really describe the project and what the NPV or additional operating profit is, and so on. So we have simplified this to really one–and-a-half pages, because there shouldn't be too much bureaucracy".

Idea evaluation takes place informally between colleagues and since only one business unit has formalized its evaluation of ideas – and copied a simplified version of the innovation process to the business unit – it can be assumed that the rule of communicating the outcome

[30] In progress prior to January 1, 2003.

of idea evaluation to all those involved is not followed in the majority of business units (including R&D). Instead, this is done through informal networks. Generally, the business unit vice president and project managers are uncertain about the rules of stage 1 and not all formal rules are followed with all projects. The level of elaborateness and exhaustiveness is low in terms of how to solve the demand for, say, "assigning ideas to innovation objectives – enhance, enrich and structured ideas". This in turn has consequently produced new rules to be marshaled as a simplified copy of the innovation rules on the process-level within one business unit. The respondents did not mention 'the level of ideas' as a problem, but it is rather their administration that appears to be linked to why rules are not followed. Responsibility is placed outside, or even prior, to the portfolio and is not a formal and centralized activity, as the portfolio activities themselves. This suggests that the rules do not impede the production of new ideas (creativity) but rather the *administration* of ideas, which in turn only serves to push a limited number of new projects into the portfolio. One respondent thus requested tools for selecting ideas.

The analysis of the information and documentation rules in stage 2 demonstrate that the rule to 'prepare the business case, assess strategic fit, competitive advantage and risks' is not followed in all projects. While the project managers reported that they had made a business plan (metrics, figure 7.1), only approximately 27 percent of the projects have uploaded the required documentation. One project manager reported that it was impossible to make a business plan for his project and that he consequently wasted two months. He went on to state his regret in not having approached an experienced project manager earlier, so as not to waste his time. Had he done so, he would have learned which rules applied to his particular project.

71 percent of the projects do not have a killer variable (see figure 7.2). In the same way, 45 percent of the projects have not documented the project plan even though all projects have registered the end date (see figure 7.2). Business units are responsible for forwarding new projects and the data suggests that they, together with the R&D department, are at least attempting to fulfill this activity, even though several respondents mentioned the need for further tools to select, for example, which ideas they should pursue and which not. In sum, the evidence suggests that this rule is followed. The analysis of gate rule application also

identified that the availability of resources is a problem (see section 7.2.1), particularly since the number of projects has not been reduced and no prioritization has been undertaken. Nevertheless, the high number of small projects reduced in line with the normative system, which is emphasized by figure 7.2. The rule of ”identify critical resources and check availability” is not followed since resources are strained beyond what is required to undertake the projects (according to project managers).

The first rule in stage 3 is to ”test and prove technical feasibility on bench and pilot scale”. While being used, the evidence on gate rule application with regard to this rule indicates that it requires interpretation. No evidence suggests that the rule to ”identify upscale-plant, determine recipe and process conditions” is not followed. The ”adapt market and competitive assessment – use pilot material for tests with customers as appropriate” rule is attempted to be followed by project managers, but the evidence suggest that a market and competitive assessment has not been undertaken with all projects. ”Obtain sign-off from manufacturing for upscale” seems to be followed.

The ”up-scaling to commercial plant” is the first rule of stage 4, and is invariably followed if the project has not been killed by the responsible vice president. The rule to ”resolve all outstanding legal/HSE/IPR issues” is, however, not followed as can be seen in figure 7.1, where approximately 65 percent of the projects have not provided an evaluation of a HSE-check. That the rule to ”obtain sign-off from commercial and plant manager for launch” is not followed in all projects is indicated by the discussion on the gate rule application.

The rules of stage 5 are all followed in the projects, including the rules to ”provide technical support with new grades to customers”, ”execute launch according to plan”, and ”hand over to line organization”. The most widespread instance of rule-deviation is found in stage 6, where none of the rules is followed in any of the projects (see table 7.2).

The analysis of rule-following in stages is summarized in table 7.2 (above). As can be seen, in aggregate 53 percent of the rules are followed, while 47 per cent are broken when applied to all projects. Rule-deviation is most frequent in stage 6, which suggests that the ideal case of learning to be part of the normative system – also amongst decision-makers – is not effected in all projects. Some meetings are carried out post-launch, when the project

is discussed, but no evidence suggests that any of the meetings focused on decisions that were otherwise required by the rule.

The stages prior to the portfolio (pre-development) are the responsibility of the business units and R&D, but the date indicates that there were several deviations from the rules in the first two stages. Here, 20 percent of the rules were followed, while 80 percent of the rules were deviated from in application. Evidence suggests that there is a link between problems and rules (March et al. 2001) and that rule-deviation can consequently be associated with the problems caused by not formalizing ideas which already obtain in the organization, since creativity or the level of new ideas does not appear to be a problem in PLASTIC.

Of the seven new projects that were formally to be approved in the September PFMM, all seven were accepted (also preliminary projects). However, no alternatives were discussed, which was probably due to the inappropriateness of doing so, but also perhaps because of resource issues. The business unit and R&D are responsible for resources in practice. Since no resource-decisions were made at the meeting and since presenting more projects would have assumed resource-competition with other business units or R&D, rule-deviation resulting from not mobilizing portfolio decisions in the gate reviews led to the problem of having too many projects with too few resources. This in turn impeded the introduction of additional new projects: As one vice president protested:

> … project with 0.1 and 0.001 people. It's a waste of time. Because you can't do a project, you cannot create a step change by adding 0.01 of a person

A possible explanation for this can be identified by reference to not following the rules. This suggests that rules which are not used produce problems elsewhere in the rule-system through interconnectivity. Other reasons can also be identified. First, the desire to finalize projects within the calendar year is a conspicuous trait of human identity, such that the last quarters before year end usually see a dearth of new projects as attention is rather devoted to finishing existing projects. As one respondent confirms: "[it is] very important that 83 percent of the project ends before 2004" (vice president). Second, the resource problems raised by the large number of project managers allows for no concession for additional ac-

tivities, which are otherwise normally allocated upto 20 percent of the resources. Again, the upshot of this is that problems are not solved by rules at the vice president level within the system, which subsequently causes problems elsewhere in the rule-system. Rules can therefore be seen to be highly interconnected in PD. Or as one project manager reasons; "because nowadays it is still very much a point of debate between various parties as to how priorities are defined and [debating] what is this and what is that" .

7.2.4 Conclusion

The extent of rule-following among the three elements of the SG approach is summarized in table 7.3 below. The numbers (in percentage form) express the extent to which the formal rules have been applied to *all* innovation projects of PLASTIC.

Table 7.3: The extent of rules application (source: Tables 7.1-7.2 and figure 7.2)

	Gate rules	**Information and documentation rules**	**Stage rules**[1]
Extent of application[3]	**38 %**	**67%**	**40%**[2]

[1]Stages: pre-portfolio:20% (Y=2, No=8) and portfolio: 53% (Y=8 and No=7)
[2]Y=10 and N=15 $\Rightarrow$ 10/25 x 100 = 40%
[3]Measured as percentage of rules followed with all projects

Twenty percent of the rules are followed at the pre-portfolio stage whereas 53 percent of the rules are followed within the portfolio. The differences can be explained by the level of responsibility (more prevalent in the portfolio), the lack of rewards or threats to using the rules prior to the portfolio, lack of clarity in the rules (too complex to use), and the fact that the design of the rules is often not elaborate enough for them to be realized. One instance of this can be illustrated at idea selection, which was identified by one manager as being too complex a task if it lacked any specific criteria or an explicit strategy.

While gate rules are applied to the lowest extent in the table, evidence nevertheless suggests that rules did indeed influence the gate meeting by directing attention to project delays and to shifts in project stages (with the exception of three projects)[31]. Information and documentation rules represent the highest proportion of application, but these rules are usually only followed as a matter of 'duty', at least by some project managers, whereas other project managers were keen with 'boxes' and therefore motivated to follow these rules. As can be seen from the table, the extent of rule-following in stages is 40 percent. However, to qualify this, it must be borne in mind that the extent of rule-following was higher in the portfolio stage than in the pre-portfolio phase, due to vagueness of responsibilities and lack of competence in following the rules.

The analysis on the organizational level (as set out in chapter six) also showed that rules in stages were normally not followed, which has thus been confirmed through the above evaluation of 40 percent. Thus, information and documentation is not available for decision-making through the databases. The portfolio manager has designed a template (appendix E) to be used by the vice president. Moreover, project managers are uncertain when to upload revised information or documentation, which impedes the portfolio perspective and the comparison of projects. Thus, the importance of rules in gates comes into sharper focus, and particularly with regard to how the vice presidents can make decisions when information is not available.

7.3 HOW RULES ARE USED IN THE GATE MEETING

The analysis in the previous sections has disclosed that, when subscribing to the theory of appropriateness, rules were not followed for a number of reasons. Surprisingly, rule-deviation was most frequent in the gate meeting, which is normally regarded as an area

[31] The vice presidents were aware of the resource problem and a new set of rules governing resource allocation was launched at the beginning of 2004. However, no respondents were able to explain the content of these rules (which were often described as 'complex'). Neither has any training been provided. These rules resulted in a discussion at the March PFMM (not observed) where two new projects which were due to enter the portfolio were apparently stopped.

where rule-following is highly formal (see chapter six). Moreover, the analyses indicated that competence, vagueness of rules, and rules to support, say, idea selection would have enabled rule-following among business units and R&D prior to the portfolio. The pre-portfolio activities (stage 1 and 2) produced seven new projects, which were all pre-approved and subsequently approved at the gate meeting. No prioritization was undertaken. Rule-deviation was also present in the gate meeting, which focused on the projects in the portfolio only. More analysis is, however, required on this issue in order to fully understand how appropriateness is actually constructed at the gate meeting and, subsequently, how rules are actually used.

Here, an analysis of appropriateness at the gate meeting is undertaken in four stages by 1) examining the projects addressed in accordance with the evoked rules (color-rule system and stage gating rule); 2) investigating projects not addressed in accordance with these rules; 3) analyzing the interpretation of the criterion of manufacturability, which is the most common identified criteria or calculable rules; and 4) investigating the role of calculations in a decision-making situation. Finally, the use of rules is discussed with respect to seeking greater understanding of decision-making under conditions of ambiguity and the role of rules in gates.

7.3.1 Projects addressed in accordance with color and SG rule

In the September 2003-portfolio, there were 62 projects with a total portfolio value of approximately €¼ billion, but only 33 of these were subject to discussion (see appendix J, column B). The projects discussed were addressed according to two rule-systems that were in use. First, the *color-rule system* categorized projects into three colors: red (more than two months delay), yellow (less than two months delay) and green (not delayed) in accordance with the expected delay of the project. The evaluation was undertaken by the vice president and portfolio manager. An additional color, white, has also been added to address new projects that are just coming into the portfolio. Second, projects that are stage gating (i.e. moving to the next stage) were to be addressed at the gate review meeting according to the formal rule of ”existing projects at major stage gates” (see table 5.4) but were also to be evaluated as green if not delayed. March et al. (2001) and March (1994) suggested that am-

biguity can produce rule-competition, so investigating possible evidence of this will also form part of the analysis.

The stage gating-rule directs attention to projects which are moving into the next stage. Stage gating projects have been evaluated in terms of their capacity to fulfill certain criteria which thereby deem them ready for the next stage by the portfolio manager and the vice president. The projects discussed in stage gate were nos. 2, 3, 47, 31, 30, 27, 23, and 70 (see appendix J for details and an overview). Three stage gating projects were concerned with manufacturability, one project with sales, and four projects (no. 2, 3, 27, and 31) were not discussed when compared with the distinct formal criterion for doing so (see appendix J, column L). Column L, appendix J, indicates whether a complete criteria-list was tendered as a definite argument during the September PFMM, and only in three cases (no. 30, 27, and 70) was an argument made for complete compliance. Three stage gating projects were, however, not addressed (nos. 12, 29,[32] and 67, see appendix J), primarily because these projects were owned by a business unit that did not have any red projects to be discussed and, as a result, did not attract any attention. This suggests that the color-rule system has more of an influence on the gate review than the stage gating rules, which consequently compete with one another. Subsequent to the formal implementation of the new rules from January 2003 onwards, the color-rule system was devised in response to problems caused through project delays, which the portfolio manager did not perceive to be solved by the introduction of new rules in PLASTIC. Evidence gathered from the September PFMM suggests that the meaning of the rule-color system has achieved an attention-directing functionality (Simons 1954) in terms of foregrounding the question: “[w]hat problems should I look into?” (1954: 3). Attention direction by rules was identified by March et al. (2001) when analyzing Stanford University and its relationship with the political environment. Applying this to PLASTIC achieved the functionality of directing attention to projects which were labeled both red and yellow: 11 projects were labeled red, nos. 4, 8, 9, 28, 33, 36, 37, 38, 40, 42, 43, and 46 (see Appendix J) and two projects were labeled yellow, nos. 29 and 32 (see Appendix J). The formal rule requiring a ”status of the current portfolio” (see table

[32] This project is yellow, but was not delayed. The project was, however, to be finalized (out of the portfolio), which indicates that the color was assigned by mistake or that, as expressed by the chairman: “a two month delay is ‘okay’ and therefore did not initiate a discussion of this project although it was in stage gate.

7.2) has been interpreted by the general manager, asset and portfolio manager of PLASTIC to start with the deviating projects and subsequently address stage gating projects.

Project no. 4 was delayed by three months due to delays in customer testing. The expected NPV was €2.8 million. The formal report stated however that the: "[P]roject will be stopped if no results have been forthcoming by the end of March". The criteria were not discussed because the customer is a global and industry leading company (important customer), thus making the project 'strategic'. Project no. 8 was stopped before the meeting by the responsible vice president, due to ambiguity. As he stated, the technical solutions were not possible and, consequently: "… we have to take back the theory of founding". Subsequently, the chairman stated his interests: "So it is stopped. We take it out – *what about the NPV?*" (emphasis added).

It must however be assumed that the chairman as such was aware of the consequences of stopping the project for the expected NPV (estimated at €5.3 million), but that the question in itself was raised indicates that the NPV is loosely coupled with the project, as is also indicated by the formal report where the comment was made: "Reformulate project and bring up for approval. Project description and resource input need improvement".

This statement and the question regarding the NPV could be interpreted as seeking to encourage the vice president to produce a new project and thus 'secure' value in the vice president's pool (ratio) of the portfolio, rather than accelerate other projects in the portfolio or initiate new ones, from other business units too. (The value was, however, removed from the business unit's active portfolio in the formal report from the September PFMM.) Project no. 9 was delayed by 36 months, also due to ambiguity. The discussion concerned whether the scope of the project had been changed or whether it needed another application in terms of 'customer market'. The formal report states the need to: "Adapt project plan to meet new end date", and the project was approved for continuation under these conditions. Project no. 28 was labeled yellow although the project was not delayed. Another new rule of only addressing projects above €2 million is also an example of a rule which was made to deal with the issue of time-to-market. The rule of €2 million was only activated during the discussion of project no. 28, which was labeled red due to a 12 month delay and was as

such also subject to the criteria of manufacturability (see section 1): As the following exchange shows:

1. Vice president: "If we take the red one, what is happening there is that there is a grain, which has been developed for both … so this for both … so this is for […], and there are two constructions of [technical explanation]. And this [… 44.28] is not working well enough. So, what we have here is, that we a patent which we are acquiring from […]; one of our customers who have different technologies [44.44] which works and what we have to is, that we have to go back to development in using this patent technology. I think one thing here is that actually, if you look at expected NPV it does not qualify for the portfolio, so the question is should the decision be basically to take it out formally to take it out of the portfolio? I do not know what you are …"

2. Unidentified participant: "That is our recommendation as well".

3. Vice president: "And it will be managed as a task … because of the resources that will be spent on it, because we are basically buying a technology which is already available".

The €2 million was only resorted to as an argument for terminating the project in the portfolio stage. The project had, however, already been terminated without prior formal approval, but the comment by the unidentified participant in section 2 indicates that some discussion must have taken place on this prior to the formal meeting, since the unidentified participant would have otherwise not used this formulation. The fact that the project had already been terminated when it was and that other activities had already been initiated by the acquisition of a patent, indicates that the meaning of the approval rule in some situations is interpreted only as a means of legitimizing issues which have already been decided. This amounts to making formal decisions merely symbolic, creating an arena for demonstrating the ability to cope with ambiguity as well as the inappropriateness of waiting to make such decisions in real terms in a formal decision-making forum. Project 32 was also labeled yellow even though no delay was specified. The project was deemed not technically feasible and the responsible vice president recommended terminating it. While the chairman did not take any formal stance, the meeting report showed that it had been removed from the portfolio. Project 33 was delayed but generated some confusion as to whether the

formal end-date had already been changed and approved prior to the meeting. This episode highlights the significance of the color-rule system for encompassing end-date changes (whereby in this case the project was no longer considered red) prior to the meeting, even though this will affect the optimum portfolio, according to the formal portfolio decision-making rules, from being the ideal focus of the PFMM. Project 36 was labeled red due to an eight-month delay. The scope of the project was changed by the responsible vice president even though the chairman did not agree with this move. In this case, the portfolio manager made the criticism that the project had been changed without any formal approval by suggesting that the project would remain red until it was finished. In this way, the color system was consequently linked what is termed the 'scope' of the project and not solely to a delay in the progress of the individual project. The chairman underlined the remarks of the portfolio manager and his comments immediately after the vice president substantiate that the delay of eight months is "okay", even with "a couple of months or so" in delay. On the question of why the project could not be pushed, it was said: "We have to drive those guys a bit harder then … [we need more] customer focus. Focus on the speed of this" (Chairman).

Subsequently, the other participants raised a general issue regarding additives in the development process. Because the properties of additives are uncertain, it was argued:

> …normally you don't know what concept is the best one. I mean some companies are claiming that they have additives, but they do not know how they will work" (unidentified participant) followed by another unidentified participant: "We test the additives to find out [1.12.04] whether this can really give us complete advantage over the competition".

In this way, the vice president was assisted by the other vice presidents in raising the problematization of additives to a general level. This in turn generates (unforeseen) complexity and was linked to the very competitiveness of the company. In response to this support, the vice president admitted that:

> It was maybe more because of optimistic planning than a real delay; because of a lack of resources or something.

An unidentified participant pointed out:

> We really do not know what is going on and it seems to be very important for us [the participant went on to suggest involving research in the work, in order to speed it up].

The chairman was nevertheless focused more on time and thus emphasized: "… good advice to speed it up". However, a simultaneous discussion was then initiated which made it impossible to identify. The portfolio manager then asked:

> What is the decision on this one? Delay as it is [… 1.13.31] or change the scope and we accept it?

To which the chairman responded:

> We have a delay like this because I do not see anything about scope [1.13.51]

The chairman's comments were followed by an unusually long break in proceedings (of approximately 10 seconds), which suggests disagreement or even surprise at the chairman's conclusions. Project 38 was labeled red because of a nine-month delay. The discussion of this project revolved around what stage the project was actually is at. The formal system indicated detailed development, as was pointed out by the portfolio manager, but the discussion showed that the project was close for launch. Initially, the portfolio manager stated:

> Stage-gate approval from concept development to detailed development
>
> To which the chairman responded:
>
> I know all this but I am just confused about detailed development; we are stage-gating here about detailed development which has to be [0.00.53] done before it comes to the plant?
>
> The chief scientist concurred by saying:
>
> I am confused about that as well.

The following discussion does, however, suggest that the project was already in detailed development and thus ready to go into launch. According to one unidentified participant:

> In reality, is it close for launch then?
>
> To which the VP BU responded:
>
> … we found out that we made a very good product also for other kinds of structural [03.29] our proposal is to finalize the project not to continue it.

The project had an expected NPV of €0.6 million, but the rule of an expected NPV above €2 million was not brought into effect because the project is connected to the building of a new plant. By way of justifying this, the chairman stated: "This is a little bit special […] the plant and everything."

The project was already in the process of going through the launch phase, and therefore formally closed in the portfolio as it had moved to line management:

> "And the answer is to close it now?" (Chairman), "Yes" (vice president), "And you have received all the documents and things like that?" (Chairman), "To be honest, I do not remember. I will check" (the responsible vice president), "It is approved but you have to check if there is something missing, we will come back [05.08] very good" (Chairman).

As is clear from this exchange, the vice president was not sanctioned but rather encouraged to proceed because the project was actually not delayed, despite its formal registration as in detailed development. It had rather moved into launch phase (which was, however, not reported). Project 40 was delayed by seven months. When discussing this, the participants seem to have had different channels of communication on this issue since the discussion revolved around the content of the project and whether the project was successful. One participant merely stated "there is a small part left and that could be an important one". This latter was in connection to a discussion on deviation from the project's original aim and whether an expected NPV of €7.5 million could be sustained despite ambiguity influencing the project. The project was red before (in the previous meeting) and was not terminated due to an expected high NPV-value. Unidentified participants suggested that a separate

meeting on this project be held before the next PFMM-meeting (in November), but the vice president maintained his position confirming the decision already made by the vice president to terminate the project in the portfolio. The vice president was supported by the portfolio manager, who had apparently already been communicating with the vice president about the project before the meeting. The project was therefore approved with the comment (from the chairman) that the portfolio manager needed to receive the final report on the project despite the fact that the chairman was convinced that the project should be terminated. Project 42 is explained by the responsible vice president:

> … a few years ago we upgraded our … product lane … but unfortunately then we recommended it to commercial production when … there was a major amount of fall out … so we had to start anew … we have produced over a period of twice a month ….we have already been able to eliminate the fall out. Only last week, we had the final test run results from a customer and our final report is therefore not ready yet […] we know it is okay now so we can move.

Due to uncertainties in the technical solutions, the project has been delayed, but the project will be approved for finalization when the final report is received. Project 43 was terminated prior to the meeting:

> Vice President: we do not want to pursue that further. It has been terminated
>
> But formally the chairman stated: But perhaps we sent in to present to stop […] decide to [portfolio manager] and he will decide to stop if anybody agree?"

The value was deducted from the business unit's portfolio in the formal report. Project 46 was delayed by 12 months. The discussion focused on whether the project should in fact be split in two or whether one part of the project should be continued and a new project formulated from a business-oriented perspective rather than the existing technical (in asset) outlook. It was decided to terminate the project (and thereby both parts) and transfer ownership to another business unit. It was further decided to delegate the work to the business unit with the idea of reformulating a new project, which was more business oriented. The reason given for not entirely dropping the project was that work so far had demonstrated

some possibilities for process improvement, which could be exploited to product development. Based on the analyses of the projects above, a number of observations can therefore be drawn:

a) All formally delayed projects were designated red according to the color-rule system, which suggests that this type of rule tends to solve the problem of detecting delayed projects.

b) The decision to halt a project is primarily based on the decisions of the vice presidents themselves and not on any other participants to the meeting. For example, projects 8 and 43 were halted prior to the meeting by the respective vice president, whereas the discussion of project 46 showed that although the project had been halted by the chairman the novelty of this raised an unfamiliar pause in the discussion. The formal rule of securing an 'optimal portfolio' requires projects to be killed or frozen, as suggested by the normative system (in chapter two) but was never put into effect.

c) Ambiguity tends to influence the progress of projects but was detected only because it caused delays. Unforeseen technical difficulties were perceived to be a legitimate reason for delays, since the projects were not sanctioned when delayed.

d) Project 33 was labeled red, which caused some confusion because the delay had been agreed with the portfolio manager prior to the meeting, while other participants remained unaware of this prior arrangement. This suggests that the scope of the color-rule system has been widened not only to encompass delays, but also to legitimize prior end-date decisions to the PFMM, albeit with the exception of projects with a high expected NPV (e.g. projects 40 at €7.5 million), Although the expected NPV of project 8 was €5.3 million, no rules prohibit a change of end date without approval.

e) The formal stage of a project is not necessarily the same as the stage shown in the databases, as was indicated in the discussion of project 38. In addition, it is not sanctioned to skip stages. It is instead encouraged because of the intention to keep projects within the end-date. This suggests that in practice, the concern is rather to integrate or skip stages than uphold the SG structure of dividing the PD process at all costs.

f) There is much concern with the value of the project. Projects that were killed were all encouraged to be re-approved after being reformulated, which implies that a project can in fact never be killed. A point which is underlined by the fact that project 40 was designated red over the period of two gate meetings (half a year).

g) It should be noted that it is difficult for the participants of the meeting to identify exactly when a decision has been made, particularly when there was some debate amongst the participants or even disagreement. Only in cases where the chairman explicitly articulated a decision, did it become distinctly identifiable to the participants. Otherwise, the device by which participants were able to recall and identify whether a decision was made, particularly if it did not concern their own projects, was through the formal report. This was substantiated in subsequent post-meeting interviews.

In conclusion, color- and stage gating rules determine which projects are to be addressed, but suffer from being inherently competitive. As a result of this, three projects were not addressed (nos. 12, 29, and 67, see appendix J). Here, attention was not directed towards the business units that were managing these projects as none of their projects had any delays. The color-rule system was not part of the initial rule-design of the SG approach, formally implemented in January 2003, but has nevertheless gained growing attention as it has become the most appropriate rule to use. In 62 percent of the cases, gate rules were not followed in all projects, and rules relating to portfolio management especially tended not to be put into action (see table 7.1 and 7.3).

7.3.2 Projects not addressed through color and SG rules

The previous section examined projects which were discussed at the September PFMM according to the application of the stage gating-rule and the color-rule system. Another question, however, arises as to whether these projects can also be addressed according to some other rules or whether problems are not in fact solved by these rules at all.

Such projects include nos. 62, 50, 22, and 24. Project no. 62 was addressed at the meeting because of a change in ownership of business units. This problem was not covered by the formal innovation rules, which may imply that if a problem is not covered, it will consequently be addressed. Project no. 50 was a new project in respect to the existing portfolio, but is a spin-off from another long-term project. The project was labeled green even though new projects are normally designated white. This was because it was already known to some extent by the participants at the September PFMM – for example, the chief scientist who also participates in the Technology Council meeting (see chapter five) which makes decisions on long-range projects. The discussion centered on project no. 50, which could indicate that the project was made part of the portfolio by mistake. The project manager and project members had been involved in the original long-range project. As they were uncertain of the rule of preparing the business case, they started to produce a business case for some elements of the long-range project prematurely. The formal rule of PLASTIC, however, requires that:

> Spin-off projects with the goals to commercialize parts of the findings are treated as regular BU and Asset project portfolio candidates.

But the meaning of the rule has been interpreted to regard a project as ready for the portfolio if a business case can be made that includes market evaluation and calculations. However, this rule is difficult to carry out in a specific situation since the participants at the meeting themselves were uncertain of the rule, which suggests that the work of the project manager and project members was too premature to be properly fulfilled (the expected NPV of this project is €9.8 million). Projects no. 22 and 24 were addressed simultaneously by the responsible vice president as he was the only participant in the meeting who at-

tempted to follow the rules concerning portfolio management, including the rule to ”prioritize projects to maximize cash flow over time” – as will be analyzed in the following discussion. It was nevertheless inappropriate to instigate these projects despite the fact that it was an attempt to follow the rules. The vice president was able to delegate decision-making authority in order to change the end-date (i.e. accelerate because of a high expected NPV for projects 22 and 24 of €25.3 million), but did not follow through with delegating although it was in total compliance with the formal portfolio rules. Furthermore, the projects were addressed at a time when another vice president was already addressing his red projects, and therefore did not constitute part of the current meeting agenda. There was consequently some uncertainty on when to address this issue because the vice president apparently believed that the agenda had moved on to new projects. As the following exchange illustrates:

1. Vice president: “No, no, this is a comment on some [projects] which are not new, but that is okay. We would like to have numbers 22 and 24 speeded up. Because the end-date is 2007, and with such a high NPV we should speed up with more resources than that. Is the silicon [? 59.04] I guess this is the […] which slightly are the one with [… 59.12]. We would like them to go faster”.

2. Chairman: “We cannot change this here … we have to take through the project and [… 59.17] because when you decided when you change the year again”.

3. Vice president: “It is being requested that you investigate what it takes to speed it up, so that is something that we need to report back”.

4. Chairman: “Please do and if you then decide to make it faster, you change the resources and you change the end line and feed it, any day, into the system. I have to be a little bit strict on the subject [… 59.55] otherwise we will be here for a full day”.

5. Portfolio Manager: “But actually you are the one initiating the investigation on what extra resources are required to speed it up. Let us take the next one”.

As we can see, one identity of the vice president generates concern about the value of the business unit portfolio, and, as a consequence, he wants to activate the formal rule of making resource changes. The vice president is thus interpreting the formal rule of ”status of current portfolio and its implications” as the need to accelerate the two projects because of the high NPV. By appealing to this rule, the vice president is, however, violating the ‘color rule-system’ (green, yellow and red), which suggests that the formal rules of making decisions on the portfolio are in competition with the rule color system, as was suggested above. In section 2, however, the chairman finds it inappropriate to utilize the formal rule of making resource decisions and, instead, opens up the possibility for the vice president to investigate the issue himself and, therefore enables him to change the end-date without further approval from the PFMM (delegation). In section 3, the vice president apparently accepts the delegation of decision-making authority (which is in itself a violation of group identity), but undertakes to accelerate the projects and deviate the formal rule of only making decisions within the formal decision-setting. The identity of the chairman is multiple and the identity of the chairman, that of the efficient time-keeper, consequently ends up competing with what is considered proper behavior according to the formal rule of making resource decisions. This results in preferencing a time-argument over the formal decision-rule of making portfolio (or resource) decisions. From the beginning of the meeting, the portfolio manager has attempted to promote the endorsement of formal rules on portfolio decision-making. Through his introduction to the meeting, he has sought to highlight the need for these types of decisions, and seems to continue this train of persuasion by attempting to motivate the vice presidents themselves to instigate the utilization of formal rules for resource decision-making. Despite the chairman’s decision, this particular delegation of decision-making authority did not, however, make it into the formal report and there is no evidence to support the fact that the end-date has been changed, as was the intention of the vice president (formal report from November PFMM). This suggests that the vice president in question adopted the identity (March 1994) of a ‘proper’ vice president, based on the conduct of the other vice presidents (the group) in regard to the use of the formal rule, which in this case was deviated from. Thus, the vice president did not conform to the dele-

gated decision authority, which was in any case a deviation brought about by the chairman that all decisions must be made at the PFMM.

The analysis of these projects suggests that widespread rule-breaking in the gate reviews (62 percent) comes about as a result of group identity, and was consistently substantiated by the participants in the meeting, even to the extent that individual actions tended to align themselves with the group identity through adoption of an ideal picture of a 'proper' vice president. This seemed to be more important in defining what a proper vice president would do as a decision-maker (March 1994), despite the prevalence of multiple identities amongst the actors. In this case, it led to the vice president using a formal rule of "optimal portfolio" that was nevertheless inappropriate in terms of the group identity, as an acceleration of projects 22 and 24 would have triggered an inappropriate discussion on resources despite there being a formal rule to secure the optimality of projects in the portfolio. Group identity activates rules concerned with securing project management and keeping projects within the time-line (end-date).

Projects in stage-gating were also addressed at the meeting, while three were excluded, indicating that the identity of the group (of vice presidents) tends not to bring about the evocation of portfolio management rules that would have consequently shifted the balance of resources – allocated to each business unit (profit center) according to the budget of each business unit.

7.3.3 Manufacturability

An analysis of the manufacturability criterion can best be achieved through taking a closer examination of projects 30 and 23.

In project 30 (expected NPV: €1.6 million) the discussion was initiated by a comment from an unidentified participant, who, with respect to the issue of manufacturability, simply claimed "we can not really make it" (see section 3). The following exchange illustrates this:

1. Vice president: "So, everything has been fulfilled in the criteria".

The issue of the manufacturability criterion is, however, raised in section 2, where the responsible vice president argues that if that particular project is not to be approved, a lot of other projects should not be approved either (section 3):

2. Unidentified participant [Difficult to hear distinctly 51.41]: "Because this is what I am concerned about with that project [… 52.14] means we can not really make it. [… 52.23] can you close a project if you have not secured the manufacturing?"

3. Vice president: "I think that then we should stop a lot of products where we have problems … so I think it is not as simple as that because we have are doing telecommunication rates [? 52.42] in the plant still, where we have 20 percent off-grade where we have production problems"

The chairman is unaware of the formal rule securing manufacturing through an agency check, which is explained to him by the portfolio manager:

4. Chairman: "Let us take it in the following way – you will have to tick off where we say … possible to manufacture or something like that?"

5. Portfolio manager: "Basically it is part of that one… it has to be approved by the commercial manager and commercial production is approved by manufacturing".

6. [Many participants talk simultaneously]

The chairman approves the project by seeking to interpret the unfamiliar rule (at least to him). His interpretation is concerned with not approving the project when it is impossible to produce, which suggests that the appropriate definition is negatively rather than positively delineated. Thus, one purpose of his participation in the PFMM can be seen to be that of partial interpreter of the identity, and thus by implication also as a means of sustaining it. Consequently, his function is to interpret which are the appropriate rules to apply rather than merely making decisions in the instrumental sense. The meaning of manufacturability is discussed in section 7, where the chairman states:

7. Chairman: [… 53.16] "because of course … with the introduction of new problems you have the problems that we if you have the objectives to able to produce it, of course, if it is impossible to produce, it is not approved

> here. Because then we would stop the project. It is possible to produce, but if it has great difficulties it should of course ideally be in the project, that we have solved everything but eh… you are continuing, I think we will approve the project".

However, an unidentified participant chose to argue against this interpretation, which was initially brought into play because of differences over defining the situation. The identity of this participant is partly influenced by the formal rule of 'pursuing the formal rule' (i.e. to make optimal decisions on the portfolio level), even to the extent that he argues for the appropriateness of the system (see section 8 below). The chairman, however, replied that the situation defined by the system should in fact eliminate un-manufacturability as a negative delimited criterion 'no one can produce it' by contrast with a positive criterion (section 9 below). Another unidentified participant then raised the issue of competing rules with manufacturability, pointing to the end-date of the project plan and the color rule system, as well as the ambiguities of positioning a project in the innovation process that would create problems of predicting the need for test-runs. It was further argued that if the ideal situation should be achieved, all the projects would in fact be designated red because they would all be delayed (section 9). These issues seemed to be of general concern (section 11).

8. (Many participants are talking simultaneously: 53.47) Unidentified participant: "It will require a number of test runs before we accept it as a commercial product, that should be linked to this and this [… 53.56] systems, which are combined, so we have a formal system to approve it".

9. Chairman: "This process should actually take away the classical things: 'this is a fantastic product but no one can produce it' (it should avoid this); 'this is a fantastic product but no one will buy it' – these sorts of hurdles should be taken away by the flow [?] Into that [.? 54.18] the point is very well taken".

10. Unidentified participant: "If I may make a comment: I am not against this type of project, everybody can agree … that the product is great, but when it comes to planning the stages of this process within a certain time … are you able to define whether you now in the middle of the process [stains? 54.45] that the product has been approved. We [usually] have to manufacture three times before it is okay. That might influence the time schedule of the product, and then we might end up in the situation that most of the products are red because …".

11. [Many participants start talking simultaneously]

The following section (12) indicates that the chairman is actually unaware of the formal rule. According to the normative rules (see chapter five), manufacturability already needs to be addressed at the beginning of the project, in stages 1 and 2. However, whose ultimate responsibility it is for complying with the rules is not clear among the business units. With the entry into the portfolio in stage 3, however, the issue of manufacturability should have been addressed, yet at this point no test runs have been made.

12. Chairman: "I think there may be a point concerning the beginning of the project, that is that you include some feedback from manufacturing and from HSE [55.22] and marketing of course [… 55.29] … I think we can approve that comment that we would like to look into the manufacturing area".

Time-to-market will increase if the ambiguities of manufacturing are necessarily reduced, ideally through three test-runs. This is also identified by March when arguing that demands (from rules) can be inconsistent and particularly when "[d]ecision-makers may be faced with deadlines that are inconsistent with required procedures (1994: 74).

The unidentified participant in this exchange suggests that following the criterion of manufacturability and complying with the end-date – which is expected to be fixed at the beginning of the project – is a question of striking the right balance between these two formal rules (section 13). If there is to be an increase in compliance with the criterion, then manufacturability with three test runs will result in a six to nine month delay (section 14). Both rules can therefore only be complied with simultaneously if an interpretation is made which aims to define what the appropriate action would be. The participants also raised the issue of up-scale production, which despite a number of test runs, could actually fail (see sections 15-19 on the issues of unanticipated contamination from the previous product or residues that could contaminate the next):

13. Unidentified participant: "I agree, I have a lot of sympathy [for this position], because the launch to market period will increase significantly. So we need to find the right balance. And I do not think we are going to solve

this issue at this meeting here. But you should be aware of what this could mean …".

14. Unidentified participant: "This delays the time to market by six or nine months".

15. [Simultaneously discussion]

16. Unidentified participant: "The worst thing that can happen to you is success with the test run…"

17. [Many laugh]

18. Unidentified participant: "… and then you launch to market and the second [attempt] does not work, and then you are really in trouble".

19. Unidentified participant: "I think we should also take into account with the launch phase which [products] you need to produce more than once".

The decision is again made to approve the project for finalization, despite the concerns raised. In fact, the chairman made this decision three times (sections 7, 12, and 20) and eventually removes the issue from the meeting altogether.

20. Chairman: "We shall take this up outside the forum – it is a very important point, [so] we approve it. The next one".

In project no. 23 (expected NPV: €1.9 million), lack of compliance to the rule was specifically noted by the vice president and, here again, the meaning of the rule of manufacturability is subjected to interpretation and discussion:

1. Vice president: "… sorry for waking up late but anyway there were two or three projects that were sent in which are not now on the list for the stage-gate; some were moving from detailed development to launch, for instance, so it is [more] a question of procedure as to how we manage this".

2. Chairman: "Are they not here?"

3. Unidentified participant: "It is in the presentation you got from [… 10.03]".

4. Chairman: "That is perhaps a problem with [portfolio manager] has to…"

5. Vice president: “I understand [portfolio manager’s] dilemma in this but to … yes okay next one. This is the […] going from detailed development to launch and if you see the – in the checklist. The formal agency check is not finalized. So, one way of doing that would then be to, let us say – okay when we have the formality the consistency of your reasoning […] we should have that, if you agree on the other points; that it […] there, we will move to launch”.

6. Unidentified participant: “There is a formality in the agency check. And that is a serious one that should be properly done”.

7. Vice president: “My comment to that is that it is impossible to get an answer from the other functions, from product liability and manufacturing, we are just not getting the answers. In this case …there are no new chemicals, there are chemicals that we are working with already, so from that point of view, there is nothing odd with it, but formally it has to be answered by production and …”.

8. Unidentified participant: “Why do not get the answer then?”

9. Unidentified participant: “So why not get the answers then, if it is something new, it should be no problem to answer”.

10. Vice president: “That is an issue, but I think we have to get those answers, I mean physically […] it should just put under their noses and signed. But if you take the … I do not know, should we have just a quick … I think there could be one question on that. I think if you move one slide back … so this is launching this higher density direct into the reactor, which is given slightly lower production rates, but we need this for the market segment of smaller conductors, which is necessary for our penetration of the market”.

11. [Several people sigh]

12. Vice president: “Yes”.

13. Unidentified participant: “How much is slightly…?”

14. Vice president: “A ten percent lower production rate … is where we are, but anyway what it can replace is also the compound in the product, the forty-four twenty-five [?] Which we are mixing high density [‘analogy’ 12.42]. It is the aim that we would replace that so far. The total production cost then it should be … eh”.

15. [Many start talking]

16. Vice president: “No the questions is can we go from the detailed development to launch?”

17. Chairman: “Yeah … and you had one problem with accuracy from manufacturing”.

18. Vice president: “When that is over with we will take it to launch”.

19. Chairman: “And we will take it according to what we have done before, you can get a decision between if you have the […] in order”.

The dialogue in sections 1 to 4 suggests that the vice president in charge is reporting to the portfolio manager about progress on the individual project, referring to a report he submitted, and so which has not been generated through utilizing the databases. The chairman was in the belief that all projects that were to be addressed were actually on the list, which further indicates that the innovation databases are not providing the decision-forum with a comprehensive picture of stage-changes in a project. This is, however, something that must be specifically made available. Section 5 discloses that the agency check has not been finalized. An unidentified participant consequently draws attention to the inappropriateness of not following the formal rule in this case. It is the identity of the vice president that elicits the action of presenting a project for stage change even though not all rules have been complied with, which also illustrates the results of having two time-lines. In sections 7 to 9, the vice president discusses the rule-violation with an unidentified participant, who does not accept the argument that there is a lack of formality in the liability and manufacturing departments. This prompts an explanation that a higher density in the reactor is producing “slightly lower production rates”. However, the vice president wants to return to discussing the project because of an argument relating to market conditions:

> “[…] but we need this for the market segment of smaller conductors, which is necessary for our penetration of the market”.

The response to this argument amongst the participants was one of dissatisfaction: several participants expressed their criticism in section 11, and one participant even quizzed the choice of the word “slightly” (section 13). In response, the vice president admitted that

the production rate was lowered by ten percent (section 14), but a positive and unanticipated benefit had been that another compound could be replaced, which additionally generated a new project objective, 'forty-four twenty-five'. Nevertheless, it was further admitted that 'total' production cost was lower since another additive could also be replaced. The use of this latter argument generated a tentative 'yes', if the vice president were able to solve the problem with a lower production rate ("accuracy", section 17). It should, however, be noted that the expected NPV calculation of project 23 changed from €1.9 million in the formal report from the September PFMM to €2.82 million in November: an increase of almost €1 million. According to the argument of saved costs and a reduced total production cost, this is an example of post-fact information gathering (March and Feldman 1981).

In sum, the criterion of manufacturability is not a 'straightforward' rule to follow. The criterion is related to ambiguity since the vice presidents tend to discuss the number of test runs required to secure product performance (even though they recognized the impossibility of this). Nevertheless, the end discussion was finalized through reaching an understanding only to undertake one test run, although everyone was aware that this would not reduce ambiguity satisfactorily. In another discussion, the manufacturability criterion was finally interpreted as not only "90 percent" but also "not impossible to produce", albeit defining the rule in negative terms. The criterion therefore competes with the color-rules in terms of not being delayed, but rather also through securing the manufacturability positively. The rule is interpreted as including one test run and many vice presidents were therefore hoping for a negative outcome as additional test runs would be considered legitimate. This would reduce subsequent ambiguity in the project. In addition, one purpose for participation in the meeting participation was to be part of the rule interpretation, as well as to present the argument in favor of more test runs. Surprisingly, the chairman of the meeting was not aware of this rule, which added complexity to the situation.

7.3.4 Calculations

Calculation influences the mind-set of vice presidents and project managers, but figures are perceived to be ambiguous to the extent that the vice president in charge of any particular project can promise to increase the figures if he is required to do so since ambiguity is ap-

propriately recognized by the other participants. Rules affect behavior by influencing what is to be expected by actors, but ambiguity also influences decision-making by legitimizing subsequent changes in norms since alternatives and their consequences cannot be fully comprehended at any one time. Changes in assumptions are regarded as legitimate as indicated in the example below:

> … all in all this went quite well. The only problem we had was that the … market in Europe is really down, and that means that the companies producing … profiles are competing like hell with each other, which means they are not prepared to invest in new tools and new systems (vice president).

March also reports that ambiguity influences decision-making:

> Behavioral studies of decision-making in organizations indicate that the portrayal of decision-making and information found in decision theory ignores of significantly underestimates the ambiguities of choice (1987: 153).

Project managers suggest that calculation can easily be a subject of manipulation. For example, product development projects in the business units receive the sales price (margin) and the expected volume from the sales- and marketing department, but manipulation is generally possible by modifying the numbers for expected development costs and license fees (particularly with technological projects). In this way, one test run can cost €1 million. The calculation of the expected NPV is therefore heavily influenced by the expected number of test runs (since three test runs are costly to PLASTIC). The costs of process improvement projects are easier to estimate since the 'market side' of the calculation is known and the investment in new plants and equipment can be easily factored. The meaning of the business case is interpreted by project managers and produces additional complexity because rule-makers (portfolio manager and board of directors) normally choose to manage all new product developments, process improvement and long-range projects within the rule-system already described in chapter five. R&D project managers (managing all types of projects) tended to follow the rules of making an expected NPV calculation, but as the portfolio manager explained at the gate review meeting in September 2003, it was not

obligatory to produce NPV calculations for long-range projects (despite the formal rule). The upshot of this is that the way the formal set of rules is designed can add complexity to using rules by making them too general and not elaborating on them, say by making different sets of rules for each type of innovation project. The respondents argued that long-range projects are more ambiguous than product development projects at PLASTIC. In recognition of the difficulty of calculating the expected consequences of such long-range projects, the portfolio manager attempted to influence the interpretation of this rule during the September PFMM by stating that it was not necessary to undertake this activity. The expected NPV calculation was to be ideally updated throughout the lifetime of the project, in the portfolio as well as prior stages. However, both project managers and vice presidents remained unsure as to whether the NPV-calculations were to be updated on a continual basis (due to the rules being unclear). Some project managers interpreted the rule such that an update was made only when new information was available. Others interpreted the rule so that the NPV was updated before a steering committee meeting, whereas yet others only updated the calculation if the project was stage gating and therefore due to be addressed at the gate review meeting. No systems are in place to monitor the output of a project in terms of the expected NPV, whose performance is only measured by the portfolio management in the amount of kilotons sold. No consensus could be discerned among the vice presidents on the subject when interviewed about the precision of calculations made by the project managers. Some claimed that they were accurate whereas others mentioned a ratio of 50 percent precision. However, as the General Manager (chairman of the gate review, September PFMM) stated when interviewed on this issues:

> The purpose is not to produce precise calculations, but to influence the mind-set of people and make them *think* in terms of profitability [emphasis added].

Even though rules were seen to be influencing the gate review meeting as well as the behavior of the vice presidents, the symbolic perspective (March 1999) was clearly visible in the meeting in several respects. For example, emphasis was placed on securing the value of the business unit's portion of the portfolio, contrary to the predictions of the instrumental

perspective, which demands that projects leave the portfolio 'pool' as soon as possible because resources could therefore be freed for other and more profitable projects, thus consequently accelerating the positive cash flow. In several cases, the value (expected NPV) was de-coupled from the project because the vice president (and the other participants of the meeting) wanted to protect the value of the business unit's sub-portfolio. Apparently further meetings were held prior to the gate meeting itself where business plans of the business unit were presented, which is part of influencing the group identity in terms of *assisting* each other to fulfill the promises made in these business plans (including budgets) rather than create conflicts. This behavior also influenced the chairman[33] because the formal goal of €90 million for new projects was well exceeded, largely through the protection of values and the vice presidents' decision to 'stand together' rather than engage in open competition for resources between the business units as a consequence of identity. Moreover, the participants wanted the September PFMM to be an 'operations'-meeting and were therefore positively inclined towards the possibility of top-management participation (the cancellation of the R&D Director's participation via video conference did not generate any observable disappointment).

Ambiguity also influenced some projects which were halted prior to the gate review meeting – due to unforeseen problems with the technology (including manufacturability) of the project (see section 7.3.1 on red projects). Project 30 was presented (stage gating project), and during the presentation other identities were evoked than those of the group. This defined the decision not to discuss each other's projects, because the manufacturability criterion in their opinion had not been fulfilled. The issue of manufacturability appears to play a central role in the individual identity of some vice presidents, to the extent that action was undertaken – in terms of expressing a dissenting opinion – regarding the vice president's claim that the criteria had been fulfilled. The vice president agreed with these opinions and subsequently resorted to using an additional economic argument by claiming that the project would produce a higher expected NPV as a result of the additional benefits in positively influencing 'total production costs'. The economic argument stopped further discus-

[33] The portfolio manager attempted to evoke the rule of prioritization of projects, but no evidence suggests that this attempt succeeded.

sion on the criterion of manufacturability, perhaps because this type of argument was ambiguous to the vice presidents. No one seemed to question the reason why this argument had not been made part of the calculation prior to the meeting.

Thus, calculable rules are not distinct and the meaning of the rules requires interpretation in the organizational practice of PLASTIC, which is itself one purpose for participating in the meeting other than prescribed by the rules. Another purpose of the meeting was to discuss new rules, for instance the RAID rule-system, but the functionality of these rules turned out not to be fully understood by the respondents when interviewed on this issue – most mentioned the aspect of complexity. Since the beginning of the formal implementation of the new rule systems, the rule of dealing with projects above €2 million has been designed to distinguish between activities and the portfolio, which is part of the formal rule-system (see chapter five). Thirteen projects were active in the September portfolio even though they were below this rule. During the September PFMM, projects with a value below €2 million were only briefly introduced as a problem, most conspicuously by a promise from the portfolio manager to specifically address these projects at the next meeting. The rule was evoked in the September PFMM only on one occasion when a new project (no. 80) was presented to the portfolio participants. The business manager responsible for the project was not, however, (formally) aware of this limit, and was surprised to learn about the rule. Despite this, he was however supported by the portfolio manager, who had pre-approved the project, and emphasized its 'strategic importance'. The business unit manager in turn supported the portfolio manager, stating that:

> "*We can easily increase it* [the value]" (responsible vice president) [emphasis added], and subsequently
>
> "… perhaps we should add more benefits just to show these are the baseline" (chairman).

This project had a high claim to legitimacy because of the issue of 'strategic importance' that was introduced by the portfolio manager. The formal report from the next portfolio manager (November 2003) showed the same value of €1.1 million, which suggested that the cut-off rule of €2 million was deviated from. Despite the statement of the chairman,

new benefits were not added (and also did not form part of the formal report of the following meeting). Thus, the €2 million rule is perceived to be an inappropriate standard to follow by the vice presidents and is thus only evoked in connection with other criteria. In addition, while the rule-design of this €2 million hurdle was motivated by a desire to simplify the PFMM-meetings, it nevertheless opened up new room for interpretation since the business units were responsible for managing projects below this figure. The evidence suggests that one business unit has designed a simplified portfolio-rule model to undertake portfolio management of projects within the business unit, which are typically low risk product modification projects. One respondent claimed, however, that these projects were consuming too many resources compared to the portfolio-projects, since the management of these projects had been moved outside the portfolio.

In sum, the calculable rules are subject to interpretation because of competing rules with inconsistent demands. Time-to-market cannot be accelerated or the project will not be on time, providing manufacturability is complied with satisfactorily with more than one test-run. Moreover, the identity of the vice presidents as a group is more likely to evoke the criterion of manufacturability because the organizational identity is that of a technical and process-oriented company whereas calculation is not distinct and considered to consist of a number of complex phenomena. The numbers are, however, *not* treated as equivalent to the more complex reality they represent, contrary to what is claimed by March:

> [T]hey create “magic numbers” (e.g., “profit”, “cost of living”) for complex phenomena, treating the numbers as equivalent to the more complex reality they represent (1988: 26).

Emphasis on calculation is new to the vice presidents when compared to the previous set of rules (PD&I, chapter five) and, as has been argued by March (1994), actors are more likely to more effectively internalize rules they fulfill than those they do not, which on the other hand does not mean to say that this creates competence in the use of new rules. Thus, competence in using rules can impede competence in creating new rules. Moreover, the vice presidents have not been provided with any training to develop such competence, for instance, in portfolio decision rules.

7.2.5 The use of rules in gates

Within the vision of a limited rationality, choices are a result of a deliberate, consequential and management-based decision-making process, and they must answer to four basic analytical questions (March 1999), which were set out in chapter four. The rules in the SG approach have programmed this activity into a set of rules, whereby through following these rules a decision is ideally reached. The rules prescribe the way a decision is made by setting the criteria for decision-making and the activities needed to be carried out in a gate meeting (observed at the September PFMM). The organizational practice which encompasses the rules in a gate meeting does, however, suggest that the stipulations of the rules are inconsistent, which adds additional uncertainty to the interpretation of the criteria or calculable rules and rather puts emphasis on how the rules are designed. Moreover, the design of rules has produced two time-lines where the gate meeting is detached from the progress of the individual project, which has created a situation where decisions that are either made prior or subsequent to the meeting are considered an appropriate undertaking by the vice presidents.

The rules prescribe who should attend the meeting and what activities are to be carried out, But actors tended to engage in interpretation of the rules, sustaining the group identity and legitimizing decisions made prior to the meeting by the vice presidents. Moreover, rule deviation with some rules became standard rather than simple and ‘automatically’ following those prescribed. Ambiguity influences many projects, but the competition that arises between the color-system rules (monitoring delay) and the rules in SG produces complexity which requires further criteria rules to be constructed through interpretation (e.g. the criterion of manufacturability). The end-date was discussed in many projects and linked to issues of manufacturability, technical feasibility, project scope, customer testing and resources. In this sense then, the decision process has become more important than the decision itself, mainly because the decisions have been transformed into a set of rules. If the project is not technologically feasible, the vice president is expected to take action without prior approval. Only in project 46 did the chairman surprise the participants by ‘stopping’ a project, which was nevertheless not killed as the formal report later encouraged the project to be reformulated and resubmitted for approval.

It is inappropriate to evoke the portfolio decision rules for reasons of group identity, which would thereby be constructed by the participants. The motive for interpretation amongst the participants does, however, also include an element of sustaining group identity and thus securing the perception of what is considered inappropriate. This is the reason why these rules are not suddenly put into operation despite the multiple identities of the portfolio manager and a vice president, who applied these rules (the vice president who evoked the inappropriate rules did not participate in the November PFMM). The portfolio manager was also influenced by group identity since the formal report was specifically designed with a page for each business unit and not, for instance, according to project numbers or project size, which would have prompted a discussion on priority.

One goal of the portfolio forum was to exceed the amount of €90 million as expected NPV each year for new projects. However, this amount was not output controlled by monitoring the projects after leaving the portfolio, mainly because one portfolio manager claimed the impossibility of making precise post-calculations. The investigator gained the impression that it was a common objective of the group of vice presidents to demonstrate a value as high as possible of the total value of the portfolio and secure this value not by accelerating projects through prioritization but rather by keeping them inside the 'pool'. This common understanding, part of the group identity, only tends to work against the time-regime monitoring delays and whether a project is accelerated. Interestingly, the inappropriateness of evoking the portfolio rules would make prioritization necessary and in turn result in a change of balance change in the resource rules (each business is a profit center and therefore has authority over its own resources). As a consequence, it is more appropriate to follow these rules (resource rules) than the rules defined by the SG approach.

The expected NPV as a criterion is perceived as a complex number and is not monitored post-portfolio. The discussion of project 8, for instance, indicates that the expected NPV value is loosely connected to the project in the sense that participants focus on securing the value of their 'sub-portfolio' despite the fact that the project as such was not technically feasible. In the specification of the formal report, it was encouraged that the project be "reformulate[d] [to bring the] project bring up for approval" even though the value has been removed from the portfolio specified by the relevant business unit. From the portfolio per-

spective, no decisions were made since no projects were halted or killed (apart from one which had already been stopped prior to the meeting by the responsible project manager) or prioritized. The rule of above €2 million was not brought into effect, perhaps because of the complexity associated with this criterion and the intervention in each business unit's ratio of the portfolio.

Analyzing the distribution of each business unit's portion of the portfolio measured in millions of Euros for quarter three and four, demonstrates marginal changes in each business ratio of the total portfolio in percentages (see table 7.4). Although no formal innovation rule regulates the distribution of ratios between the business units, as this would compete with the requirement for making optimal portfolio decisions independent of each business unit, the individual business unit's portion of the portfolio was considered a matter of concern by the chairman and the participants in the portfolio meeting, as was illustrated during the discussion on many of the red projects. The analysis of the distribution (table 7.4) indicates an explicit rule governing the ratio of the projects in the portfolio, which is substantiated by the discussion of the projects and the decoupling of value from the project to protect each business unit's sub-portfolio. This is exemplified by the case of the vice president, who prior to the meeting, had presented his business plans to the other participants in order to legitimate his ratio of the portfolio.

Table: 7.4: The distribution of each business unit's part of the portfolio in Quarter 3 and Quarter 4 – November PFMM in € million and percentages.

	A	**B**	**C**	**D**	**E**	**F**	**G**	$\sum_{AG}$
Active Q3	44	32	40	18	35	7	46	221
Active Q4	60	33	52	19	40	7	56	267
Percent of $\sum_{Q3}$	**20%**	**14%**	**18%**	**8%**	**16%**	**3%**	**20%**	100
Percent of $\sum_{Q4}$	**22%**	**12%**	**19%**	**7%**	**15%**	**3%**	**21%**	100

The decision situations occur quarterly, but are detached from the individual progress reports of a project, which might be a contributing factor for the appropriateness of making decisions prior to the PFMM and subsequently to secure formal approval. Thus, rules tend

to produce formality, and formal approval is a concern of the participants even though they are willing to take prior action and deviate from the portfolio decision rules themselves. One peculiarity of the SG approach in PLASTIC is the existence of these two time-lines. Project managers do not, however, seem to consider this a problem, because the they can contact the chairman of the steering committee – who often is the vice president himself – if a decision is required, and will subsequently will get formal approval from the portfolio meeting (no projects are killed). Fifty-eight percent of projects, however, reported that they did not have a designated chairman of the steering committee (analyzed below) and some project managers argue (even criticize) that decisions are often made outside the PFMM. The informal decision-making that takes place in the gap between the two time-lines opens up the opportunity for what Weber (1968) characterizes as 'friction', despite the fact that in Weber's understanding rule should reduce 'friction' (see chapter four).

As was outlined above, the color-rule system competes with the stage-gating rule and also generally with the performance of the project itself (Rosenau 1993). Here the data suggests that not all criteria can comply simultaneously as time is also a scarce resource. Evidence further indicates that time is connected to the 'scope of the project' and the criterion of 'manufacturability', and more generally can be considered a driver for interpreting the meaning of rule criteria in the rule system which was formally implemented at the beginning of 2003. Thus, the color-rule system in particular (relating to the end-date) appears to have influenced the PD process[34] more than the gate reviews have intervened in the innovation process with objective decision-making as required by the normative system (see chapters two and five). In addition, the participants recognized that much more time needs to be allocated to the meeting itself, especially for detailed discussion of all projects rather than merely red and stage-gating projects.

Rules affect behavior by influencing the identity of the actors, but ambiguity also influences decision-making by legitimizing subsequent changes in NPV-values, especially because the consequences of these decisions cannot be fully comprehended at the outset. Changes in conditions are, however, legitimate as was indicated in the discussion of pro-

[34] Davila investigated the drives of management control in new product development and indicates: "[…] that management control systems in product development, following project management techniques, are focused around time" (2000: 399). Davila was, however, focusing particularly on budget rules.

jects that particularly dealt with technical issues. Moreover, rule-deviation was prevalent in gates (62 percent), which relate to competition between the attention granted to formal rules inside the SG rule-system, but also with other rule-regimes, such as resource-rules and time. The latter has led to the development of a color-rule system that appears to consist of the rules deemed most appropriate to utilize from the perspective of the vice presidents' combined group identity.

The decision situations in the gate review are not entirely like the Garbage Can (Cohen et al 1972) decision models, as rules did in fact influence the meeting and produced 'decisions' in some situations, particularly in discussions examining whether a project actually complied with required criteria. The extent of information and documentation rule-application demonstrates the highest percentage ratio of application, but the analysis below suggests that rule-deviation was in fact most frequent with in the case of documentation rules, and that the documented information did not establish a basis for rational decision-making in the instrumental case because of ambiguity, particularly amongst 'red' projects. However, the Garbage Can-decision model suggests that the decision process is more important than the decision itself. Here, *similarities* can be identified with the decision-occasion in PLASTIC, which rather served to provide a platform for interpreting rules and maintaining the group identity of the vice presidents, including being able to guarantee the application of decisions which had already been made outside the formal decision-making arena. The participants in the meeting struggled to follow rules, but only to the extent that their respective group identity perceives the need to actively employ the rules as being appropriate. Rules that threatened to unbalance a business unit's portion of the total portfolio, and thus its resource allocation, are considered inappropriate to follow, even though the identity of one of the vice presidents prompted the question of accelerating projects no. 22 and 24.

Although rules influenced the meeting, complexity could not be eliminated. Projects that did not follow rules and rule-competition generated complexity. In particular, the color rule-system tended to compete with the quality of criteria, as illustrated by the green projects where the meaning of the criterion of manufacturability was discussed. The vice presidents wanted to eliminate uncertainty by undertaking more test runs, but the motives

that underlay the design of the color-system in the first place not only obliged that projects be finalized as soon as possible but also prohibited the actual requirement for reducing quality problems and product performance. The rule of having quarterly meetings was one of the few rules that was religiously followed, as were the information rules of project dates, even though the rule of having a business plan tended to be deviated from. Finally, in this study, calculable rules were interpreted as criteria, and are a construction of what constitutes appropriate behavior, since this ultimately comes down to the identity of the decision-makers, as the following illustrates:

> General Manager: "No, you can do with criteria whatever you want, I mean – it can kill or it can support, [31.17] it depends very much on how you look at things. It will depend very much on people sitting around the table making the decision and to have some people really want to carry it through. Again it comes down to how people *feel* about the whole thing – that will make the difference that comes out" (emphasis added).

The analyses indicated that although rules reduce ambiguity, rule-competition and multiple identities tended to produce complexity in PD, adding to ambiguity. Rule-competition existed between the color-system rules and the rules requiring projects to be decided upon when changing stages. Some of the red projects were subject to ambiguity in terms of unforeseen technical problems, but other projects were delayed because of the expectation that projects would be accelerated, which was largely produced by these rules. As a project manager, one does not want one's project to be red and therefore become the focus of attention. The calculable rules are subject to interpretation because of competing rules and the prevalence of a degree of ambiguity in relation to PD projects. None of the calculable rules are distinct, which means that the meeting becomes an arena for interpretation of the formal rules and thus for legitimizing subsequent decisions to make additional test-runs. An action, however, is not automatically brought about based on the rule (Simons 1954), but subject to the filter introduced in figure 7.1.

To summarize, the question was initially raised as to how rules are used with respect to decision-making (section 7.1), and the answer can be seen to be that rules influence deci-

sion-making. Some rules are used but require interpretation, whereas other rules are deviated from. The use of rules in decision-making therefore becomes a *struggle* for the participants between both following and deviating.

7.4 CONCLUSION

Although the objective of rules from the instrumental rule-perspective is to reduce rational decision-making to a programmed set of rules by prescribing the activities to be carried out in stages, how information is produced and documented, the activities needed to be carried out in the situation itself and which criteria to apply, the analysis of the use of rules in PLASTIC suggests that the use of rules is subject to the 'filter' of appropriateness, as was also identified in the cross-case analysis (chapter six). Nevertheless, rules *do* indeed influence PD activities in PLASTIC.

The analysis in this chapter was structured into two parts. First, the extent of rule-following was analyzed in PLASTIC and thus consequently the extent of rule-deviation that was also prevalent. Second, an analysis of the use of rules in the September Portfolio Management Meeting (PFMM) presented a number of explanations of rule-following and rule-deviation.

The first section asked the question to what extent rules were used in the PD activities of PLASTIC. The answer to that question is summarized in table 7.4 above, which showed the percentages of the rule-following in PLASTIC with respect to gates (38 percent), information (67 percent) and stages (40 percent). Earlier, in chapter six it was indicated that gates were normally kept formal, but the analysis in this chapter suggests that formality is particularly concerned with the holding of quarterly gate meetings, having an agenda and discussing the projects addressed because of rules, whereas rules concerned with portfolio management in particular were not evoked during the meeting. The information and documentation rules indicated the highest rate of rule-following (and lowest rule-deviation) in percentage terms, but also that the databases into which the information was uploaded and to some extent documented, were not utilized during the meeting, which instead relied on a

form that was to be filled out by the respective vice president before the meeting. The analysis of the stage rules pointed to the use of rules particularly in the pre-portfolio activities (stage 1 and 2) and the low level of rule usage in the last stage (6) concerned with the lessons that could be drawn from the project's launch.

The first section yielded a number of analytical observations with respect to the use of rules. Rules solve problems and problems that are not solved produce problems for other rules because of their inherent interconnectivity. The lack of portfolio decision-making pushed the problem of prioritization 'downwards' in the organization. Learning occurs and problems not solved through rules in the case of PLASTIC do not lead to the reformulation of rules but rather to the creation of new rules, which in turn are perceived as complicated because of a lack of training and the high degree of complexity in the new rules. Some project managers followed the rules more out of a sense of duty than through any internal commitment since no one really wanted to be singled out in the meeting because of a problem concerned with quality or information and documentation. However, the action of reporting did not lead to a *general* behavioral change amongst some project managers since these rules had not been internalized. The intake of new projects was limited due to stretched resources, as was argued by one respondent who pointed out that increasing the project by 0.01 people was a waste of time. The resources were stretched in PLASTIC because of the reluctance to prioritize projects of indeed the and unwillingness to kill a project. This has led to the establishment of many small projects and some projects which are even a combination of up to eight old projects. Moreover, the new set of rules which have been valid since the beginning of January applies to all projects, which has in turn produced additional complexity in using rules. Finally, evidence of vice president responsibility was absent in the first two stages of the SG approach of PLASTIC.

The second section of this chapter set out to ask how rules are actually used with respect to decision-making (gates), and this was observed through a gate meeting (PFMM) that took place in September. The section set out three questions as its point of departure, which jointly leads to an understanding of how rules are used with respect to decision-making. The color-rule system addressed all delayed (red and yellow) projects but was seen to compete with the stage gating rules since three projects that shifted stages were not addressed.

The business units that owned these projects did not, however, have any red projects and therefore did not draw attention to these rules. Appropriate rules are evoked and the color-rule system seemed the more appropriate system to utilize as rules tend to influence decision-making. Inappropriate rules in contrast to group identity were, however, also evoked because of multiple identities among decision-makers in the case of projects 22 and 24, where the owner (vice president) of these projects wanted to accelerate them with added resources and, consequently, found it more appropriate to follow the portfolio management rules than the other participants. The vice president, however, abandoned the delegated decision authority in the process. The latter was in itself a deviation from the rules, which require decisions to be made in the gate meeting. As a consequence, the real option available to the vice president was to accelerate the projects with the resources available through his own business unit. Problems not regulated by rules also surfaced in the meeting, for example, where project 62 was addressed in terms of its ownership, which suggests that rules do not only relate to problems that can be discussed at the gate meeting. The criteria by which projects are compared are not distinct and therefore require interpretation. The most commonly discussed criterion were those that were influenced by ambiguity. For example, where one successful test-run was considered to sufficient with regard to whether the project product could be successfully manufactured, but the number of test runs could be reduced if the rules placed contrary demands on the criteria. The color-system rules require rules to be on time (i.e. not delayed) whereas the quality of the product could consequently be compromised. Problems that were not solved in some cases produced subsequent quality problems which required resources and, in turn, resulted in the resources that were available to PD being even more stretched and unmanageable.

Another criterion is calculations, which not was treated as equivalent to the complex reality they purported to represent. No consensus was detected among the respondents with respect to issues of precision, but the wide acceptance of ambiguity and, in some cases, unforeseen technical difficulties also served to influence the perception of calculations, which tended to be perceived as indicators rather than exact numbers. This might explain the construction of an ‘important’ project when the expected NPV value had reached a level of, say, €7.5 million. As a consequence, the participants in the meeting engaged in a discussion

when a project was successful (e.g. project 40) and accepted that a vice president can increase the value of an expected NPD when 'pushed', as the comment: "We can easily increase it" serves to prove. This behavior was widely accepted among the participants, which further demonstrates that the calculation was rather regarded as a construction than an absolute number. However, the vice presidents (or project managers) were not provided with any training in relation to the rules, and a competence trap could to some extent consequently be identified, especially since the criterion of manufacturability was an aspect which proved more readily comprehendible to the vice presidents than the calculation.

March (1994) argues that actors are more likely to fulfill roles when they possess competence. Resource-rules constituted another rule-regime in competition with the rules in the SG approach, as illustrated in table 7.4. The resources are linked to the budget of each business unit (a profit center) and, as consequence, the values of the project became loosely coupled to the extent that the value of a terminated project (initiated by the vice president) was protected and the vice president was encouraged to fill the slot with another project in order to secure each business unit's portion of the portfolio. These rules are more appropriate to evoke than the portfolio management rules (table 7.1) and a role which is easier to adopt than the role of instigating rules that require prioritization and, consequently, upsetting the balance of consensus.

The initial aim of this chapter was to understand the use of rules from the perspective of appropriateness in PLASTIC. The evidence suggests that the notion of appropriateness provides a fitting explanation as to why and how some rules are used whereas others are not. The theory of appropriateness is indeed a 'filter' between the formal rules and the actions of the actors, as was illustrated in figure 7.1 above. Actors apply a different form of rationality (March 1994) which makes more sense for them to use one set of rules over others. This puts much more focus on behavioral issues and the role of superiors when attempting to understand rules in the SG approach as a managerial technology, which will be the focus of the next chapter. The boxed area in figure 7.1 draws attention to the constructedness of appropriateness. This will be summarized and elaborated in the following chapter, together with a discussion of the two perspectives taken together.

CHAPTER EIGHT

Summarizing two perspectives on decision-making in practice: the case of PLASTIC

This chapter summarizes the two perspectives by which rules have so far been analyzed throughout this study (instrumentality and appropriateness) with special reference to PLASTIC. It further aims to elaborate how appropriateness is constructed according to the interpretations made by the actors involved. Moreover, the chapter attempts to provide a better understanding of the mobilization patterns which were identified in the previous chapter, where rule-following and rule-deviation were analyzed with respect to gates, information and documentation, and stages.

8.1 INSTRUMENTALITY AND APPROPRIATENESS

Cyert and March originally presented the theory of appropriateness in the epilogue to *A behavioral theory of the firm* (1992: 230-32). However, in their treatment the authors fail to discuss the implication of this theory with respect to each instrumental rule, which were subsequently analyzed as part of the standard operating procedure (instrumental perspective), precisely because they were not considered within their context of appropriate application. So far in this study, rules have been categorized in task performance rules, information and recording rules, and planning rules. In this chapter, however, rules will be elaborated in terms of the specific rules that were designated to each category by Cyert and March (1992), see the instrumental rules listed in table 4.2 above.

Table 8.1: Rules in two perspectives

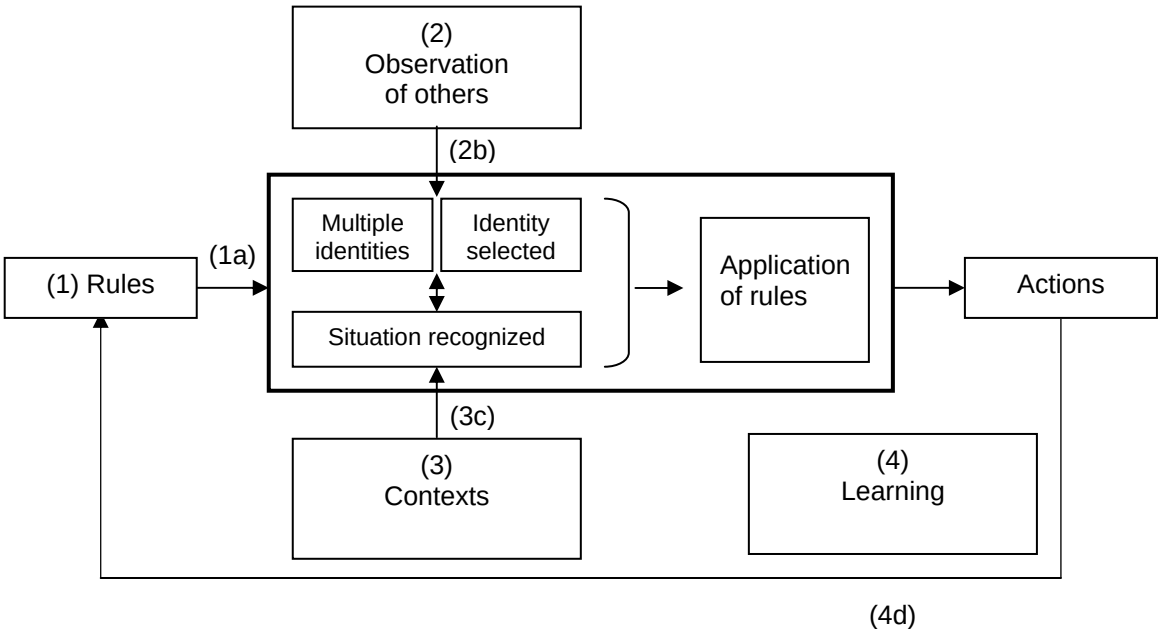
Normative SG rules	Rules in context: Appropriate application
Coordinative mechanism	Projects are not awaiting formal decision(s). It is inappropriate since time-to-market is dominant in the mind-set of the actors, demonstrated by the detachment of the gate review from the individual progress of the project.
Gate tasks according to a standardized format	The gate rule mobilization pattern (see table 7.1), and because of competition from the resource rule regime, those which are connected to organizational structure business units. Portfolio management rules in particular are not evoked.
Stage activities according to a standardized format	Formal rules prescribe the activities to be undertaken in the stages, but particularly in the two first stages many activities prove inappropriate, which inhibits innovation – as analyzed in the mobilization pattern (see table 7.2) for these rules, due to unclear responsibilities.
Gate keeper activities required to be undertaken	More appropriate for the Gatekeeper to seek consensus in the group than to evoke rules that would disrupt consensus. The identity of what a proper vice president actually does is rather defined by a fellow vice president than corporate concern.
Project managers generate information to be used in gates	Project managers generate some of the information, but generally rules are not followed, and only limited information is available for decision-making. Some project managers are eager to generate information whereas others rather follow rules as a 'duty'. The organizational identity is not homogenous in this respect.
Information production is determined by the activities taking place in stages	New projects entering the portfolio as well as existing projects can lack information. In one case, information was explicitly generated to validate a decision that had already been made.
The information must be reported (documented) to the decision-makers	Not all information is documented. A project manager can record that the business plan has been made, but in some cases documentation is nevertheless not uploaded. The portfolio manager has devised a template to be filled out by the vice president and used during a meeting.
The reporting format follows the stages, which must include marketing, production (technical issues) and finance.	The design of the rules in PLASTIC prescribes the same criteria to be applied throughout the entire process. The reported information is constantly modified as more information is generated but reporting is interpreted differently by the project managers.
Performance criteria, should and must meet	The normative design of the rule system does not include should and must meet criteria. As such, the rule-system is not designed for disclosing disagreement with respect to portfolio decision-making.
Project plans (including end-dates)	In approximately half the cases, a project plan has not been uploaded (see figure 7.2), but the end-date set at gate 3 when entering the portfolio does indeed seem to be an appropriate rule to follow.

The table suggests that rules are interpreted in their context. The section below therefore attempts to take the issue further by seeking to construct appropriateness as it is applied in PLASTIC. This is done in order to yield possible explanations to the rule mobilization patterns identified and summarized in table 7.3, which illustrated that 38 percent of the rules are evoked at PLASTIC whereas the remaining 62 percent are not.

8.2 CONSTRUCTING APPROPRIATENESS IN PLASTIC

The second theme of this chapter is concerned with how appropriateness is constructed. The center box in figure 8.1 below illustrates the room for interpretation in the three processes inherent in the theory: the process of self awareness – to clarify identity; the process of recognition – to classify the situation in which actors finds themselves; and finally the process of search and recall – to match appropriate rules to situations and identities. The variables influencing the three processes are illustrated by a narrow line in the figure. The number refers to the content of the box whereas the number and the lower case letter refer to the process by which the three processes are influenced. The interpretation of rules can, for instance, be influenced by inconsistencies in formal rules (1 and 1a); observation of others, which can influence how identity is defined (2 and 2b); and the context, which influences how situations are understood (3 and 3c). Moreover, learning processes influence the interpretation of rules too (4 and 4d). Here, action is considered to be a result of these three processes and is therefore not singled out for analysis. The discussion of the construction of appropriateness that follows is a further elaboration on the argument so far put forward, in particularly in the previous chapter. Each box and its respective process is discussed in more detail below. It should, however, be noted at the outset that it is not being claimed that variables cannot also have mutual influences on each other. That they can do, will become evident in the discussions below. Moreover, it should be noted that this model is only an *attempt* to comprehend how appropriateness is constructed by the actors in PLASTIC. Compared to figure 7.1, the model presented here does, however, include more variables and is generally considered to be an elaboration.

Figure 8.1: How actors construct appropriateness



(1) Rules

The set of rules in PD and the color-rule system were not initially designed to be part of the set of rules that became valid from January 2003, and are summarized in table 8.1 below. However, another rule-regime relating to the organizational structure of PLASTIC can also be seen to be influencing PD. This rule-regime lies outside the rules in PD and links resources to the business units, which are independent profit centers with an individual budget and their own resource responsibility. The set of rules in PD include rules for gates, for instance, calculable rules (criteria) by which compliance of the project is analyzed, rules for stages and rules for information and reporting. The color-rule system was added by the portfolio management to manage the PD process, and monitors whether the project has been delayed from the planned end-date. Other monitoring rules include the quality information systems, which are designed to monitor whether the information and recording rules are actually applied by the project managers.

(1a) Rules influence on interpretation

The set of rules in PD competes with the color-rule system. The color-rule system emphasizes time over other criteria such as manufacturability, as was shown earlier, and is

a more appropriate rule to apply. Observation of the November PFMM showed that no projects were designated red, compared to the September PFMM where 11 projects were deemed red and 2 yellow. At the meeting, the portfolio manager stated that it was inappropriate to have delayed projects in a business unit and suggested to the vice presidents that they should be more aware of this in the future. The reduction in the number of delayed projects suggests that the situation has now been recognized, where project delays are not permitted. As a consequence, end-dates become subjects of negotiation, as has also been suggested by the research of Jönsson (2004) who describes the situation where an upcoming gate review at VOLVO was negotiated in favor of postponement due to ambiguity in the development project of the S/V40-model. The evidence in PLASTIC suggests that end-dates can be changed informally, which nevertheless had the consequence of causing some confusion with one project. More importantly, rule competition resulted in interpretation of the criterion, where manufacturability changed from “90 percent possible” to “not impossible to produce”. In this respect, March states:

> “Decision-makers may be faced with deadlines that are inconsistent with required procedures” (1994: 75).

The mobilization pattern of rules in gates was analyzed in the previous chapter and is summarized in table 7.1, which indicates that 38 percent of the rules were applied to all projects in PLASTIC. In particular, portfolio management rules were not evoked in the gate meeting, which can be ascribed to competition from another rule-regime linking resources to the business unit’s budget. The discussion that developed with regard to projects 22 and 24 and later observation and documentation provide proof of such rule-competition. In this case, the vice president who was responsible for these two projects recognized the situation as a decision-situation according to the formal set of rules and therefore evoked these rules in order to requesting more resources for his projects. This was accepted as being part of his identity as an appropriate decision-maker, which was in turn one of the identities constituting his collective self. The vice president was given the decision authority to make these decisions by himself, but this in itself was a deviation from the rules. The chairman’s interpretation was not accepted by the vice president and was in any case inconsistent since the report of the subsequent gate review disclosed that no changes had been made with respect to the end-date or resource alloca-

tion of these projects. Moreover, the options that were realistically available to the vice president were limited since the resources to accelerate these projects could only come from their re-prioritization within the vice president's portfolio. The situation, formally described as Portfolio Management Meetings (PFMMs), was no longer recognized as a decision situation by the vice president, which might explain his reason for allowing the development managers of his business unit participate in the next meeting, as well as his decision to leave the gate meeting two hours early. The last issue on the agenda was portfolio management. The vice president had the group identity imposed on him and was therefore subject to accepting the *in*appropriateness of evoking these particular rules. The vice president did, however, seem to have difficulties accepting this identity since he chose not to participate in the subsequent meeting[35].

To sum up, therefore, not only were the rules in SG inconsistent, due to the addition of a set of rules to monitor delay, but they were also subject to competition from another rule-regime. March explains this thus:

> Violations of rules due to inconsistent demands will increase as rules multiply and become more complex, where coordination is weak, and where independent authorities have the right to impose rules (1994: 74).

Moreover, while the rules in the SG approach generally require decisions to be made, it does not however make sense for the participants to make decisions they presume will not be carried out by their colleagues and project managers. Motivation and acceptance are central issues in this respect, as was identified by the vice president albeit in the mistaken belief that killing a project was practically impossible in PD because of the existence of highly motivated and educated personnel. "It's impossible to stop a project in R&D; people are very motivated and highly educated."[36] This in turn suggests that decisions must be *motivated* in order to have an effect as a behavioral change. Similar observations could also be heard among the project managers:

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[35] It has been attempted to address the dynamics of appropriateness in figure 8.1 (and 8.2) by adding learning as a variable, but as such, is the dynamics of e.g. internalizing an identity not built-in which remains an issue for future research.

[36] One vice president raised the problem of continuing a project which had formally been terminated because it did not have a project number cost allocation in SAP etc., but on the other hand revealed that project descriptions could be so broad at PLASTIC that they did not say anything about the real content of the project in practice. A terminated project can easily be camouflaged without the portfolio-manager (or vice president) being aware of this.

> Project manager: [laughing] we have also seen in this building up here that (50:46) when a scientist wants to work in this direction, he works in this direction.
>
> Investigator: […] despite what has been decided?
>
> Project manager: Despite this. That is exactly what I meant, despite what has been decided […].

According to another project manager:

> If people are not participating in the project, then no matter how fine are the forms you have there is no way you are able to make a decision unless you have enough *interest* to listen to it and to take part in it […] I mean you can buy a technology now, you can buy people with the skills, you can buy a whole business area if you like, but you cannot buy the [0:50:34] scientist if he doesn't want to be bought […] when a scientist wants to work in this direction, he works in this direction [emphasis added].

March argues that "accepting an identity is a motivational and cognitive process" (1994: 62), and as this citation suggests, the acceptance of rules is vital if the rules are to call forth the intended as prescribed by the normative system. A distinct output of a decision-meeting is important in the instrumental perspective, but the evidence indicates that an output from a gate meeting is viewed *jointly* with an evaluation of the behavioral change on the project management-level, so as not to become a 'pseudo decision' with no behavioral impact. With one exception, all projects that were terminated at the gate meeting had in fact been halted prior to the meeting and only once the vice presidents (and the project managers) had come to the conclusion not to pursue them any further. In this respect, it should be noted that it can take up to 14 days for the decision to be communicated to the project manager, an issue which also was raised at the gate meeting. The vice presidents are, however, aware of the importance of motivation with respect to decisions. As one of the project managers says:

> Yes, but you can twist the project in many ways and [34.03] it goes under […] another project, so that is one of the challenges to get right in these unofficial things, and to get people to work on what we committed them to work upon.

Interestingly, the multiple identities that constitute the 'collective self' (March 1994) also encompass an identity that evokes a feeling of duty. Thus, for instance filling out templates in the databases and, in some cases, uploading the documentation required without accepting the role defined by the rule will nevertheless make a project manager continue in his/hers own direction according to another role that determines the behaviour of a proper project manager. In these situations, a difference emerges between what people say they do and they actually do afterwards. Similarly, Argyris and Kaplan (1994) analyzed another management technology, that of Activity Based Costing, and identified what they describe as both internal and external commitment to the management technology in question. Within their own terminology it could be argued that the identity constituted by performing a duty is nevertheless based solely on external commitment. In this respect, March argues that:

> [S]trong external threats or dramatic rewards can be used to explain behavior without the need for internal commitment, so fail to stimulate internalization (1994: 66).

The information and documentation rules, particularly the former, might constitute a strong external incentive to the project manager who wants to upload information to the database so as to ensure that his/her project does not gain any attention (i.e. becomes red or yellow) on account of lacking information. On the other hand, the documentation rules are not followed to the same extent since the majority of project managers interviewed had apparently learned that a lack of compliance did not necessarily lead to any negative sanctions other than the portfolio manager emphasizing improvements in this area at the beginning of the gate meeting. As a consequence, rule-following with respect to information and documentation increased by 11 percent from the September PFMM to the November-PFMM, but this could still be based on actions resulting from a sense of duty (contractual identities) rather than on internal commitment (internalized identity). Consequentially, March puts more emphasis on motivation through rewarding an identity than rewarding behavior:[37]

[37] The managerial implications of this will be discussed in a forthcoming chapter.

> People are asked, for example, to sign a petition to show they are ecology- or community-minded. The act is minor, but the interpretation of being a certain kind of citizen is made explicitly by outsiders. This is, of course, usually in the context of being rewarded for being that kind of citizen (1994: 66-67).

Finally, actors are more likely to fulfill identities where they see themselves as effective (March 1994). Here, the evidence suggests that it is more fulfilling for actors not to be concerned with being delayed, according to the distinct criterion of time, than to evoke rules where the necessary criteria are not fully understood, either due to their ambiguity and or their conduciveness to manipulation. Compared to other criteria, time is therefore a more distinct criterion to mobilize.

The vice presidents have different backgrounds, which fall into two broad categories: either economic or what can be described as 'technical/chemical'. The vice president, who attempted to mobilize the portfolio management rules with respect to projects 22 and 24 had a background in economics, but the majority of the vice presidents have gained their education at a technical university. Furthermore, the new portfolio manager, who also had a technical/chemical background, argued for the impossibility of making post-calculations. Assuming this impossibility is a common perception among decision-makers at the gate meetings, where the economic criteria do not seem to be a legitimate rule for others to evoke if they do not have a background in economics. By this, it is however not being claimed that actors with the technical/chemical background cannot comprehend calculation, only that the criteria associated with this role is perceived as more effective to apply and therefore more frequently evoked than other criteria. This line of reasoning might be one motive for not introducing output control of the expected NPV calculation after the product has been launched. Instead, only sold kilo tons is monitored.

(2) Observation of others

As March notes, "An identity is a conception of self organized into rules for matching actions to situations" (1994: 61) and is fulfilled by observing others, since actors aim to be socially reliable. The gate meeting was one such occasion for participants to observe each other's behavior and to confirm their interpretation of what ideally constitutes a decision-making situation. A member of the executive committee should have partici-

pated through video-conference, but was unable to do so due to technical difficulties. As a consequence, the participants did not have an opportunity to observe a higher level of hierarchical behavior, but vice presidents are nevertheless aware that rule-deviation is not sanctioned by the executive committee. The same applies for the project managers, who observed that vice presidents did not use the uploaded information and documentation despite the fact that several projects had complete information and documentation available.

(2b) How observation of others influences rule interpretation

As already established, the decision situation does not involve portfolio management decisions but rather the attention that is being paid to whether each individual project complies with the calculable rules (must meet criteria). The formal rules do, however, force respondents to recognize the situation, also as a portfolio decision-situation – as became evident when interviewed about the gate meeting. In this sense, the set of rules prescribe how the situation ought to be recognized, but, on the other hand, social approval is also gained by fulfilling the identity that has been outlined above, since attention is directed outward toward the group rather than inward to the participants. A vice president reflects his self-image in other fellow vice presidents, confirming his interpretation of the situation and the identity as a proper vice president rather than with the behavior of the member of the executive committee who did not participate (and might have required decisions). Furthermore, in order to be socially reliable with the group, inappropriate actions disrupting the distribution of resources were not undertaken, as the example of the vice president and projects 22 and 24 illustrate (see section 7.3.2 above). Social reliability could, however, have affirmed a new role for the vice president through the participation of the member of the executive committee and his potential efforts to evoke the rules that otherwise were perceived as inappropriate by the group of vice presidents at the gate meeting. As a consequence, one role of the vice president is to protect his budget and the resources of the business unit; a possible cut in projects would also mean a cut in resources.

The rule-mobilization pattern for information and documentation rules was shown in figure 7.2 above, where it was indicated that documentation rules in particular were not followed and that a project manager could still indicate that a business plan has been

made although it had not been uploaded as the market plan. The project managers observed that rules were deviated from in the gate meeting and furthermore recognized that it was a situations where portfolio management decisions were not to be made. Some project managers, however, were concerned at the outcome of the meeting, particularly if their projects had been designated as red, since they recognized that the situation constituted a formal check on project progress but necessarily one of being a decision situation. Moreover, the newly appointed portfolio manager suggested that a problem of motivation arose for project managers when vice presidents did not use the rules, as the project managers then observed that higher hierarchical levels deviate from rules as much as they observe their colleagues to do so. In sum, what rule is appropriate to use depends also on observation. Proper behavior is defined through observation and, consequently, establishes social reliability.

(3) Contexts

The company has a history of creating breakthrough innovations and has the reputation of being an innovative company (according to respondents). Many of the actors have already been part of the company's merger with four other companies since it was established in 1994. The respondents argue that different company cultures are no longer a problem, but that national differences can pose a problem particularly with regard to differing attitudes towards rule-following. The social context is to some extent influenced by a corporate identity that has been implemented as a new set of corporate values, ideally to influence the behavior of actors. The interviewed respondents, however, suggested that these values are defined so generally that they cover just about everything. Nevertheless, downsizing in R&D, the removal of decision authority, and the organizational placement of 'D' under the Business Units, indicated to the project managers that (long term) innovation was no longer considered a legitimate concern. Stretched resources and thus a lack of funds for experimentation together with the emphasis placed on customer-driven development by the business units suggests that PLASTIC is currently in a phase of exploitation rather than exploration (March 1994). The company has an operating profit of €85 million (2003), corresponding to 2.5 percent of the turnover, and all respondents – including project managers – argued that this constituted a serious problem for the future of the company. Project managers particularly from

R&D, however, maintained an attitude of resolving this issue through exploration since they believed that the key to future profits lay in radical innovation and the development of new products for other business areas currently not yet defined. This difference in attitudes between R&D and the business units might also be a reason why the issue of selling patent licenses is still unresolved at PLASTIC, which to R&D is crucially perceived as a key to increasing profitability whereas the business units perceive the development of new products as taking turnover away from existing sales. Finally, the actors perceive the context itself as ambiguous, which, for instance, sometimes makes it legitimate to terminate a project that was considered technically infeasible. On the other hand, market reasoning does not seem to constitute the same legitimacy, perhaps in this case because of the vice presidents' respective backgrounds.

(3c) The influence of context on rule interpretation

Many actors are influenced by the historical context of a company where exploration was once considered legitimate, but is now witnessing an increased focus on the short-term and exploitation. This is a possible reason why the vice presidents are focused on demonstrating short-term results, which, as a consequence, invariably lead actors to seek fulfillment of an identity rooted in securing their budget and their 'own' resources rather than concerned with the company as a whole. This would otherwise have made changes in resources legitimate through the mobilization of portfolio management rules, as can be seen in table 7.4, where the distribution or ratio of the portfolio is settled amongst the vice presidents. Moreover, whether radically new products can actually come out of the work of R&D is considered to be more a result of chance than deliberate management on behalf of the vice presidents, even though respondents did not assume that the rules impede any form of radical innovation instead of facilitating the innovation process. The vice presidents are in fact more focused on incremental customer-focused developments which are undertaken in the business units as a substitute for push-based radical innovation from R&D. The overall impression of the company's own interpretation of its situation is that of an attitude which is more fixed on exploitation as a substitute for exploration. This also goes some way to explaining why the design of the new set of rules, including the disenfranchisement of project managers and the decision not to design rules that would facilitate portfolio decision-meeting e.g. the

should-meet criteria and the 10-point-Likert scale, illustrates the level of agreement and indeed disagreement between decision-makers in the gate meeting.[38]

In conclusion, it seems to make more sense to the decision-makers to recognize the situation as one of exploitation and therefore seek to secure their 'own' portfolio. The mobilization pattern identified in table 7.1 is consequently intentional and does not arise as a result of, say, overlooking rules or deficiency in competence. This interpretation, moreover, seems to be stable, since it remained unchanged in the following meeting. Information from the latest PFMM-meeting, however, suggests that two new projects, which had been pre-approved prior to the meeting, were in fact not approved in the subsequent meeting. This was the first attempt to initiate resource decisions approximately one-and-a-half years after the introduction of the new set of rules. Project managers also recognized the seriousness of the economic situation, which further influenced their identity and, together with the monitoring of possible delays, made their attempts to secure the project according to the project plan more appropriate than reformulating the project altogether. Even when a better idea was developed in the course of the project, this was identified as problem by some project managers. In addition, the criterion of manufacturability was interpreted to include the appropriate number of test rules required.

Moreover, since the context was often perceived as ambiguous, this necessarily had an influence on the criteria that were evoked during the September PFMM. Calculable rules, such as the expected NPV calculation, would have been one of the should-meet criteria enabling a closer analysis if the projects had been discussed in the gate meeting.[39] The actors in the meeting did not, however, raise any objection or even make a comment when one meeting participant stated baldly that "we can easily increase it". This suggests that calculations are *not* treated as equivalent to the more complex reality they purport to represent, as was suggested by March:

> They create "magic numbers" (e.g., "profit", "cost of living") for complex phenomena, treating the numbers as equivalent to the more complex reality they represent (1988: 26).

[38] For differences in the normative systems, see section 5.4.
[39] Refer to chapter two for a description of the normative system as outlined by Cooper et al.

As was also argued by a General Manager, the purpose of the new calculation rules (criteria) was not to generate programmed behavior (Simons 1954) that conformed to rules within the instrumental perspective, but rather was not to:

> ...produce precise calculations, but to influence the mind-set of people and make them think in terms of profitability.

The numbers represents a complex reality to the vice presidents, but they still insist on project managers making these calculations. The immediate purpose is, however, not to produce rational calculations in the instrumental perspective, but rather to influence the identity of project managers, as is evidenced by the above quotation. This aim is different from the normative rule system.

(4) Learning

The interpretation of rules is also influenced by learning. Rules do not fit all situations, and therefore require some fine-tuning through experiential learning in which the outcome of actions forces actors to interpret rules and subsequently teaches them how to interpret rules when the next situation occurs (March 1994). In this study, this learning process could be identified with respect to both project managers and vice presidents. The latter learned that the problems relating to portfolio management were not resolved according to the formal rules. Instead of evoking these rules, however, which were in fact impeded by competing rules (see section 1 and 1a) and which were not recognized as a decision-making situation at the gate meeting, the portfolio manager designed new types of rules to regulate the problems. As previously analyzed, the vice presidents did not, however, possess sufficient competence in using these new rules and therefore did not evaluate them as appropriate either. Neither was the problem appropriate to solve.

(4d) Learning, rule interpretation and application

The application and interpretation of rules can be influenced by the complexity of rules and competence in using rules. A common criticism of project managers was the general lack of training in the new rules, as well as the recognition that rules did not fit all situations and therefore had to be interpreted. As one respondent put it:

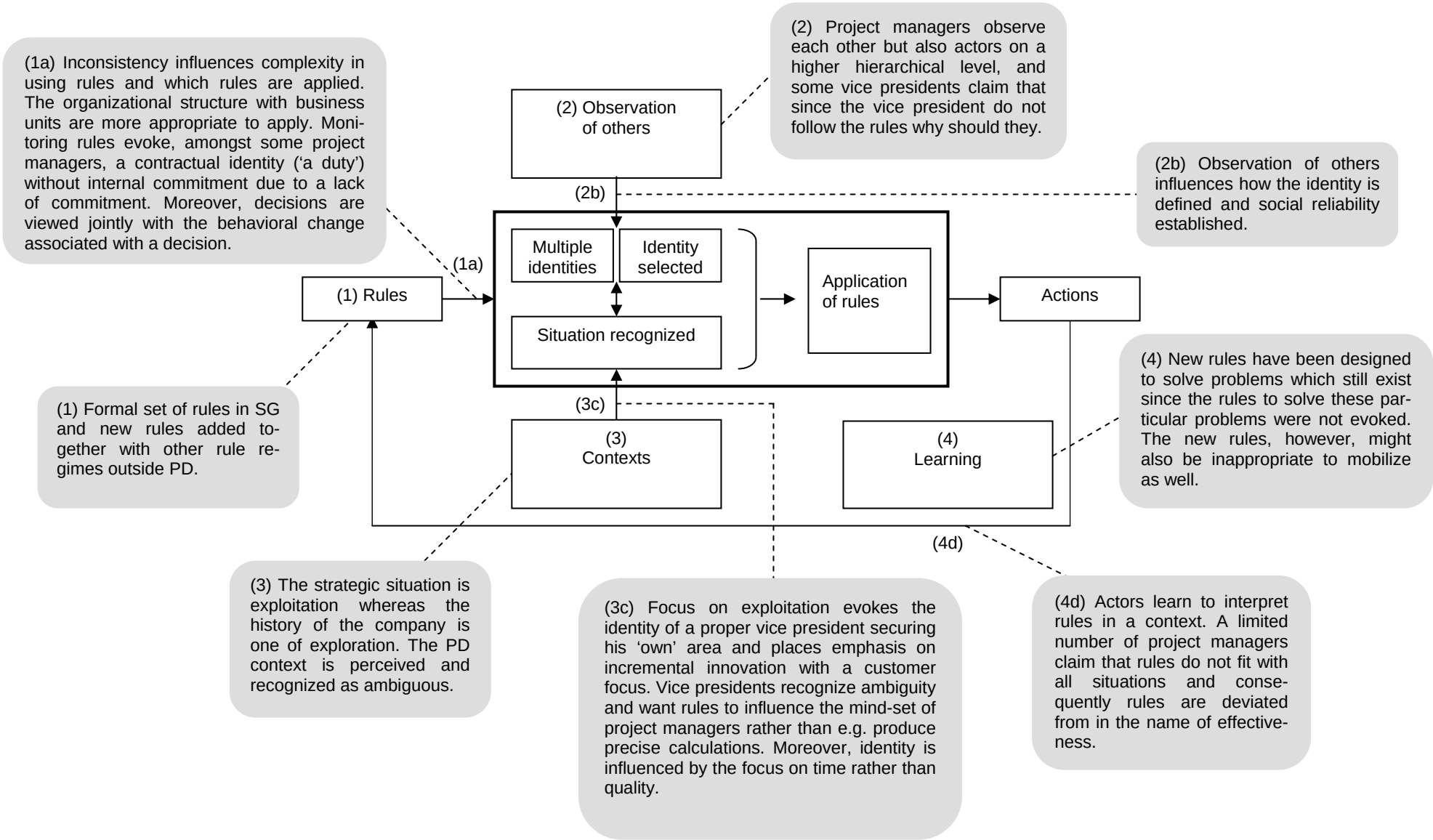
> But after, say, three, four years of usage people had already realized how to use it effectively and that was, that was the thick book on how to use, PD&I, but only say one fourth of the book […].

Some project managers in fact learn when a deviation from the rule is more appropriate since the rules of the SG approach do not fit all projects in all situations either. In this way, a project manager claimed that his project was unique and went on to describe how he had wasted two months on market research, which ultimately proved the process infeasible. This outcome did not, however, trigger the formal development of more elaborate rules or even the abandonment of this rule, as would have been expected. March indeed argues that rules are more likely to be deviated from when the rules are not easily changed, "Violations in the name of effectiveness are more likely when the rules are relatively rigid than when they are easily changed" (1994: 74).

This citation emphasizes that performance (effectiveness) is an important issue when evoking performance arguments over, say, rules prescribing activities to be carried out. In this case, the experience of wasting two months led the project manager to suggest that he would henceforth seek the help of a more experienced project manager, and work out which rules to use before starting the project. The outcome of using that rule therefore made the project manager more discretionary in rule application. March (1994) suggests that the 'hallmark' of the experienced decision-maker is knowing when to deviate from the rules. The same can be observed at the project management-level where rigidity (not changeable rules) and insistence on formality in PLASTIC added to the complexity of working with projects in PD, and the hallmark of the experienced project manager really was to know when to break rules. However, as one respondent testifies, the rule of making a 'business case' in stage 2 was not compatible with all situations:

> I went through everything and I tried to do … I tried to do a market plan, which is impossible for my project, which it only turned out to be after I had tried it for two months (project manager).

Figure 8.2: How decision-making in practice is constructed by actors



As already mentioned, learning also took place for the portfolio manager where the problems associated with portfolio management were not solved. This in turn gave birth to a new set of rules to handle resource-allocation. At the time of the interviews, vice presidents had only limited competence in these new rules, but were generally very skeptical of them, maybe due to the inappropriateness of making resource decisions across business units and because of an awareness that the solution needed to be found elsewhere. Instead of evoking the existing rules, the portfolio manager designed a new set of rules to solve the problems through visibility in resource-constraints on the organization. As suggested previously, two new projects were terminated one-and-a-half years after the new set of rules had been introduced into PLASTIC, and it seems an obvious conclusion to suggest that the vice presidents will in turn deviate from these rules. Moreover, the vice presidents also learned that compliance with the €90 million goal was accomplished not by accelerating projects and maintaining the interpretation of deviation from the portfolio management rules, since these were not sanctioned. Most focus seemed to be placed on budget, which required each business unit to manage resources according to their own interpretations. Social reliability was achieved by not disrupting the interpretation of the appropriate rule mobilization pattern.

8.3 CONCLUSION

The construction of appropriateness in PLASTIC is summarized in figure 8.2, where the boxes in grey represent a summary of the discussion above. Rules in the SG approach become a management technology through actors. Actors base their actions, either intentionally or unintentionally, on achieving a match between what they interpret as appropriate when recognizing a situation with the identities defined. This line of reasoning is, however, different from the rationality inherent in the normative management technology, where actions are assumed to be conformed in accordance with prescriptions. As such, the rationality claimed by the normative SG approach is *derivative* of appropriate rule application. Only if rules representing instrumental rationality are appropriate to evoke are they applied. Thus, it can make sense to actors in the organization not to follow the prescribed rules, as

the analysis suggests, but it can also make sense to follow the rules if they are considered appropriate, which seems to be the most widespread attitude amongst the project managers interviewed.

The instrumental rule perspective claims that some of the deviations can be ascribed to the design of the rules, but without the acceptance of actors, the rules in the SG approach become illusory. PLASTIC maintains the formality of rule-following, but at the same time, the company is in a phase of exploitation with respect to resources, which includes exploiting the present portfolio of new projects and continuing to strain resources, to the extent that the required 20 percent allocated for experimentation is not made available. The proper behavior of the vice presidents is to focus on their own business unit and secure the necessary budgets and resources, instead of concerning themselves with the company as a whole. Group identity is strong and one vice president who attempted to behave inappropriately while at the same time following the formal rules waived this undertaking and, to some extent, consequently had the group identity imposed upon him by way of sustaining social reliability.

Formality is maintained in PLASTIC, but it could prove a viable rule strategy to make rule-following a discretionary matter, which seems to be the appropriate interpretation in practice anyway. Instrumentality would, however, claim to increase not only elaborateness but also exhaustiveness, which, within this line of reasoning, would make the PD process more manageable through, for instance, the use of should-meet criteria. Interestingly, MACHINERY seems to have accomplished manageability by paying attention to both perspectives. The owner of the company was present during the gate meetings, and thus able to make decisions, and R&D was regarded with more legitimacy. A designated department was responsible for securing learning's with rules and project managers were, moreover, expected to apply rules only as a guideline (appropriate to their project). Through this, rigidity was avoided, even though the level of elaborateness (and exhaustiveness) was increased simultaneously.

It is obvious that one can speculate more about the possible implications and ramifications all this has for management. This will be the focus of the next chapter, which will also

return to the questions framed in the first chapter of this study in order to provide some answers.

CHAPTER NINE

Conclusion and implications

The purpose of this chapter is to return to the problem stated in the introductory chapter and formulate a conclusion and answers to the questions framed there. Moreover, the chapter will take the findings and the conclusion one step further by speculating about the implications for the management of PD processes and discussing the implications for theory and future research. Finally, the contributions are summarized. The chapter is structured accordingly.

9.1 CONCLUSION

Returning to the first question framed in the initial chapter of this study, the SG approach has been described. Conceptually, the PD process is a management technique dividing the PD process into distinct stages divided by gates (decision-making points) and prescribes the activities in the stages and gates that are necessary to undertake in order to achieve the promised performance, such as increased effectiveness and reduced time-to-market. The analysis suggested that prescribed activities which should be carried out are more elaborate in the gates, but also that the research underlying the model was based more on instrumental research than a sociological understanding of actors and their behavior.

The notion of bureaucracy and rigidity raised by the previous literature inspired the study to understand the SG approach as rules, which was underlined by the number of

similarities between the ideal Weberian bureaucracy and the normative, conceptual model of SG. The primary characteristic of a bureaucracy is rules and subsequently, the SG approach was translated into a set of rules as a way of understanding rules in the organizational practice surrounding PD. Standard operating procedures were introduced by Cyert and March (1992), and the analysis indicated that the set of rules in the SG approach could be aligned with the types of rules inherent in a standard operating procedure. These authors, however, in the epilogue to their book, introduced the notion of appropriateness, but did not elaborate on the implications for the standard operating procedure based on this very notion, which is one of the contributions of this study. Thus, answering the second question framed in the first chapter of this chapter, formal rules in organizations can indeed be studied through the perspective of instrumentality inherent in an standard operating procedure and the ideal Weberian bureaucracy, but also through the perspective of appropriateness which enabled a behavioral understanding of the relationship between actors and rules by which the activities are not automatically conformed (Simon et al 1954).

The third question concerns the implications of the instrumental perspective. At – what was characterized as – the organizational level, three analyses were carried out. First, it was established that the five companies in question all employed an SG-influenced model for designing the formal rules of their PD processes, but that variation could be detected with respect to the two dimensions of exhaustiveness and elaborateness. Secondly, the formal and structured approaches appeared to provide the process with stability and predictability, but the rules were changed, however, two or three times in a ten-year time perspective when the companies had gained sufficient experience. Thirdly, some of the promised effects of the Weberian bureaucracy could be identified including the removal of ‘random’ projects and ‘friction’, but PLASTIC, in particular, could not remove lobbying, even though some friction had been reduced. Stability could also be accomplished in the short term of two or three years. The company had recently reverted to a facilitated SG approach rather than the third generation and was the only company under investigation where rules were analyzed as very exhaustive and with a normal level of elaborateness. In addition, PLASTIC and PAINT were the only companies that met the requirement for formal compliance with the formal rules. The rules in PLASTIC were disclosed at the level accessible for investigation (limitations

were described in the initial study), and the detailed analysis of exhaustiveness pointed to a number of differences, such as that the rules of PLASTIC not included should meet criteria and therefore support consensus among decision-makers.

The final question departed from the perspective of appropriateness. Among the findings in the first chapter analyzed from this perspective was that the general attitudes to rules differed among the analyzed companies. Three companies viewed rules as guidelines, whereas at PLASTIC and PAINT rules must be followed obediently. Moreover, a variation with respect to gates, information and documentation and stages was identified. Rules seemed to be applied at the discretion of the project managers, whereas the gate rules and preparation of documentation were kept formal. Rules influence the identity of actors but not homogenously since differences could be identified among different groups with different educations and departmental associations. The conclusion of the first appropriateness chapter was to argue that rule-'following' is a construction of which appropriate rules should be applied, rather than programmed activities shaped by rules (Simons, 1954). Building on this chapter, the next chapter first of all undertook an analysis of the variation in rule application and disclosed a rule mobilization pattern with respect to gates (38 percent), information and documentation rules (67 percent), and stage rules (40 percent). The percentages express the extent of rule-following and the difference to 100 percent is the deviation from rules. Subsequently, the chapter investigated rule deviations and attempted to explain why only some rules are followed whereas others are not. The analyses indicated that rules in the SG approach in particular create inconsistent demands, and rule-regimes from outside compete with the rules of the SG approach. Moreover, analyses in both chapters indicate that in some cases rules have to be fine-tuned to the situation, and the ambiguity omnipresent in PD makes some projects unique. The findings in PLASTIC also included the fact that problems not solved by the rules generated problems elsewhere in the organization. Yet even though rules are designed to cope with these problems, it may be inappropriate to solve them. Consequentially, rule-following in the instrumental perspective is subject to a 'filter' of appropriateness, and subsequently, the last analytical chapter attempts to understand how appropriateness is constructed in PLASTIC but also to summarize the implications of applying the instrumental rules within the context of appropriateness. More-

over, the aim of the last analytical chapter is to understand the rule mobilization pattern and point to possible explanations as to why rules are deviated from.

Returning to the problem initially stated to guide this study, the rules in the SG approach do become a management technology through these very rules since they indeed shape the actors. The performance imperatives claimed to be an effect of SG can be achieved to some extent, but the management of the PD process does not seem to be as straightforward, however, as otherwise claimed by the normative literature and the management technique. Without recognizing members of the organization as actors pursuing another type of rationality than the instrumentality normatively inherent in SG, the technique becomes an illusory *technology*. The collective self of an actor consists of multiple identities that are dynamic and, furthermore, these identities are evoked under circumstances that must be made apparent if the PD process is to be managed. Rules require an interpretation of the context in which they are to be applied. As a result, discipline can result from an appropriate application of rules, but is not an automatic effect of formality and rigid rule employment. As such, the rationality inherent in the conceptual model of the SG approach becomes a derivative rather than an existential condition in PD.

Companies maintaining the requirement to comply with the rules to the full experience resistance within the organization, since it makes sense to the actors in some situations not to follow the rules because the situation cannot be recognized as being in accordance with the rules, thereby making it more appropriate to apply other rules. Moreover, inconsistent demands can be placed on actors in PD, and the interpretation depends on how actors identify themselves and recognize the situation. A particular model of appropriateness was developed based on the analyses of PLASTIC including the interpretations of the situations and how and why actors identified themselves as they do. This model is also a contribution to the understanding of appropriateness, and does for instance disclose that the perception of situation of PLASTIC as severe makes the interpretation of time-compliance more appropriate than securing manufacturability and freeing resources for experimentation. The situation of PLASTIC was interpreted as exploitation. The identity of the vice presidents as a group is strong and the interpretation of the situation is stable since the vice presidents – evoking an identity of mobilizing portfolio management rules whereby the projects could have been prioritized – waived

this undertaking in order to be socially reliable. Compared to the cross-case analysis, the analysis indicates that gates might be subject to rule-deviation more than stages. Moreover, some performance-monitoring rules can constitute such an external threat to the actors that the evoked identity is more contractual than internalized and subsequently without internal embedment because of a lack of commitment.

In summary, the rules in the SG approach can become a management technology, but since the application of rules is determined by recognizing the situation, evoking or defining a new identity, competence in applying the rules, motivation and commitment (see figure 8.1 and 8.2 in chapter eight).

Previous research involving the SG approach focuses on decision-making functionality, suggesting that the model is an impediment to creativity, and finally brings attention to the issue of rigidity. Furthermore, Hamel (2000) advocated that structured and formalized approaches like SG become 'bureaucratic' and therefore impede innovation. A return to decision-making rules is indeed influencing here. Also from an instrumental perspective in which projects are compared with the criteria prescribed by the rules, but which are inconsistent in practice influenced by ambiguity as an underlying condition, rules created inconsistent demands on the actors. Emphasis by the chairman of the meeting is on consensus rather than disagreement which was explained by competition from another rule-regime. Performance measurement and performance focus were never a distinct purpose of this study, but the evidence seems to *indicate* that neither creativity nor innovation are impeded by rules. Quite the contrary, since the rule-mobilization pattern showed 80 percent rule-deviation in the first two stages of the SG approach in PLASTIC. Respondents did not complain about a lack of ideas, even though it could appear so, since the deposits of the idea bank were the not usable, but complained about a lack of resources for making experimentation with these ideas in order to substantiate their validity as a viable idea. Returning to the issue of rigidity raised by the previous literature, rigidity is a complex phenomenon to comprehend and requires understanding from both perspectives. Cyert and March (1992) argue from the perspective of instrumentality that choice and control depend on the elaboration of standard operating procedures, and the data seem to support that more elaboration could reduce some complexity. Furthermore, some problems are not solved, which moved the problems downward in the organization. From the other perspective of appropriateness, rules are not

perceived as either rigid or bureaucratic by the actors if they are interpreted as appropriate, which comes back to the model and what is required to make rule 'following' appropriate.

In conclusion, within the limitations previously described, it is claimed that innovation can be managed through rules, but that making it work in an organizational practice is a complex undertaking, however. The management technique can become a technology through the appropriate shaping of actors, which requires leadership rather than management since the keywords are commitment, identity and promoting an identity, rather than controlling behavior. Rules should be *appropriate* to 'follow'.

9.2 SPECULATING ABOUT MANAGERIAL IMPLICATIONS

March et al (2001) presented four images of rules[40]: Rules as rational efforts to organize. This was the initial motive by top-management when employing the management technique and the motive for the design inherent in the conceptual model described in chapter two through the division of the PD process into phases and structured activities. Similarities between the SG approach and Weberian bureaucracy were also identified in chapter four. Rules as proliferating mechanisms that generate even more rules. Project managers learned that some projects are unique and therefore cannot be distinctly categorized into a set of rules, which in turn constitutes a new rule of not following the existing rules, but since only formal rules were subject to investigation, it is difficult to develop this further. Interestingly, however, based on an analytical approach[41], new rules were designed in PLASTIC. The problems of no portfolio management and the evaluation of projects compared to other projects were solved by designing new rules, instead of following the formal rules ideally to solve these problems. The rules were inappropriate to evoke as the mobilization pattern showed in chapter seven, however. The evidence could suggest that rules generate more rules, since the new rules were designed to solve an 'old' problem, and also indicated that the new rules became just as inappropriate to evoke since the problem in itself was inappropriate. Rules as constructions of meaning have already been established in the previous chapter and in the dis-

[40] Please refer to chapter one.
[41] March (1994: 78) describes five processes by which the rules and environment are intertwined.

cussion above, for instance, with calculations, but the evidence does not support an analysis of whether an organization wants to be known for these rules. Nevertheless the CEO of MEDICO precisely stated that the reason for the success of innovation efforts (winning the innovation award 2002) was the military discipline by which they employed the SG approach. As chapter six indicates in particular, the practice surrounding PD differed somewhat, possibly indicating that at this company, rules were a symbol to the surrounding world. Rules as coding of history were precisely what was observed at PLASTIC. Rule dynamics were never an explicit subject of analysis, but the problems of too many projects were associated with the empowerment of project managers which was the reason for the new version of the set of rules for managing PD. To sum up, the four images described above propose an understanding of how rules are used through the two perspectives employed in this study: instrumentality and appropriateness.

Within the appropriateness perspective, the role of management should be associated with leadership rather than control when the innovation process is to be managed. Bass & Stogdills argue that, "What leaders really manage in organizations are the employee's *interpretation*s or understanding of what goes in the organization," (1990: 10, emphasis added). The perspective of appropriate rule application is precisely concerned with interpretations, but particularly with recognizing the situation in which the actor finds himself matched with the definition of the identities possessed by each individual. Interpretation requires motivation and commitment and, moreover, actors are generally in constant pursuit of being socially reliable. The latter is observed by observing others and was a result of the different variables identified and described in the previous chapter. As such, management techniques become a technology through leadership. Thus, it could be argued that insisting on formality and maintaining a structured approach, dividing the PD process within an instrumental perspective, is not the way to manage the PD process. As discussed in appendix F, the practice surrounding PD indicates that PLASTIC is *integrating* stages, yet formality is not upheld, although this is mandatory. This is remarkable, since the SG approach is associated with precisely these properties.

Appropriateness revealed a complexity of rule 'following', but also that, for instance, MACHINERY had devised a number of anti-anti-programs (Latour 1991) in order to make the PD process manageable including the division of R from D with two distinct processes, particularly reducing the technical uncertainty of development. A department

was given the responsibility of ensuring learning with rules in order not to produce a perception of rigidity with the increasing elaborateness of rules which in turn reduced the level of complexity when managing projects, the participation of top-management in selected gate meetings (3 and 5, see appendix F), and a centralization of the R&D organization. Although stability was demonstrated as an instrumental effect in the short term (2-3) years it must be supported in a *dynamic* perspective where the learning is picked up, since standardization can only be accomplished to some extent and uncertainty reduced. Ambiguity still makes some projects unique (see appendix H).

Weber argued for the dehumanization of the ideal bureaucracy: “Je mehr sie sich entmenschlich[en], je vollkommener” (Weber 1972: 563). The ideal bureaucracy cannot be identified to a full extent due to ambiguity, and actors pursue another type of rationality, although rules actually influence the PD process. In Weber’s statement, the organization is more important than human beings. But the findings in this study indicate, however, that without recognizing people in organizations, the management of innovation through rules turns out to be an illusion. Rules influence identities (but organizational identity does not become homogenous), they impart meaning as a language, they are interpreted and some are followed unconsciously; some are followed in an interpretation whereas other rules are more appropriate to evoke. Moreover, mandatory rule application from an instrumental perspective does not seem to be an appropriate way to undertake the management of innovation through rules exemplified by the companies applying a third generation, compared to companies that insist on a second–generation, facilitated, SG approach, which PLASTIC reverted to.

Finally, Davila (2000) requested more enquiries in the initial chapter on why control systems are important to performance, and although performance never was a distinct object of analysis, the evidence suggests that management control systems can affect performance through appropriate rule application. Even so, the relationship between control systems and performance can be much more complex than assumed by normative management techniques. The causal relationship is more *indirectly shaped* than directly – as also argued by Miller and O’Leary (2002) – through the interpretation processes described. Studying the appropriateness model can, within limits, be regarded as a contribution to management control in innovation since the focus has been on explaining. Whether calculations can be precise in PD is still an unsettled issue, but as explic-

itly argued by a respondent, the purpose of management control is through calculations, not precise calculations, but calculations that influence the mindset of actors to *think* in calculation: an example of indirect shaping.

9.3 IMPLICATIONS FOR FUTURE RESEARCH

The study has produced a number of implications for existing literature, which in turn point to further research in a number of areas separated in the two perspectives of appropriateness and instrumentality respectively:

9.3.1 Appropriateness

Appropriateness was constructed in the previous chapter. The model of appropriateness proved to be quite complex, and it could prove to be an interesting path to pursue by mapping out the relationships between these variables in more detail than done here, including an observation of the project managers. The model was not particularly focused on the dynamics of appropriateness albeit learning was built-in, and a new role or an internalized identity will also have an effect on how rules are interpreted or which rules are evoked, which suggest that the model of appropriateness should be further explored with emphasis on *dynamics*.

Furthermore, an attempt could be made to understand the "matching" of situations with identities and the search and recall process in which rules are applied more comprehensively. This could be a lifelong undertaking, but might be interesting since organizational identity seems to be an increasing concern, also with respect to change and brand management. March (1994) argued that identities could be imposed but also *created*, which suggests a closer understanding of the processes in the perspective of appropriateness, particularly with actors in PD, perhaps through more psychological focused literature e.g. Weick (1979, 1982). Part of this analysis should include norms and informal rules in general, since these are one of the limitations to the study undertaken here. The findings indicate that the interconnectivity among rules is also important, since they compete for the actor's attention. Yet they also indicate that the rules are interconnected since problems can move around different organizational hierarchical lev-

els without being solved, but also across organizational areas – like the financial responsibility of the business unit to R&D – and that seemingly functional areas far from each other compete for attention.

The notion of 'objective' decision-making with 'objective' criteria was challenged by the findings of these studies. The information to be documented for decision-makers was compromised and, even though it was available, the information was not used by the decision-makers. Appropriate decision-making is much more complex, and it did not make much sense to the vice presidents to make decisions when they suspected the decision would not be executed, for instance. Consensus appears to be important to PD practice, by contrast with the normative theory on PD that emphasizes, for instance, that disagreement among decision-makers should be disclosed, and it could be interesting to pursue the role of consensus vs. non-consensus in decision-making even further.

9.3.2 Instrumentality

Instrumentalists might also take a further interest in appropriateness but would focus, for instance, on how long time it takes before an identity is imposed by a rule system. The SG approach, and probably many management techniques in general, is transformed into a set of rules in an organizational practice, and instrumentalists would like to identify things like the limits of rules in the sphere of actors, which cues evoke which identities, etc. Moreover, the total numbers of procedures that actors can cope with would be of particular interest and raised a number of 'design rules' for employing management techniques in an organization.

All investigated companies operate as B-t-B, and it would be interesting to have included B-t-C companies in the investigation as well in an attempt to analyze whether contingencies such as industrial conditions are different if they are more volatile, for instance. In general, it might prove interesting to develop the contingencies and include performance issues more directly in the study. Moreover, rule application could be investigated, as could a linking of the balance between formal rules and norms with the competitiveness of the company.

The evidence indicates that not all performance criteria (calculable rules) can be applied simultaneously to the same extent. Time appears to be the most important criteria to comply with at PLASTIC, due to the interpretation of the exploitation situation and a

short-term focus, demonstrating quick results, but which also may be due to a perception of this criterion as more distinct than other criteria that require interpretation. Quality could be compromised as the number of test runs, for instance, had been reduced, which in turn made resource management even more complex because more resources had to be allocated to fixing problems with products already launched on the market. Rosenau and Moran (1993) pointed out the problem of complying with all criteria simultaneously but did elaborate on the relationship between these variables, which could be an issue for further enquiry.

The cross-case analysis conducted in chapter five (and six) could be further developed with a stronger focus on the differences among the case companies based on a contingency perspective (e.g. Lawrence and Lorsch, 1957). For instance, it could be interesting to pursue the link between the strategy of the company and how they design structured and formal approaches to PD. Moreover, performance issues could be further elaborated and linked to how formal and structured approaches are applied also within a contingency perspective.

9.4 CONTRIBUTIONS IN SUMMARY

As in the first section of this chapter, the four questions raised in the first chapter (see section 1.4) are addressed by an accordingly structure where the contributions to each question are framed in summary based on what has been learned in this study.

(1) What constitutes the SG approach and what issues have been raised regarding the approach in the previous literature?

- Previous studies on SG were analyzed in chapter three and it was found that these studies have been dealing with the main issues of idea generation, rigidity, the division of the PD process in stages. These studies have been based on a number of different approaches such as single and multiple case studies, consultant observations, and surveys – and almost all from a normative perspective.

- The contribution from the present work compared with prior studies is that my study makes an explicit theoretical standpoint (instrumental and appropriate perspectives), I study the SG approach in a "rule perspective", have done both exploratory multiple case studies and a in depth case study, and have included general observations and detailed observations from decision making situations (gate meetings)

- The SG approach was analyzed (in chapter four) and was identified as: An administrative management technique, based on sets of rules regarding information needed, calculations to be performed and how to make decisions. Overall one could characterize the SG approach as based on a rational choice model to be applied on the innovation and product development process (an engineering view). Thus, the present study represent a new approach to the study of SG by introduction of the appropriate perspective on decision making.

(2) How can rules in organizations be studied?

- The study of rules is not new in research on organizational behavior, but this perspective is new when studying management techniques for management of product development and innovation. In chapter four, previous research on organizational rules was outlined, and a framework for the study of "innovation rules" was derived. This is a contribution from the present work. The developed framework focuses on the study of rules by analyzing how rules are applied appropriately to the PD process. The model presents important factors and some processes that can explain how organizations and decision makers make "appropriate" gate decisions.

- Another contribution to the study of rules for product development management is the definition and application of two perspectives on rules: The instrumental perspective, and the appropriate perspective (in chapter four).

- *The instrumental perspective* is based on the assumption that actors follow administrative rules in a programmed way (Simons, 1954) with 'no questions asked', ideally to the extent where the organization is dehumanized (Weber, 1968). There are four types of instrumental rules: information, records and reporting rules, plans and planning rules and task performance rules which all could be aligned with the SG approach (see table 4.2).

- *The appropriate perspective* is based on the assumption that individuals (or organizations) are assumed to ask the following questions: what kind of situations is this (recognition), what kind of person am I (identity), and a match between these two: what does a person a person like me do in a situation like this (rule application). March (1994) suggests the logic of appropriateness also is rational but however of another type than the instrumental perspective.

- Also, a model for the study of how rules, organization and actors engage in the "appropriate decision making" is developed and presented in chapter seven and eight. This model is new in the study of organizational decision making and in the study of product innovation. The model is subsequently applied to analyses in chapter seven and eight.

- The application of these two perspectives on rules in product development is new, and it is also new to apply two perspectives on the study of rules in the same study, but also a challenge for the researcher doing the research.

(3) What are the implications of rules in an instrumental perspective?

- Even if rules originates from same set of theoretical foundations, they are modified, adapted and implemented in different ways in companies, based on cross case analysis. The actual design and use can differ in various ways, but it seems that one significant driver for the design and re-design (changes in rule regimes)

are managers concerns about strategic (re) orientation(s). Rule development, design and modification becomes related to strategic issues, and rule design are used as one way that management can influence organizational orientation by influencing mindsets of actors and their behavior.

- Rules produce some organizational effects. Stability, predictability, reduction of political “friction” (Weber, 1968) was accomplished to some extent as the evidence illustrates within a 2-3 years timeframe (based on multiple cases).

- Rules does however not create an administrative bureaucracy in product innovation since rules are applied on a discretionary basis based on four possibilities towards rules: (1) refuse, (2) interpretation, (3) find alternative rule, and (4) develop a new rule.

(4) What are the implications of rules in a perspective of appropriateness?

- Rules become a management technology through appropriateness as showed in figure 8.2 (see chapter eight) where the application of rules depends on the illustrated variables including social interaction with other actors.

- The shaping of appropriate decisions on product development are processed according to rules, but influenced by how various actors makes interpretations of the organizational setting, strategic situation and organizational setting, while at the same time considering how other actors are behaving, what common practice is and how the actual obedience (or negligence) to rules makes them a respected member of the organization and group. Even rather "clear" rules are subject to such interpretations, and established and created norms about appropriate behavior seems in many situations to be of higher importance than the official policies, e.g. the norm that divisional managers does not interfere on projects in divisions controlled by other managers, even if these projects does not comply with important requirements in the rules.

- Miller and O'Leary (2002) suggested that technologies of management "shape or influence them [actors]", and the logic of appropriateness developed in figure 8.2 with respect to rules in product innovation, has made the relationship (shaping) between actors and management tools more sophisticated through the institutional mechanisms on rules within the social collectivity.

- Using the notion of technologies of managing (versus management techniques) has been especially developed in management accounting, but has not prior been used to study management of product development. The concept has helped to distinguish more clearly between management techniques (mostly studied in an instrumental perspective and the technologies of managing (here studied through the lenses of appropriateness).

Appendices

Appendix A

Overview empirical activity

Date	Activity	Position	h	Documentation	pp.[3]	Firm
24.09.04	Reporting the findings and conclusions	Different top positions	1	Recording	-	PLASTIC
09.03.04	Car meeting and coffee in airport	New portfolio manager	1	N/A (no rec.)[6]	-	PLASTIC
11.02.04	IW, R&D Site	Project manager	1	Recording	-	PLASTIC
11.02.04	IW, R&D Site	Project manager	1	Recording	-	PLASTIC
11.02.04	IW, R&D Site	Product Development Mgr	1	Recording	-	PLASTIC
12.12.03	Observation, HQ	Various	1	Handwritten field notes, recording	6	PLASTIC
24.11.03	Observation, Portfolio Meeting	Different top positions	5	Handwritten notes, recording	5	PLASTIC
13.11.03	Telephone interview	VP BU	½	Recording	-	PLASTIC
10.11.03	Telephone interview	General Mgr Asset PP	1	No rec.[1], notes reconstructed (attempt)	1	PLASTIC
05.11.03	Interview, site visit	Project Mgr. (long range)	1	Recording Transcribed	32	PLASTIC
05.11.03	Interview, site visit	Group leader	1	Recording Transcribed	42	PLASTIC
05.11.03	Interview, site visit	Plant Dev. Mgr.	1½	Recording Transcribed	54	PLASTIC
05.11.03	Interview, site visit	Project Mgr & Group Leader	1	Recording Transcribed	48	PLASTIC
04.11.03	Interview, site visit	Project Mgr	1½	Recording Transcribed	42	PLASTIC
04.11.03	Interview, site visit	Controller	1	Recording Transcribed	57	PLASTIC
04.11.03	Interview, site visit	Group leader & Task Mgr	1	Recording Transcribed	47	PLASTIC
04.11.03	Interview, site visit	Head of pilot plant	1	Recording Transcribed	41	PLASTIC
03.11.03	Interview, site visit	Head of R&D, one country	1½	Recording Transcribed	71	PLASTIC

03.11.03	Interview, site visit	Project Mgr & Group Leader	1½	Recording Transcribed	69	PLASTIC
03.11.03	Interview, site visit	Project Mgr	1	Recording Transcribed	45	PLASTIC
21.10.03	Follow up meeting	HR Mgr R&T	1½	N/A	-	PLASTIC
21.10.03	Telephone interview	General Mgr Asset	1	Recording Transcribed	20	PLASTIC
21.10.03	Telephone interview	VP BU	1	Recording		PLASTIC
16.10.03	Telephone interview	Chieff Scientist R&D	1	Recording		PLASTIC
13.10.03	Telephone interview	VP R&D	½	Recoding Transcribed	18	PLASTIC
13.10.03	Telephone interview	VP BU	1	Recoding Transcribed	20	PLASTIC
08.10.03	Telephone interview	Chief Scientist	1	Recording Transcribed	24	PLASTIC
12.09.03	Observation, Portfolio Meeting	Different top positions	5	Recording Transcribed Handwritten notes	1707	PLASTIC
10.09.03	Presentation of project, R&D management meeting	Different top positions	1	N.a.		PLASTIC
24.06.03	Start up meeting	Portfolio manager HRM Mgr R&T Database-designer	1½	Recording Handwritten notes	5	PLASTIC
13.06.03	Telephone conference	Portfolio manager	1	Handwritten notes	3	PLASTIC
03.12.01	Interview	Project Manager	1	Transcribed[2]	20	MACHINERY
03.12.01	Interview	Project Manager	1	Transcribed[2]	25	MACHINERY
03.12.01	Interview + presentation of the SG approach	Process Manager	2	Transcribed[2]	51	MACHINERY
23.11.01	Interview	Project Manager	1	Transcribed[2]	18	PAINT
07.11.01	Interview	Project Manager	1	Transcribed[2]	19	MEDICO
24.10.01	Interview[5]	Project manager	1	Transcribed[2]	23	CONTROL[4]
16.10.01	Interview	Project Manager		Transcribed[2]	19	MEDICO
11.10.01	Interview[5]	R&D Mgr	1½	Transcribed[2]	27	PAINT

11.10.01	Interview	R&D Mgr	1	Transcribed[2]	16	INGREDIENTS
09.10.01	Interview[5]	Research Mgr	1	Transcribed[2]	17	CONTROL[4]

[1] Technical problem with recording device; only investigator's voice recorded.
[2] Recorded with cassette: no digital recording. All other recordings are digitally.
[3] Approximately 1,062 pages transcribed interviews (800 single-case study and 235 pages multiple-case study)
[4] Interviews were conducted with a Medico firm not formally applying a SG approach. The firm was very focused on research and the early stages of the SG approach and our-sourced the development of new drugs to global companies. Development was also conducted in a gate process because of the governmental requirements e.g. on testing on humans. Interestingly, the firm applied informal controls of research by employing people with the same background (pharmacists) instead of doctors who were claimed to have hierarchical training. The company did not want subordination. The data indicated that that it made no additional empirical points to include a company with no formal rules, since the focus was on formal rules and not for instance norms, which however would have required this kind of company.
[5] With Professor John K. Christiansen.
[6] Impossible to record because of noise in my car (21 years old); the talk was undertaken by driving the new appointed (Feb 1st, 2004) portfolio manager to Copenhagen Airport (CPH) from Corporate Headquarters.

Appendix B

Nodes used for coding in Nvivo

NVivo revision 2.0.163
Licensee: Claus Varnes
Project: PLASTIC
User: AdministratorDate: 30-08-2004 - 18:01:32

NODE LISTING

Nodes in Set: All Nodes
Created: 13-10-2003 - 13:24:08
Modified: 13-10-2003 - 13:24:08
Number of Nodes: 79

4 (100) /RULE DESCRIPTION
- 5 (100 1) /RULE DESCRIPTION/Comparison SG and PLASTIC
  - 6 (100 1 1) /RULE DESCRIPTION/Comparison SG and PLASTIC/Stages comparison
  - 7 (100 1 2) /RULE DESCRIPTION/Comparison SG and PLASTIC/Info+docu comparison
  - 8 (100 1 3) /RULE DESCRIPTION/Comparison SG and PLASTIC/Gate rule comparison
- 9 (100 2) /RULE DESCRIPTION/Rule description gates
- 10 (100 3) /RULE DESCRIPTION/Stage rule description
- 11 (100 13) /RULE DESCRIPTION/Info+docu rule description

12 (200) /RULE APPLICATION
- 13 (200 1) /RULE APPLICATION/Gate rule application
- 14 (200 2) /RULE APPLICATION/Stage rule application
- 15 (200 3) /RULE APPLICATION/Info-docu rule application

16 (300) /RULE INFLUENCE
- 17 (300 1) /RULE INFLUENCE/Competence
- 18 (300 2) /RULE INFLUENCE/Identity influence by rules

19 (300 3) /RULE INFLUENCE/Decision-making
20 (300 4) /RULE INFLUENCE/Rule regime competition
21 (300 5) /RULE INFLUENCE/Innovation rules competition
22 (300 7) /RULE INFLUENCE/New rules
23 (300 15) /RULE INFLUENCE/Bureaucracy
24 (300 25) /RULE INFLUENCE/Ambiguity
25 (300 32) /RULE INFLUENCE/Implementation
26 (300 33) /RULE INFLUENCE/Idea generatioon+Creativity

27 .PFMM Sep 12, 2003
28 .PFMM Sep 12, 2003.Project 10
29 .PFMM Sep 12, 2003.Project 11
30 .PFMM Sep 12, 2003.Project 12
31 .PFMM Sep 12, 2003.Project 14
32 .PFMM Sep 12, 2003.Project 15
33 .PFMM Sep 12, 2003.Project 16
34 .PFMM Sep 12, 2003.Project 17
35 .PFMM Sep 12, 2003.Project 18
36 .PFMM Sep 12, 2003.Project 19
37 .PFMM Sep 12, 2003.Project 2 and 3
38 .PFMM Sep 12, 2003.Project 20
39 .PFMM Sep 12, 2003.Project 22 and 24
40 .PFMM Sep 12, 2003.Project 23
41 .PFMM Sep 12, 2003.Project 25
42 .PFMM Sep 12, 2003.Project 27
43 .PFMM Sep 12, 2003.Project 28
44 .PFMM Sep 12, 2003.Project 29
45 .PFMM Sep 12, 2003.Project 30
46 .PFMM Sep 12, 2003.Project 31
47 .PFMM Sep 12, 2003.Project 32
48 .PFMM Sep 12, 2003.Project 33
49 .PFMM Sep 12, 2003.Project 34
50 .PFMM Sep 12, 2003.Project 35
51 .PFMM Sep 12, 2003.Project 36
52 .PFMM Sep 12, 2003.Project 37
53 .PFMM Sep 12, 2003.Project 38
54 .PFMM Sep 12, 2003.Project 39
55 .PFMM Sep 12, 2003.Project 4

56 .PFMM Sep 12, 2003.Project 40
57 .PFMM Sep 12, 2003.Project 41
58 .PFMM Sep 12, 2003.Project 42
59 .PFMM Sep 12, 2003.Project 43
60 .PFMM Sep 12, 2003.Project 46
61 .PFMM Sep 12, 2003.Project 47
62 .PFMM Sep 12, 2003.Project 5
63 .PFMM Sep 12, 2003.Project 50
64 .PFMM Sep 12, 2003.Project 59
65 .PFMM Sep 12, 2003.Project 6
66 .PFMM Sep 12, 2003.Project 60
67 .PFMM Sep 12, 2003.Project 62
68 .PFMM Sep 12, 2003.Project 63
69 .PFMM Sep 12, 2003.Project 66
70 .PFMM Sep 12, 2003.Project 67
71 .PFMM Sep 12, 2003.Project 68
72 .PFMM Sep 12, 2003.Project 69
73 .PFMM Sep 12, 2003.Project 7
74 .PFMM Sep 12, 2003.Project 70
75 .PFMM Sep 12, 2003.Project 71
76 .PFMM Sep 12, 2003.Project 72
77 .PFMM Sep 12, 2003.Project 8
78 .PFMM Sep 12, 2003.Project 9
79 .PLASTIC

Appendix C

Interview guide single-case analysis, non decision-makers

1. The respondent

- Date of interview (IW)
- Name of the respondent
- Title
- Position, duties
- Number of years with the company
- Number of years with that position
- Former education
- Formal education

2. Company situation

- Describe how you perceive the current situation of the company? (Market and customers, strategic challenges, technological and innovation challenges, financial situation, managerial and management control issues, competence related challenges etc.).

3. Information and documentation [documentation rules]

- How is information organized?
- What is level of availability of information?
- Are all relevant of information made available for decision-making?
- Are all information explicitly documented?
- Are all information used? (Are all documented information used?).
- Is it possible to compile all information for decision-making?
- Is it necessary to document information?
- In your experience, what is the link between the documentation and the quality of decisions?
- What is the quality in decisions?

4. Decisions [decision rules]

- Are decisions made as usual?
- Are the goals explicit and easy to understand? What are they? And are they hierarchical?
- Are all alternatives (in your opinion) for reaching the goals expressed in the formal setting?
- Is it possible to comprehend the consequences of the alternatives?
- What criteria are applied when evaluating the project?
- Do criteria’s have the same weight? Are new criteria added?

- Describe the outcome of the formal meeting?
- What was the outcome of the meeting (relevant)? (Has a project ever been terminated?)
- Are all relevant persons participating in formal meetings?
- (In your opinion) what are the consequences of the decisions made
- In what way do you feel formal decision-making is useful?
- Are decisions influenced by other rules/procedures within the organization?
- Is time a pressure on decisions and if so, what are the consequences on decision-making?

5. Influence [of rules]

- Are the preferences stable over time or can a decision suddenly be looking less attractive later on? If 'yes' what happened?
- In your experience are the decisions made relevant and precise?
- Are the decision made a representation of consensus among the meeting participants?
- What are the greatest challenges of decision-making in product development?
- Do you believe that the formal meetings have en influence on the activities taken place within the R&D department?
- Have a formal meeting ever been skipped and if 'no' why are the formal meetings of particular importance for product development?
- In your opinion what are the effects of having a management system for product development?
- In your opinion, is the decision made corresponding to the feeling in the team (would they have made the same decision)?

6. Competences/learning (rule change)

- Why was the Innovation Process redesigned?
- What have been changed? Describe the differences between the old innovation processes compared to the new IP?
- Was the change part of a conscious improvement process?
- (In your opinion) is the company in need of an entirely new or even better way of organizing the product development process (problems that are not solved with the new process)?
- In your opinion, does the R&D organization gain competence in working with the procedure for product development?
- If so' has this competence gain ever resulted in new rules (procedural changes) besides the recent change in the new Innovation Process?

5. Resources, evaluation and performance measurement

- What are the relation between the strategic goal and the development activities? (close, ongoing discussed, not open for debate)
- What is the role of considerations concerned with starting and prioritizing development activities? (is the relationship between the necessary and present resources considered)
- Are the development activities monitored in terms of performance? (what, how, when)

- Does a final evaluation of the development activities take place?
- How would you evaluate the benefits of the development activities in company today (do the activities bear up with the resources used? Do they contribute?)?
- How would you evaluate the results and benefits of product development (satisfactory, room for improvement etc.)? And describe the results in terms of time-to-market, effectiveness, and efficiency.
- Does the R&D department become continuously better in achieving the specified goals of NPD?
- Have radically new products come out of the process or is it more gradual improvements?
- What formal methods and tools are applied for planning, reporting, and management of individual development activity?

8. Future and wishes

- In your opinion, what are the substantial challenges in NPD today? (does anyone agree on this?).
- Are dilemmas apparent and/or in conflict in relation to coordination of development activities (describe)?
- What would you change – if you could (without asking others or agree with them)
- (In your opinion) has something relevant not been addressed with the questions asked and do you like to add anything?

Appendix D

Interview guide single-case analysis, gate participants (decision-makers)

1. The respondent

- Date of interview (IW)
- Name of the respondent
- Title
- Position, duties
- Number of years with the company
- Number of years with that position
- Former education
- Formal education

2. Company situation

- Describe how you perceive the current situation of the company? (Market and customers, strategic challenges, technological and innovation challenges, financial situation, managerial and management control issues, competence related challenges etc.).

3. Information and documentation [documentation rules]

- How is information organized?
- What is level of availability of information?
- Are all relevant of information made available for decision-making?
- Are all information explicitly documented?
- Are all information used? (Are all documented information used?).
- Is it possible to compile all information for decision-making?
- Is it necessary to document information?
- In your experience, what is the link between the documentation and the quality of decisions?
- What is the quality in decisions?

4. Decisions [decision rules]

- Are decisions made as usual?
- Are the goals explicit and easy to understand? What are they? And are they hierarchical?
- Are all alternatives (in your opinion) for reaching the goals expressed in the formal setting?
- Is it possible to comprehend the consequences of the alternatives?
- What criteria are applied when evaluating the project?
- Do criteria’s have the same weight? Are new criteria added?

- Describe the outcome of the formal meeting?
- What was the outcome of the meeting (relevant)? (Has a project ever been terminated?)
- Are all relevant persons participating in formal meetings?
- (In your opinion) what are the consequences of the decisions made
- In what way do you feel formal decision-making is useful?
- Are decisions influenced by other rules/procedures within the organization?
- Is time a pressure on decisions and if so, what are the consequences on decision-making?

5. Influence [of rules]

- Are the preferences stable over time or can a decision suddenly be looking less attractive later on? If 'yes' what happened?
- In your experience are the decisions made relevant and precise?
- Are the decision made a representation of consensus among the meeting participants?
- What are the greatest challenges of decision-making in product development?
- Do you believe that the formal meetings have en influence on the activities taken place within the R&D department?
- Have a formal meeting ever been skipped and if 'no' why are the formal meetings of particular importance for product development?
- In your opinion what are the effects of having a management system for product development?
- In your opinion, is the decision made corresponding to the feeling in the team (would they have made the same decision)?

6. Competences/learning (rule change)

- Why was the Innovation Process redesigned?
- What have been changed? Describe the differences between the old innovation processes compared to the new IP?
- Was the change part of a conscious improvement process?
- (In your opinion) is the company in need of an entirely new or even better way of organizing the product development process (problems that are not solved with the new process)?
- In your opinion, does the R&D organization gain competence in working with the procedure for product development?
- If so' has this competence gain ever resulted in new rules (procedural changes) besides the recent change in the new Innovation Process?

5. Resources, evaluation and performance measurement

- What are the relation between the strategic goal and the development activities? (close, ongoing discussed, not open for debate)
- What is the role of considerations concerned with starting and prioritizing development activities? (is the relationship between the necessary and present resources considered)
- Are the development activities monitored in terms of performance? (what, how, when)

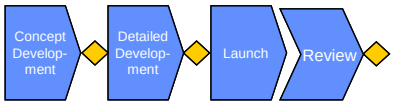
- Does a final evaluation of the development activities take place?
- How would you evaluate the benefits of the development activities in company today (do the activities bear up with the resources used? Do they contribute?)?
- How would you evaluate the results and benefits of product development (satisfactory, room for improvement etc.)? And describe the results in terms of time-to-market, effectiveness, and efficiency.
- Does the R&D department become continuously better in achieving the specified goals of NPD?
- Have radically new products come out of the process or is it more gradual improvements?
- What formal methods and tools are applied for planning, reporting, and management of individual development activity?

8. Future and wishes

- In your opinion, what are the substantial challenges in NPD today? (does anyone agree on this?).
- Are dilemmas apparent and/or in conflict in relation to coordination of development activities (describe)?
- What would you change – if you could (without asking others or agree with them)
- (In your opinion) has something relevant not been addressed with the questions asked and do you like to add anything?

Appendix E

Templates to be used as preparation for the gate meeting by vice presidents



Stage Gate Transfer Approval

Project name	IPNr.	...	Status*
……			From** Launch to Final

Key deliverables in finalised Stage	Target	Result
• ……	……	……
• ……	……	……
• ……	……	……
• ……	……	……
• ……;	……	……

Stage Gate review criteria	Signed***off		Comment
Innovation process checklist run	PM	V	see checklist in IP Bordocs
Business case updated	MM	V	M€ exp NPV
Launch plan updated +Step 1	MM	V	……
Plant Test run approved by Asset Dev Mgr	ADM	V	……
Commercial production approved	ADM	V	……
End of Launch approved by Commercial Mgr	CM	V	……
Final Report and post learning to Portfolio Mgr	PFM	V	……

*** Mark V to confirm done

** Indicate CD to DD or DD to Launch or Launch to Final

* drag colour corresponding with project progress status

Innovation Project candidate summary "Title"

Project description

- ……..
- ……..
- ……..
- ……..

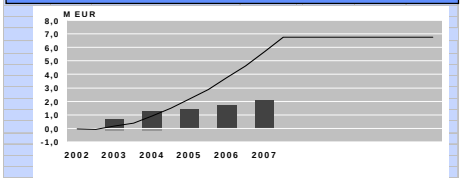
Resource requirements

Project team	FTE	03	04	05	06	07

Key characteristics

Technology platform:	HP Autoclave
Recom. Project manager:	……..
Exp. NPV (€ M):	5
Forward looking IRR (%):	-
Strategic fit:	2
Probability of success.:	60%
Investment total (M€):	0.75
Project start:	01/04/2003
Launch date:	31/09/2004
Launch end :	31/05/2005

Cash Flow



Notes: graphic: copy paste picture from Business case / project team members by name or function otherwise

Appendix F

INTEGRATION OF STAGES

The first implication relates to the coordinative mechanism, which was mentioned in chapter four and formally regulates whether stages are allowed to overlap and gates therefore not are enforced. In PLASTIC, no formal rules directly prohibit overlapping in the stages, but the intention was clearly by the rule makers to secure objective decision making by dividing the process into distinct stages which ideally should enable objective decision-making on new projects. The organizational praxis surrounding PD discloses, however, that the behaviour of actors in some cases are concerned with *integrating* the activities rather than keeping them separate otherwise required by the formal system, The instrumental perspective would ascribe this to the design of rules and probably argue that the two timelines between the gate meetings and the progress of the individual project enforces an integration in practice rather than attempting to secure distinct stages and based on this learning change the rule. One project that skipped a stage (and therefore also a formal decision point) was encouraged rather than sanctioned by the vice presidents (maybe also because it was delayed).

From the appropriateness perspective, vice presidents are making decisions prior to and after the gate meeting, reasoning that the time-to-market criterion is more appropriate than awaiting formal decisions. This issue was raised by the literature (Ottosson 1996; Jenkins et al. 1997; Perel 2002). *Not* to stop a project and await a decision, seems to be a logic inherent in the identity of the actors in PLASTIC and made more sense to them than following the rules of making portfolio decision-making which would require all projects to be stopped prior to the meeting and all information and documentation uploaded to databases including the expected NPV calculation and business plan. Moreover, the physical production system is mobilized when confusion on the current status of the project in terms of stages is to be comprehended. In that sense, the physical plants, test plant and the laboratories are competing with the administrative management system since these also can be an actant (Latour, 1991). Takeuchi and Nonaka (1996: 137) argued for abandoning a “sequential approach” to PD

but in his most recent work, Cooper (2002b) does maintain the requirement for distinct gates where stages are stopped while awaiting decisions.

The issue seems to be unsettled but PD practice analyzed in this study seems to suggest that an implication for management could be that the gates prior to development (gate 3 in the conceptual model) and before launch (gate 5 in the conceptual model) is a particular concern whereas everything else prior to gate 3 and also between 3 and 5 is could be more relaxed. Moreover, vice presidents in PLASTIC rely on the project managers to kill a project themselves in accordance with the criteria formulated by the project managers themselves more in line with the IPD approach accentuated by Anderson (1996)[42] based on contractual empowerment although the contract not is formal.

[42] Refer to chapter three.

Appendix G

CREATIVITY AND INNOVATION

The second implication is concerned with a distinction between creativity and innovation (Levitt 2002). A standardized format was addressed by Smith and others (1999), Shaw and others (2000), Hughes and Chafin (1996), Stevens and others (1999) and Perel (2002), when criticizing the SG approach for not being creative and fuzzy in the front end, which however not can be substantiated in the single-case analysis of PLASTIC. Rather, as argued by Buggie (2002), the notion can be supported here, that fuzziness is occurring *at* the front-end of the SG approach in PLASTIC (first two stages), which relates to the low level of rule-following as established in previous chapter (20 percent rule-following), the MATT-process (downsizing of R&D), and the lack of responsibility by business units for mobilizing the rules in the first two stages (pre-portfolio) for instance in the first stage where ideas must be selected and inventors rewarded.

In this respect, Hamel (2000) advocates that new opportunities not can be facilitated by structured and formal approaches applied in innovation because they become 'bureaucratic', but the evidence indicates that the level of radicalism in new ideas and number of new ideas not negatively are influenced by the SG approach, but on the other hand not is supported – since rule-deviation in the gate meetings not produced any kill decisions and freed the necessary resources for the 20 percent of time assumed to be free for specifically idea generation and very preliminary experimental work. In this respect, it should however be mentioned that one project manager explicitly argues that the deadline impedes creativity as the project moves closer to the deadline since entirely new ideas to design the project, not can be exploited if the deadline is to be complied with (although the rules supports this).

Compliance with time-limits is an imposing identity on actors in PLASTIC which was the opposite point-of-view in the conceptual SG approach earlier described, where quality is emphasized over time. The conceptual SG approach reasons that time-to-market is reduced by looking at all projects as one entity and can be reduced since

unprofitable projects are filtered away. The logic inherent in the conceptual approach suggests that by focusing on quality in producing information, little rework is needed as the project progresses and projects not eligible are terminated. Normatively, the SG approach is an administrative management system for securing no stages were skipped, decision-making is objective and undertaken in a manner 'killing' ideas not profitable enough (compared to others) - and thereby facilitating the innovation process but is not assumed to be a creativity management system and also emphasized by the appointed vice president of R&D[43]:

> Because this process, if not – managed carefully – is also an excellent killer of ideas. You have actually organized the killing of ideas – if talking very careful management – and that's why I think the decision-makings – should be much more decision-making meetings and really understand what you decided or not. And maybe stop some of the [30.37] development are room for some of these very innovative things, but that will be the success or the failure of the innovation process. If we manage to let some of these very innovative things come through or not […] the process will not contribute with generating ideas. The process will only allow dealing with ideas in a proper way - generation has to be stimulated through the organization and through the people, but the process as such will not generate any ideas. It will only support ideas generated or not.

The assumption underlying the ideal SG approach is that the both push and pull driven ideas can be administered in the process from idea to launch. PLASTIC is experiencing problems with the input of new projects as emphasized by several respondents on both the project management- and vice president-level, and the literature mentioned above (Smith and others 1999; Shaw and others 2000; Hughes and Chafin 1996; Stevens and others 1999; and Perel 2002) would claim that formal and structured approaches are killing too many ideas. However, this claim cannot be supported here based on the evidence available, which indicate that the problem not is the termination of ideas, but instead the *link* between the idea and the process into the administrative system which is to managed by the business units in PLASTIC. Moreover, this is an indication of an avoidance to make kill decisions since the decision makers not are aware which projects will be radical and therefore will avoid this decision in order to allow these (unidentified radically) projects to pass.

[43] The R&D vice presidency was vacant until February 1, 2004.

In summary, the administrative system is an innovation system and as such not concerned with producing creativity. In addition, evidence does not suggest that creativity is impeded by the rules. Rather vice-versa. A possible implication to management is that they avoid enforcing rules, but the set of rules in PLASTIC has however yet to prove that radically new products can come out of the process. An instrumental response in this respect is to add criteria for measuring the level of radicalism in new products[44].

[44] This type of criteria was not among the criteria in the normative system previously described in chapter two.

Appendix H

WHAT IS BUREAUCRATIC?

Hamel (2002) argued that structured and formal approaches can be 'bureaucratic', which raises the implication generally to management whether this should be avoided as claimed by Hamel. Gate activities according to a standardized format requires distinct decisions, but the evidence suggest that PD practice reveals several other decision types than the normative conceptual approach including "conditional kill", "ownership transfer", and "stop but reformulate" (see appendix K, column H). Problems not solved by the normative rules are also brought up for discussion but however addressed on the basis of the stage-gating rule and color-rule system. A vice president argued that if the rules for portfolio management not were mobilized and thereby produced the intended consequence, the rules would be perceived as 'bureaucratic 'in terms of just being paperwork as also mentioned by several project managers. The previous rule-system in PLASTIC, (PD&I), was associated with 'bureaucratic' because PLASTIC late in the period of 1997-2002 needed a "real reason" for having this particular version of the SG approach in place. Respondents are concerned with an emergent and similar perception of the new rule system:

> If we don't implement the fundamentals [26.19] which are behind it – the prioritizations, the idea generation, the proper decision-making […]. If it is properly managed, yes. And we really start to implement as is it was intended - then yes. If it is a bureaucracy, it will delay.

The previous analyses suggested that rules for making portfolio-decision making including resource decisions, not were mobilized in the gate meeting, because of other an agreement (rule) not to criticize colleagues, but particularly the other rule-regime where resources followed the business unit and not the project, was shaping the actors in this role rather than the rules ideally in the SG approach. Thus, rules in the SG approach are impeded in being used in accordance with their initial intention by other rule regimes, which in turn produces the increasing perception of the new set of rules as 'bureaucratic'.

Thus, rules are not automatically linked to the adjective of ‘bureaucratic’ by the actors, but perceived as such particularly *if* the activities to be conducted according with these rules not has a consequence in terms of solving the problems intended, which suggests that if the problems are solved as required by the Weberian-bureaucracy (the formal set of rules) the rules are not perceived as bureaucratic. Moreover, the term is associated with work that has no affect on the innovation ability of the company. In other words, if a rule is accepted and associated with the role of the actor, the rule is not ‘bureaucratic’. Interestingly, rules designed for resource prioritizations (portfolio management rules) are legitimate to mobilize by project managers but by vice presidents who are to carry out these rules. Limited resources are considered legitimate by the project managers.

Another issue relating to the perception of bureaucratic is rigidity. The perception of rules is also influenced by the time required to comply with e.g. information and documentation rules, which in turn depends on the level of detail and numbers of papers to be filled out and the number of databases that are not communicating with each other in PLASTIC. The latter renders it necessary to “fill in a lot of numbers” to SAP for cost, time in another system, project characteristics in the innovation database, and documentation in the archival system.

> [A]nd I would probably try to simplify the system, se we don’t’ have the separate [47.47] databases and everything.

The respondent linked paper to templates and the general impression was that the previous rule system, PD&I, contained slightly more templates and that there now is more freedom to present a project and have templates to remember what for instance is required in for instance the final report. The perception of ‘bureaucratic’ is also connected not only to rule competitiveness with resources and the lack of consequence (as previously discussed) but also to the color-rule system monitoring deviation from the planned end date. These rules are imposes what appropriate behavior is. The rules are interpreted (as intended) to allow for redefinition of a project, but the color-rule system puts emphasis on finishing the project in time no matter whether an entirely new idea for making the product happen comes up late in the process (see above). The design of the rules does not prohibit a redefinition of a project, but the mentality is influenced by the time-rules (color system-rules):

> […] but mentally I think there is so much focus that you have to deliver what you promised that is a kind of the borderline of going to be too rigid.

The respondents mention that it would be enough to have informal controls in terms of clear defined roles and a sense of responsibility, but on the other hand they do understand the requirement for control in terms of templates and reporting systems because the resources available for R&D is limited.

Central to appropriate rule-following, is the identity of the individuals including mentality and attitude towards the rules, which in turn is influenced by rules and rule-competition that consequently will add to the ambiguities of one or several identities constituting the collective self. Some project managers, more than others, are predisposed for following rules due to their educational background where particular engineering is mentioned as a background familiar with ‘boxes’ whereas others consider it a “duty”, but also the national background of actors was mentioned as a factor in the predisposition towards rules.

Gate activities according to a standardized format has so far been concerned with the instrumentality perspective to rules, and that increasing elaborateness and mobilization of rules actually not impede innovation, but evidence suggests that in some cases, tasks cannot be standardized as also suggested by Olin and Wickenberg (2001) who claims that rules might be broken when rules becomes to standardized and therefore not can be aligned with the specifics of each particular situation. In one project, a project manager wasted two months on complying with a rule, which not could be complied with. This suggests that even though tasks is standardized and maybe even made very elaborate, they on the other hand are needs to be general and therefore require situational interpretation in some cases since some projects can be unique.

Appendix I

Quality information (projects 4, 9, 22, 23, 24, 33, 36, 47)

Basics	4	9	22	23	24	33	36	47
Innovation Objective in archive database	0	0	2	2	2	0	0	2
Description	0	0	1	1	1	0	0	1
Innovation Objective Keeper	0	0	1	1	1	0	0	1
URL for further reading	0	0	0	0	0	0	0	0
Innovation database								
Project in Innovation Data Base	1	1	1	1	1	1	1	1
Target	2	2	2	2	2	2	2	2
Description	2	2	2	2	2	2	2	2
Project category	1	1	1	1	1	1	1	1
Technology Platform	1	1	1	1	1	1	1	1
Proprietory Technology	1	1	1	1	1	1	1	1
Business owner	1	1	1	1	1	1	1	1
Chairman steering Committee	0	0	1	1	1	1	1	1
Project Manager	1	1	1	1	1	1	1	1
Decision forum	1	1	1	1	1	1	1	1
Project file	1	1	2	2	2	2	2	2
Project Dates	1	1	1	1	1	1	1	1
Task specified (1Q pt /task)	1	1	1	2	5	2	3	2
Allocation and Cost / SAP order Nr	2	2	2	2	2	2	2	0
Metrics								
Probability of success	1	1	1	1	1	1	1	1
Business case	1	1	1	1	1	1	1	1
Cost and FTE	1	1	1	1	1	1	1	1
Documentation								
Business case	0	1	1	1	1	1	1	1
Market Plan	0	0	1	1	1	0	0	1
Killer Variables status in market plan	0	0	0	1	1	0	0	1
Project Plan	0	1	1	1	1	1	1	1
IPR Evaluation/status	0	0	0	1	1	0	0	0
Innovation Tasks								
Description	0	0	1	1	1	1	1	1
Stage	1	1	1	1	1	1	1	1
Status	1	1	1	1	1	1	1	1
Task leader	0	1	1	1	1	1	1	1
Task Time and Cost	1	1	1	1	1	0	1	1
HSE Evaluation : check status	0	0	1	1	1	1	0	1
HSE Check document URL	0	0	1	1	1	1	0	1
Task Member insert	0	2	2	2	2	0	0	2
Task Bottle neck Resources insert	0	2	0	2	2	0	0	2
	4	**9**	**22**	**23**	**24**	**33**	**36**	**47**
Rule-deviation	**42%**	**27%**	**12%**	**3%**	**3%**	**24%**	**27%**	**9%**
Rule-following	**58%**	**73%**	**88%**	**97%**	**97%**	**76%**	**73%**	**91%**

Note: Zero equals rule-deviation and is marked with yellow. Numbers above zero is a weighted expression. The red indicates a quality information problem. Source: PLASTIC.

Appendix J

Active projects in the September 2003-portfolio

In order to understand the gate meeting all active 62 projects in September 2003 are summarized in the table below and are structured as follows:

- *Column A* is the project number (please note that in two cases were two projects addressed simultaneously). The total expected NPV of these projects is approximately €¼ billion (the sum of column K).
- *Column B* indicates whether the project is addressed in a Boolean-expression suggesting that 35 projects were addressed at the meeting with a total value of €120.5 million € (T=true).
- *Column C* indicates the color of the project according to the color-system described in the case-description of the Plastic firm which is designed to illustrate the delay of the project. More than two months delay is labeled 'red', less than two months is 'yellow' and 'green' indicates that the project is within the formal end date that was approved when the project entered the portfolio in the gate "Entry into portfolio" after the second stage of preparing a business case.
- *Column D* indicates the formal stage of the project prior to the meeting.
- *Column F* is the owner of the project (business unit).
- *Column G* shows the criteria that were mobilized in the discussion during the discussion of the particular project.
- *Column H* the 'decision' made[45].
- *Column I* is the minutes spent on the particular project. 42.5 effective minutes were spent on 'red' and 'yellow' projects, 93.5 effective minutes were spent on new projects, and 19 effective minutes spent on green projects which suggest that emphasis was placed on new projects compared to existing projects. Please note the correlation coefficient is calculated to -0.011222 between time and the

[45] This is within the investigator's interpretation (since it was difficult to identify when and what a decision actually was made in the instrumental perspective)

expected NPV, which shows that there is practically no correlation between the economic size of the project and the time spent on the discussion of it. This allocation of attention underlines the impression of a decision making situation which is focused on the inflow to the 'bathtub' as characterized metaphorically previously.

- *Column J* is also a Boolean-expression indicating whether the project was specifically mentioned in the formal report on the meeting, which was sent to the participants after the meeting. The table discloses that projects no. 22, 24, and 43 were discussed but not specified in the formal report from the meeting, and that projects 12, 29, and 63 were specified in the report but not made part of the discussion during the PFMM September.
- *Column K* stipulates the expected NPV on each project with exceptions due to no access to reports from the meeting prior the September-meeting.
- *Column L* indicates whether complete fulfilled criteria were mobilized as an argument when the project was discussed at the meeting.

A	B	C	D	E	F	G	H	I	J	K	L
Project	**Disc.**	**Color**	**SG**	**Stage**	**BU**	**Criteria**	**Decision**	**Min.**	**Report**	**NPV**	**Checklist**
Project 22, 24	T	Green	F	CD	A	End date + resources	Approved ressource change – delega	1,00	F	25,30	No
Project 47	T	Green	T	Launch	A	Manufacturability	Conditional launch	0,50	T	4,10	No
Project 31	T	Green	T	To final	A	NA	Conditional go delegate	1,00	T	0,80	No
Project 30	T	Green	T	To final	A	Manufacturability	Approved	3,00	T	1,60	Comp.
Project 27	T	Green	T	Launch	A	NA	Approved	1,00	T	0,40	Comp.
Project 23	T	Green	T	To launch	A	Agency check – manufacturability	Conditional go delegate	3,00	T	1,90	Not compl.
Project 62	T	Green	F	DD	B	Steering committee	Ownership transfer	4,00	T	2,60	No
Project 70	T	Green	T	To final	C	Sales	Approved	2,00	T	9,50	Comp.
Project 50	T	Green	F	CD	F	Business case and NPV	Portfolio material from long range	3,00	T	9,80	No
Project 2, 3	T	Green	T	Final	G	N/A	Taken out of portfolio	0,50	T	NA	No
Project 74	T	New	T	N/A	B	N/A	N/A	7,00	T	2,00	No
Project 76	T	New	T	CD	C	N/A	N/A	10,50	T	6,30	No
Project 77	T	New	T	N/A	C	N/A	N/A	9,50	T	2,60	No
Project 78	T	New	F	DD	D	N/A	N/A	14,50	T	3,80	No
Project 79	T	New	T	N/A	E	N/A	N/A	6,00	T	6,10	No
Project 64	T	New	T	N/A	F	N/A	N/A	11,50	T	14,80	No
Project 65	T	New	T	N/A	G	N/A	N/A	8,00	T	2,20	No
Project 80	T	New	T	N/A	G	N/A	N/A	6,30	T	1,10	No
Project 81	T	New	T	N/A	G	N/A	N/A	20,30	T	4,00	No
Project 28	T	Red	T	Launch	A	Manufacturability and then < 2 mio	Taken out of portfolio	4,00	T	NA	Not compl.
Project 43	T	Red	S	Stopped	B	NA	Conditional killed	0,50	F	NA	No
Project 42	T	Red	T	To final	B	Final report	Conditional closing	3,00	T	0,90	No
Project 40	T	Red	T	To final	B	Final report	Conditional closing	4,00	T	7,50	No
Project 38	T	Red	T	To final	B	N/A	Conditional closing	5,00	T	0,60	Not compl.
Project 37	T	Red	T	To final	B	N/A	Approved	2,00	T	1,20	No
Project 36	T	Red	F	DD	B	Enddate	Approved delay	5,00	T	3,00	No
Project 33	T	Red	F	Launch	B	Enddate + customer test	Approved delay	3,00	T	5,60	No
Project 9	T	Red	F	Launch	C	Enddate + project scope	Accelerated	9,00	T	NA	No
Project 4	T	Red	F	Launch	C	Enddate + customer test	Conditional go	0,50	T	2,80	No
Project 8	T	Red	S	Launch	C	Manufacturability	Reformulate project	3,00	T	NA	No

A	B	C	D	E	F	G	H	I	J	K	L
Project 46	T	Red	S	DD	F	Driver and business owned	Stop but reformulate	3,00	T	NA	No
Project 32	T	Yellow	S	Launch	A	Manufacturability	Taken out of portfolio	0,50	T	NA	No
Project 60	F	Green	T	CD	A	N/A	N/A	N/A	F	11,00	N/A
Project 25	F	Green	F	DD	A	N/A	N/A	N/A	F	1,90	N/A
Project 71	F	Green	F	CD	B	N/A	N/A	N/A	F	9,00	N/A
Project 34	F	Green	F	DD	B	N/A	N/A	N/A	F	5,90	N/A
Project 35	F	Green	F	DD	B	N/A	N/A	N/A	F	4,20	N/A
Project 41	F	Green	F	Launch	B	N/A	N/A	N/A	F	1,20	N/A
Project 39	F	Green	F	Launch	B	N/A	N/A	N/A	F	0,50	N/A
Project 5	F	Green	F	Launch	C	N/A	N/A	N/A	F	5,30	N/A
Project 69	F	Green	F	DD	C	N/A	N/A	N/A	F	5,00	N/A
Project 59	F	Green	F	N/A	C	N/A	N/A	N/A	F	4,40	N/A
Project 6	F	Green	F	Launch	C	N/A	N/A	N/A	F	3,90	N/A
Project 7	F	Green	F	Launch	C	N/A	N/A	N/A	F	3,70	N/A
Project 72	F	Green	F	CD	C	N/A	N/A	N/A	F	2,00	N/A
Project 20	F	Green	F	N/A	D	N/A	N/A	N/A	F	5,60	N/A
Project 67	F	Green	T	N/A	D	N/A	N/A	N/A	F	3,20	N/A
Project 68	F	Green	F	Launch	D	N/A	N/A	N/A	F	3,10	N/A
Project 66	F	Green	F	DD	D	N/A	N/A	N/A	F	1,90	N/A
Project 16	F	Green	F	Launch	E	N/A	N/A	N/A	F	6,80	N/A
Project 15	F	Green	F	Launch	E	N/A	N/A	N/A	F	10,00	N/A
Project 17	F	Green	F	Launch	E	N/A	N/A	N/A	F	2,50	N/A
Project 18	F	Green	F	Launch	E	N/A	N/A	N/A	F	1,70	N/A
Project 11	F	Green	F	Launch	E	N/A	N/A	N/A	F	2,40	N/A
Project 14	F	Green	F	Launch	E	N/A	N/A	N/A	F	1,60	N/A
Project 10	F	Green	F	Launch	E	N/A	N/A	N/A	F	2,80	N/A
Project 19	F	Green	F	Launch	E	N/A	N/A	N/A	F	1,00	N/A
Project 12	F	Green	T	Final	E	N/A	N/A	N/A	T	2,80	N/A
Project 63	F	Green	F	CD	F	N/A	N/A	N/A	T	18,40	N/A
Project 29	F	Yellow	T	To final	A	N/A	N/A	N/A	T	N/A	N/A

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