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Sang Hyung Ahn
Editor-In-Chief
Seoul National University

www.kinforms.org
Email: kinforms@kinforms.org

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Innovation Factory and Innovation Atelier Business Design for 'Routinized Innovation'

Ursula Deplazes
ETH Zurich – The Swiss Federal Institute of Technology
Department for Management, Technology and Economics,
Kreuzplatz 5, 8032 Zürich
Switzerland
Email: udeplazes@ethz.ch

Wolfgang Deplazes
ETH Zurich – The Swiss Federal Institute of Technology
Department for Management, Technology and Economics,
Kreuzplatz 5, 8032 Zürich
Switzerland

Roman Boutellier
ETH Zurich – The Swiss Federal Institute of Technology
Department for Management, Technology and Economics,
Kreuzplatz 5, 8032 Zürich
Switzerland

ABSTRACT

The paper aims at addressing the challenge how to design the firm's innovation activities while taking into account requirements stemming from the progressive routinization of innovation, the need for ambidexterity and contingency. The authors adopt a perspective of business design and introduce the complementary concepts of 'Innovation Factory' and 'Innovation Atelier'. In combination with

findings from a series of case studies of business design, the approach builds on insights stemming from systems theory, economic theories of growth, process philosophy, theories of business design, and theories of contingency on organization. The authors support their argument with a case study of a Fast Moving Consumer Goods (FMCG) manufacturer.

***Keywords**: Innivation Facotry, Innovation Atelier, Business Design*

INTRODUCTION

The paper aims at addressing the challenge how to design the firm's innovation system combining the design imperatives of design for routinized innovation', 'design for ambidexterity', and 'design for contingency'. It adopts a perspective of business design and introduces the complementary concepts of 'Innovation Factory' (referred to as I-Factory) and 'Innovation Atelier' (referred to as I-Atelier). The approach builds on insights stemming from systems theory, economic theories of growth, process philosophy, theories of business design, and theories of contingency on organization as well as a series of case studies of business design.

A. Design for 'routinized innovation'

A variety of economic growth theories (among others Schumpeter, 1955; Baumol, 2004) have underlined the importance of 'routinized innovation' in generating growth. In a number of industries, routinized innovation activities have become a must for survival. Practitioners must therefore embrace the phenomenon of 'routinized innovation' and reap the growth-benefits associated with it. Specifically, they need to give particular attention to the design of efficient innovation structures, since (i) routinized innovation has "everything to do with organization and attitude and very little to do with nurturing solitary genius"

(Hagardon and Sutton 2000) and (ii) "(i)nnovation becomes an internal bureaucratically controlled process" (Baumol, 2004). Based on this, we define the business design imperative of 'design for routinized innovation activities'.

B. Design for 'ambidexterity'

Theories on ambidexterity (among others Duncan, 1976; O'Reilly and Tushman, 2004) advocate that companies need to adopt a dual innovation strategy combining the imperatives of 'exploit' and 'explore'. Innovation structures need to have the ability to simultaneously generate heterogeneous types of innovations such as incremental (small improvement in the existing products), architectural (fundamental changes of some component of the business), and discontinuous (radical advances) innovations. Based on the above, we define the business design imperative of 'design for ambidexterity'.

C. Design for 'contingency'

Theories of contingency on organization (among others Thompson, 2003), maintain that there is no universal way or one best way to manage an organization, that effective organizations have a proper 'fit' with their environment and between their sub-systems, and that the needs of an organization are better satisfied when they are properly designed and the management style is appropriate to both, the tasks undertaken and the nature of the work. The design approach thus needs to accommodate for the specific context of the firm. Based on this, we define the business design imperative of 'design for contingency'. The authors present a conceptual discussion supported by a case study of a Fast Moving Consumer Goods (FMCG) manufacturer. We set out by discussing the company's innovation system and its sub-systems 'I-Factory' and 'I-Atelier' (section 2). We then proceed by differentiating

these concepts with regard to their innovation scopes (section 3), approaches to structure their innovation scopes (section 4), and innovation processes (section 5). Subsequently, the matching of the innovation scopes and the innovation processes is presented (section 6). As the concepts are discussed, we gradually introduce the case study of an FMCG manufacturer. The paper concludes with a discussion of the I-Factory of the FMCG manufacturer (section 7).

INNOVATION SYSTEM (I-FACTORY AND I-ATELIER)

We view the firm's innovation activities as a complex adaptive system aimed at generating a continuous flow of innovations to secure the firm's current and future strategic positions. The innovation system can be structured into an 'exploitative' and an 'explorative' sub-system. This is supported by theories of ambidexterity and systems theory.

A. Ambidexterity

Theories of ambidexterity claim that companies need to develop explorative and exploitative innovations simultaneously to secure current and future strategic positions. The concepts of exploration and exploitation are well established by a variety of research streams adopting perspectives, such as organizational learning and strategy (Levinthal and March, 1993; Vera and Crossan, 2004), innovation (Daneels, 2002; Rothaermel and Deeds; 2004), and entrepreneurship (Shane and Vekataraman, 2000) (compare Jansen, Van den Bosch and Volberda, 2006).
From the business design perspective adopted here, we conclude that companies need to embrace dual innovation strategies accommodating simultaneously for the requirements of 'exploration' and 'exploitation'. The firm's innovation system thus needs to generate simultaneous streams of 'incremental' and 'more disruptive' innovations.

B. Exploitative and explorative sub-systems

From an organizational perspective, various authors of theories on ambidexterity argue that organizations develop explorative and exploitative innovations simultaneously in different organizational units (among others Tuschman and O'Reilly, 1996; Benner and Tushman, 2003). However, they also conclude that companies have not been very successful at implementing ambidextrous organizations (Kaplan and Henderson, 2005; O'Reily and Tushman, 2004). Issues encountered were associated with the difficulty of consolidating the different scopes and organizational requirements of the exploitative and explorative sub-units.

From a business design perspective, it is therefore key to adopt a holistic view of the firm's innovation activities and embed the two sub-units into the parent innovation system of the company. This calls for a clear differentiation between the two units with regard to their innovation scopes, structures and processes.

Combining these findings with insights from systems theory, we start our considerations at the level of the firm's overall innovation activities, i.e. its innovation system (in the following referred to as I-System). It is defined as a 'system of processes' that is hierarchically structured into an 'exploitative sub-system' and an 'explorative sub-system'. We refer to the first as the I-Factory and the latter as the I-Atelier.

C. Integration of I-Factory & I-Atelier

I-Factory and I-Atelier serve different innovation sub-strategies and have varying organizational requirements. However, they are complementary and 're-compose' (Simon, 1996) into the parent I-System to jointly deliver on the company's dual innovation strategy. As the landmark between I-Factory and I-Atelier one could see "the initiation of the diffusion of the innovation among potential adopters"

(Rogers, 1995). This differs from the conventional separation between pre-development and development or the distinction between research and development. In practice, we observed that this usually happens at the stage of 'proof-of-concept'. An overarching process of 'Innovation Integration' (I-Integration) ensures the horizontal integration of the two sub-systems, but also their vertical integration into the parent I-System (Fig. I). It guarantees and monitors the compatibility of the company's innovation activities with the company's strategic objectives. It is also in charge of resource allocation and definition of strategic frameworks for the I-Factory and I-Atelier. Importantly, I-Integration decides whether an innovative output from the I-Atelier should be transferred into the I-Factory or be sold externally. For perspective, companies such as Procter & Gamble have adopted the policy to commercialize innovative outputs externally, if they have not been adopted by the organization within a certain time period from development.

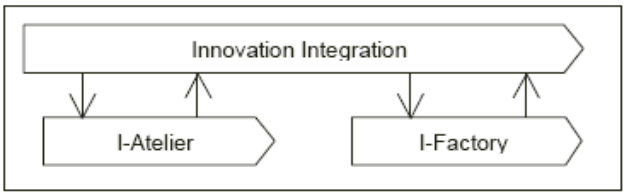

Fig. I: I-System and its sub-units

As illustrated in Fig. I, the systemic approach adopted to structure the I-System allows for a modular integration of I-Factory and I-Atelier. This accommodates for their different organizational requirements without jeopardizing their integration. I-Factory and I-Atelier are combined by the overarching Innovation Integration (I-Integration) to ensure the compatibility of their activities with the innovation strategy.

D. Case study - company presentation and issue set-up

Cocoa Ltd. produces and distributes branded packaged chocolate goods. Increased competition and price pressure eroded Cocoa Ltd.'s market share and margins. In a news-driven market, the company repeatedly failed to establish new initiatives, either because it missed out on consumer trends or because initiatives were late. Promotions based on price appeared as the main means to fight the erosion of current market positions. The principal driver behind this was the insufficient innovation capability of the company as evidenced by its long time-to-market, 24 months versus 6 months for leading competitors, and the lack of systematic capability-building in the company. Top management revised the company strategy. Besides aggressive internationalization the following innovation objectives were defined: (i) establish sustainable innovation leadership in current product categories by generating a continuous flow of upgrades, line extensions, promotional and seasonal offerings; and (ii) exploit the convergence trend in the food sector by leveraging current capabilities into new product categories and market segments.
The product development organization had undertaken substantial efforts to increase the efficiency of its project-based development process by introducing lean techniques such as cross-functional project teams, multi-tasking, and concurrent development. In the face of the new innovation objectives, it became however clear that a major organizational re-shuffle was needed to allow for the generation of a continuous flow of product news.

INNOVATION SCOPE (I-FACTORY AND I-ATELIER)

The scope of the I-System is to generate a continuous flow of streams of heterogeneous innovative outputs, including 'incremental' and 'more disruptive' innovations. From a business design perspective, this

heterogeneous scope of the I-System needs to be structured into sub-scopes that are attributed to the I-Factory and the I-Atelier respectively. Typologies of innovation have to be identified, which allow for a clear allocation of the company's innovation activities either to the scope of the I-Factory or of the I-Atelier.

A. Typologies of innovation outputs

A literature review showed that there is a variety of typologies of innovation outputs associated with the concepts of 'exploitation' and 'exploration'. Such 'object-based' typologies include incremental vs. radical innovations (Abernathy, 1979); continuous vs. discontinuous technological innovations (Porter, 1986); incremental vs. breakthrough innovations and competence enhancing vs. competence-destroying innovations (Tushman and Anderson, 1986); conservative vs. revolutionary innovations (Abernathy and Clark, 1985). Studies confirm significant differentiation levels when considering individual theories of innovation types. However, Damanpour and Gopalakrishnan (2001) report that studies combining several theories of innovation types did not confirm any significant differentiation among the innovation types. For example, the typology 'incremental vs. radical' does not qualify the degree of newness in absolute terms. It is contingent on the specific organizational context. In line with findings from theories of contingency on organizations, we need to find a typology of innovations, which accounts for the specific perspective of the individual company. This implies the need to conceptualize the specific context of the organization and its innovation scope. Concepts approaching 'new-to-the-organization' to 'disruptive' innovations are not specific enough and thus not actionable from a business design perspective.

B. Broadening scope of Innovation studies

Literature reviews of innovation theories in fields of management science such as R&D, marketing and business strategy showed that the object of innovation studies has been broadening over the past decades. We notice, that the perspectives of separate disciplines are converging towards a more holistic view of innovation. Based on insights from R&D, marketing and business strategy literature, we introduce the concept of 'value delivery system' to differentiate incremental from more disruptive innovations.

1) Perspective of R&D

From the perspective of R&D management, a literature review (Mitterdorfer-Schaad 2001) illustrates the broadening understanding of innovation from a narrow and fragmented focus on products, technologies, and processes to a broader focus on 'company performance' including aspects of 'effectiveness', 'profitability' and 'customer satisfaction'. More recent definitions view innovation as the first-time and successful economic use of a novelty by the specific company (Mitterdorfer-Schaad, 2001). The core of organizational research on R&D is more concerned with innovation aspects in the field of product, technologies, and manufacturing and does not systematically adopt a holistic view considering innovation areas such as marketing, distribution and promotion on a par with areas related to technology, product and manufacturing. This need for a holistic view is also not adopted by other popular typologies such as 'product vs. process innovations' (Utterback and Abernathy, 1975), 'technical vs. administrative innovations' (Daft, 1987), and 'continuous vs. discontinuous technological innovations' (Porter, 1986). However, in a variety of industries, companies are facing markets driven by innovations not exclusively related to the physical product and

associated processes, but to other dimensions of a company's 'value delivery system' (see following paragraph), such as brand development, promotion, distribution, primary services and after-sales services. This trend sets in latest when the differentiation potential of product innovation is exhausted.

2) Perspective of marketing and business strategy

Also the disciplines of marketing and business strategy have broadened their perspective over the past decades. Anterasian and Phillips (1988) and Webster (2002) illustrate the evolution of the marketing and business strategy perspective over the past decades. It went a long way from Drucker's 'marketing concept' (Drucker, 1991) advocating that the fundamental purpose of the firm is to create a satisfied customer. This lead to the introduction of concepts such as market segmentation, targeting, and positioning. Subsequently, the marketing concept and strategic planning were integrated into a common concept of long-range planning. The first of a series of approaches to combine market needs with the company's capabilities was Kaldor's concept of 'imbricative marketing' (Kaldor, 1971). Subsequently, strategic planning was dominated by financial management viewing return on investment and profit as the objective of business activity at the expense of creating satisfied customers. In the mid-1980s the rediscovery of the marketing concepts was driven by severe market in-roads of Asian competitors better able to capitalize on the tastes, preferences, and buying habits of customers. The concept of 'total quality' was equalled to 'customer orientation'.
More recent authors propose the concept of 'value to the customer' as the strategic force driving company performance. Sources of value, and thus also sources of innovation, are associated with product and service, customer intimacy, and operational excellence (Treacy and Wiersenna, 1995). Webster (2002) defines the marketing concept as the process of

defining, developing, and delivering customer value in the modern business environment. Anterasian and Phillips (1988) maintain in their 'value delivery theory of competitive advantage' that "sustainable competitive advantage is rooted in the abilities of a business to deliver superior value to customers at a profitable cost (…). This skill-based advantage may manifest itself in one or more areas of a business' value delivery system, i.e. its abilities to choose, provide, and communicate a superior value proposition to target customers. Skill(s) may reside in individual workers, functions, or may even become institutionalized and possessed by the business unit as a whole. Once institutionalized, these skill-based advantages become difficult for competitors to easily replicate, forming the basis for truly sustainable advantage" (Anterasian and Phillips, 1988).
From these findings we conclude that the 'value delivery system' of a company is a dual construct consisting of (1.) the value a company proposes to the customer and (2.) the way it structures the value for delivery. It is a highly contingent construct enclosing the essence of what the company is about.

C. Typology based on 'value delivery system'

Combining insights from innovation literature and literature on marketing and business strategy, we define a typology of innovation activities based on the concept of 'value delivery system' (in the following referred to as VD-system). Innovation activities can thus be differentiated based on whether they aim at generating incremental changes within the current 'VD-system' of the company ('exploitative innovations' associated with I-Factory), or whether they aim at more disruptive changes of the 'VD-system' (i.e. 'explorative innovations' associated with I-Atelier). This typology is also confirmed by analogy by the pragmatic view shared by many R&D practitioners. They differentiate innovation activities based on whether they are

associated with generating changes within the product architecture or changes of the architecture.
From a business design perspective, adopting the concept of VD-system addresses two needs identified earlier. First, it allows for a holistic view of the company's innovation activities. Second, it accommodates for the requirements of theories of contingency on the organization, since the VD-system is highly contingent on the company's strategy and specific context.

D. Scope of the I-Factory

The I-Factory's innovation scope covers the company's current VD-system. Exploitative innovation activities are about scrutinizing all elements of the company's VD-system for incremental innovations, product upgrades, product and module variants, line extensions and new combinations of existing modules. The aim is to generate a continuous flow of incremental innovations. This flow enables the company to adapt to immediate and mediate environment changes and exploit the opportunities presented by these changes.

E. Scope of the I-Atelier

The I-Atelier's innovation scope covers the company's future VD-system. It deals with the 'creative destruction' associated with a corporation's long-term competitiveness and performance (Foster and Kaplan 2001). Explorative innovation activities aim at replacing the company's current VD-system or significant parts of it with new VD-systems. This includes fundamental changes of some key component of the business, architectural changes, new platforms, new technologies and new business models. The scope of the I-Atelier is a 'landscape of projects'. Its outputs are completed development projects (either single-

projects or portfolios of projects) ready for diffusion and adoption internally or externally.

F. Case study - Defining the scopes of I-Factory & I-Atelier

The innovation activities associated with the I-Factory of Cocoa Ltd. include a continuous flow of news in terms of product variants, upgrades, line extensions, seasonal collections, promotional sizes, fillings and ingredients (Fig. II). They are associated with an exploitative process.

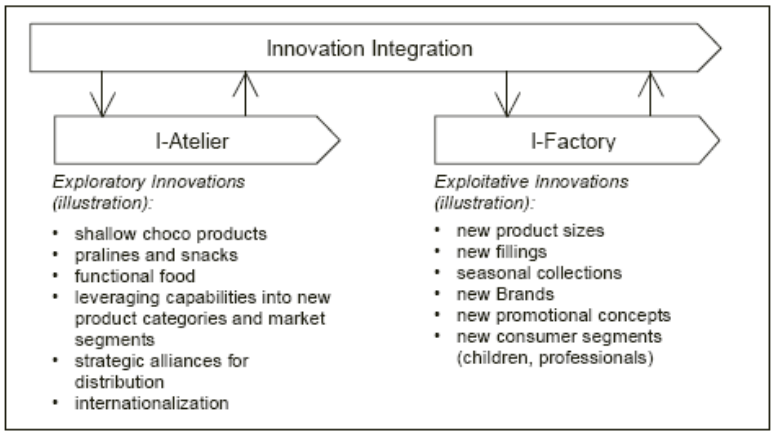

Fig. II: I-System of Cocoa Ltd.

Innovation activities associated with the I-Atelier are radical from a company perspective and require an explorative process. They include: the development of new product formats such as chocolate candies, moulded chocolate products, functional food products, leveraging capabilities (e.g. brands and distribution) into new product categories

such as biscuits, exploring new distribution possibilities (e.g. web-based and alliances) and entering new markets (specifically Central and Eastern Europe). Historically, the company had not made the distinction between 'exploitative innovations' and 'explorative innovations' and handled all innovation activities as single-projects based on a new product development process (NPD) .
For perspective, Cocoa Ltd. associated some apparently 'incremental' innovation activities, such as the development of shallow chocolate products, with the I-Atelier, because it was a disruptive innovation from the perspective of the company and did not enter its actual VD-system. A competitor, however, associates similar initiatives with its I-Factory, since it is part of its specific VD-system. The typologies contrasting 'incremental' and 'disruptive' innovations are thus not absolute, but contingent upon the specific context of the firm.

STRUCTURING THE INNOVATION SCOPES

A. Structuring for manageable sub-scopes

Having clarified the broad innovation scopes of the I-Factory and the I-Atelier respectively, these scopes need to be fragmented into manageable sub-scopes. In line with systems theory and the theory of modularity, we define the scopes as hierarchical 'parts-within-parts' structures. These can be further fragmented into modular sub-scopes (Simon, 1996) until scopes of a manageable size are identified. Being different in nature, the scopes of the I-Factory and the I-Atelier can be structured based on different criteria without jeopardizing their integration into the parent I-System. We adopt the concept of 'value delivery architecture' (VD-architecture) to structure the scope of the I-Factory. Commonly, project architectures combined with grouping strategies are used in the context of I-Ateliers.

B. VD-architecture for I-Factory

The scope of the I-Factory is the company's current VD-system. In analogy with the concept of 'product architecture' that has been used as a basis to structure R&D activities, we introduce the concept of 'VD-architecture' as a base to structure the innovation scope of the I-Factory. The concept of 'product architecture' is well documented in literature of engineering and product development. In organizational research, it has been established as an efficient base for structuring R&D organizations (Oosterman, 2001). However, the approach of organizational design based on the product architecture appeared as insufficient in industries driven by innovation in areas not exclusively related to the physical product.

Thus, we integrate the concepts of VD-system and VD-architecture into our design approach. They accommodate for innovation areas such as brand development, promotion, distribution, primary services and after-sales services. The current VD-system is structured into a VD-architecture composed of modular parts. Being a 'nested system' composed of 'parts-within-parts' (Simon, 1996), the architecture can be decomposed until modular sub-scopes of a manageable size are reached. Establishing a VD-architecture is highly contingent upon the company's context and has a series of strategic implications, since it defines the way a company structures its VD-system.

It also appears to be relevant to traditional manufacturers facing increased pressure for non-product innovation, such as establishing brands, internationalize their business, and develop new distribution opportunities. In some cases the VD-architecture can also be used as a framework to develop company strategy or to delimit business divisions.

C. 'Project architecture' for I-Atelier

The I-Atelier specifies projects in line with the company's exploration strategy and generates a set of completed development projects (either single-projects or portfolios of projects) ready for diffusion and adoption internally or externally. The scope of the I-Atelier covers the company's future VD-system and is in most cases a 'landscape' of more or less pre-defined projects. This was also the case for Cocoa Ltd.'s I-Atelier (Fig. II). Concepts associated with the 'project architecture' can be used to structure the scope of the I-Atelier. The basic idea is to structure innovation projects into modular and manageable portions. Highly heterogeneous and unique projects are usually structured based on their dedicated project architecture. More homogeneous projects are clustered into portfolios of projects for which consolidated portfolio architectures are designed. Such techniques are also referred to as strategic project mapping. A variety of tools are proposed by the burgeoning literature on project, lean project, and multi-project management. In the case of a maintenance company, the I-Atelier was structured into 'Innovation Fields' that are explored systematically to generate ideas and broadly defined projects. They are closely associated with strategic business development.

D. Case study - Cocoa Ltd.'s VD-architecture

After defining the innovation scopes of its I-Factory and I-Atelier in line with company strategy, Cocoa Ltd. proceeded by structuring these innovation scopes. It adopted the VD-architecture and the 'project architecture' to structure the scopes of the I-Factory and the I-Atelier respectively. Importantly, innovation areas not related to the physical product were systematically introduced into the scope of the I-Factory to account for the specific FMCG context. Thus, the VD-architecture underlying the I-Factory provides a framework integrating all areas of

Cocoa Ltd.'s activities prone to incremental innovation: product, marketing, promotion, and distribution. The VD-architecture for the I-Factory is illustrated in Fig. III.

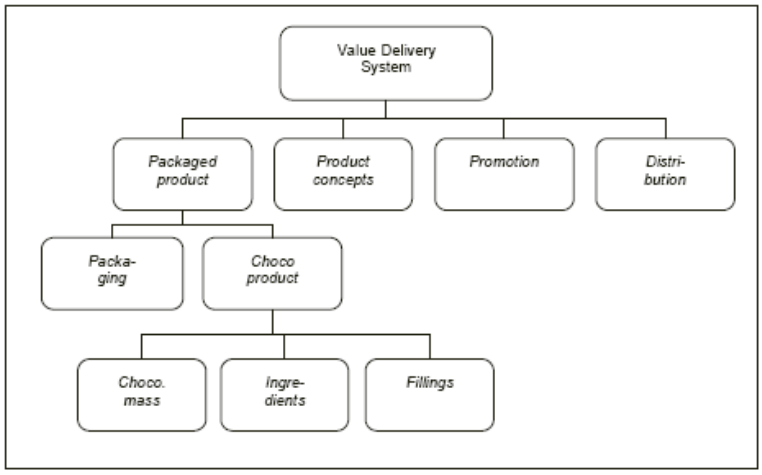

Fig. III: VD-architecture of Cocoa Ltd.

INNOVATION PROCESS (I-FACTORY AND I-ATELIER)

A. Processes for I-Factory & I-Atelier

Having structured the innovation scopes of I-Factory and I-Atelier into architectures, the processes best suited to handle these innovation scopes need to be designed. Conventional models of innovation processes adopt a broad view covering the entire innovation cycle from a unitary perspective. We advocate that this perspective does not meet the requirements of the business design perspective adopted here. It appears that the exploitative process of the I-Factory is significantly different from the explorative process of the I-Atelier and that these

processes need to be tailored contingent upon the innovation scopes they will be associated with.

1) Conventional models of innovation processes

Our literature review produced a variety of well-established models of innovation processes. However, most adopt a unitary view of NPD and cover the broad scope from the decision to begin research on recognized or potential problems, to development, commercialization, diffusion, decision to adopt, implementation, and consequences (Rogers, 1995). For a review of models of innovation processes, we refer to (Anterasian and Phillips, 1988). However, a unitary perspective of the innovation process does not account for our perspective of the I-System, in which the I-Atelier develops explorative innovations, which are subsequently transferred into the I-Factory. Table I shows an overview of conventional models of innovation processes.

2) Organizational view of processes

Benner and Tushman (2003) maintain that units engaging in explorative innovation pursue new knowledge and develop new products and services for emerging customers or markets. Units pursuing exploitative innovation build on existing knowledge and extend existing products and services for existing customers (Benner and Tushman, 2003). It can be concluded that the two units innovate in different ways: Exploration is more emergent and can be characterized by variation, search, experimentation, and discovery, whereas exploitation is more planned, and can be characterized by selection, refinement, choice, and execution (Damanpour and Wischnevsky, 2006). Damanpour and Wischnevsky (2006) liken their concepts of 'generation and adoption processes' to 'exploitation and

exploration' respectively and conclude that these processes differ considerably and have different organizational requirements.

Table I: Models of Innovation processes (adapted from (Antesarian and Phillips, 1988)

Study	Model of Innovation process
Kanter (1988)	Idea generation → coalition building → idea realization → → transfer or diffusion
Klein and Sorra (1996)	Research → development → testing → manufacturing → packaging → dissemination → awareness → selection → adoption → implementation → routinization
Roberts (1988)	Recognition of opportunity → idea formulation → problem solving → prototype solution → commercial development → → Technology utilization and/or diffusion
Rogers I (1995:133)	Needs/problems → research (basic and applied) → development → commercialization → Diffusion and adoption
Rogers II (1995: 392)	Agenda-setting → matching → redefining/restructuring → clarifying → routinizing
Rothwell and Robertson (1973)	Idea generation → project definition → problem solving → design and development → production → marketing
Tornatzky and Fleischer (1973)	Research → development → deployment → adoption → implementation → routinization
Zaltmann et al. (1973)	Knowledge awareness → attitudes formation → (adoption) decision → initial implementation → continued-sustained implementation

Table II: Exploitative and explorative processes

	I-Factory (exploitative processes)	I-Atelier (explorative processes)
Objectives	Generate continuous flow of 'exploitative innovations' within the company's current VD-system.	Generate and complete 'exploitative innovations' of the company's current VD-system.
Strategies	Routinizable problem-solving and information-processing	Creative problem-solving, creation of new ideas and outputs
	Generation of continuous flow of innovative outputs	Completion of single-projects (or clusters of projects)
Mgmt focus	Increasing the efficiency of the flow generation from the perspective of the entire I-Factory.	Increasing the efficiency of the project completion at the level of either single-projects or portfolios of projects.
Process	Process is "relatively orderly, more like a periodic and sequential progression of phases" (Cheng and Van de Ven 1996)	Process is "relatively disorderly, more like a random process of chance and chaotic events" (Damanpour/Wischnevsky 2006: 274)
Output	Flow of outputs with a high degree of similarity.	Highly differentiated single-outputs or categories of outputs.
Repetitiveness	A given set of clearly defined activities is repeated regularly with a high similarity between successive cases.	A given set of broadly defined activities is completed at relatively low frequency with a low similarity between successive cases (single-projects or portfolios of projects).

Table II: Exploitative and explorative processes (continued)

	I-Factory (exploitative processes)	I-Atelier (explorative processes)
Orientation (process vs object)	Process-orientation: continuous, highly repetitive process delivering a sustained flow of outputs.	Object-orientation: Tasks with distinct beginning, end and deliverable.
Driver of novelty	Process-orientation: the exploitative process is itself the source of continuous novelty.	Object-orientation: the completed project is the source of novelty.
Routinization	High degree of routinization (exploitation processes)	Low degree of routinization (project management processes)
Organizational Design	Process-orientation	Project-orientation
Fragmentation *('de-composition' Simon 1962)*	I-Factory is structured based on process typologies.	I-Atelier is structured based on project typologies.
	Structure exploitative sub-system into modular sub-processes for scope and scale economies	Structure explorative sub-system into groups of projects, then groups of tasks for efficient coordination.
Integration *('re-composition' Simon 1962)*	Integration of specialized sub-processes based on 'VD- architecture' underlying the I-Factory	Integration of tasks based on project or portfolio architecture underlying the single-project or the portfolio of projects
	Secure the integration of specialized sub-processes at the level of the I-Factory.	Secure the integration of project tasks at the level of single-project or portfolio of projects.

This was also confirmed by our findings from business design cases and interviews with R&D managers. These findings are compiled in

Table II showing a non-exhaustive list of contrasting characteristics of 'exploitative' and 'explorative' innovation processes. From a business design perspective, it is important to understand these differences and customize the processes accordingly.

B. Process for I-Factory

To secure the generation of a sustained flow of incremental innovations, the I-Factory continuously searches its dedicated innovation scope for 'existing' ideas and assimilates them to address recognized needs. The exploitation process is characterized by "selection, refinement, choice and execution" (Damanpour and Wischnevsky, 2006). It is about routinizable "problem-solving", "information-processing" (Nonaka, 1990) and not about creating 'new' ideas. Exploitative processes adopt the perspective of continuous and efficient exploitation of defined innovation scopes or sub-scopes for new variants, upgrades, alternatives, and elsewhere available solutions. The developed ideas are stocked for assembly.

The process of integrating the outputs of the exploitative processes is of secondary importance, since the associated innovation sub-scopes are modularly linked in the VD-architecture and integrated in the overarching integration process at the level of the I-Factory. From a perspective of 'design for routinized innovation', exploitative processes are particularly important, since they need to be designed for a high degree of routinization. This includes developing object-independent knowledge such as routinized problem-solving and information processing. In fact, "to create incremental innovations, a firm often needs to do no more than make key organizational processes routine in order to maximize organizational effectiveness" (Cusumano and Nobeoka, 1998). From a business design perspective, we maintain that

the core of 'routinized innovation' is associated with the exploitative I-Factory.

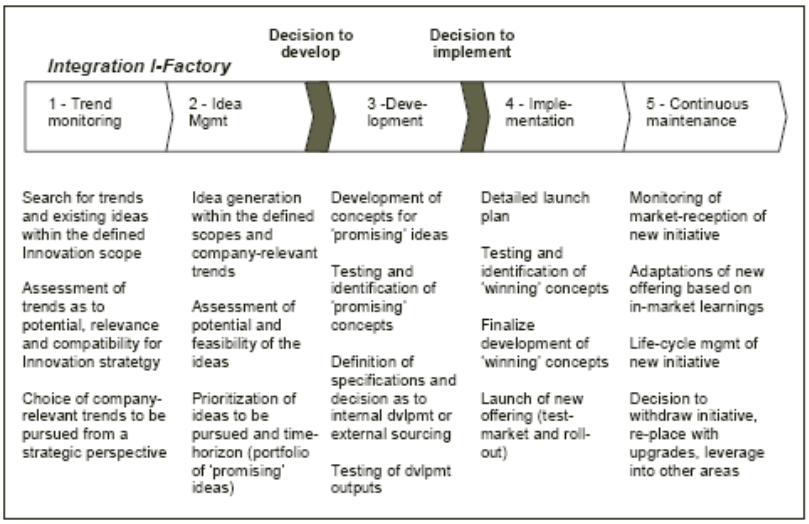

Fig. IV: Exploitative process of I-Factory (Cocao Ltd.)

C. Process for I-Atelier

The I-Atelier's explorative process generates a highly heterogeneous set of completed development projects. The process is about creating new ideas, making them work and preparing them for diffusion, internally or externally. As mentioned above, the exploration process is characterized by variation and discovery. It is a creative process in which new and existing ideas are combined in a novel way to produce an invention or a configuration that was previously unknown (Duncan, 1976). In the context considered here, the explorative process of the I-Atelier adopts an 'object-based' perspective of 'structuring and

integrating tasks for the completion of complex projects' (single-projects or portfolios of projects). The explorative process is managed based on approaches described in project management literature (project, lean project, and multi-project management) (Cusumano and Nobeoka, 1998).

From the perspective of 'design for routinized innovation', explorative processes are not about routinizable problem solving and information processing. Nevertheless, increasing attention is given to the routinization of explorative processes. This is in line with Schumpeter's view that most innovation activities are positioned somewhere between routine and non-routine behaviour (Schumpeter, 1955). The dichotomy of 'routinized' vs. 'non-routinized' routines appears to be thus merely conceptual. Additionally, in analogy to Schumpeter's process of 'progressive rationalization' (Schumpeter, 1950), it can be theorized that once processes are put in place correctly, their degree of routinization tends to increase with the number of occurrences. Thus, if the I-Atelier is 'designed for routinization', each case will add to the company's capability of 'integration for project completion'. The FMCG manufacturer considered the development of such capabilities as an important asset to face a market environment of accelerating innovation rates, internationalization, consolidation and significant price pressure on conventional offerings.
It can be maintained that explorative processes are less prone to routinization, since they have limited similarity and low frequency levels and aim at achieving highly differentiated innovative outputs. However, we maintain that if a company wants to reap the full benefits associated with 'routinized' innovation, it needs to achieve a combination of both, exploitative and explorative routines. For perspective, the standardization of processes documented in project management literature can be associated with an attempt to design for 'routinized innovation'. The benefits of process standardization in

product development go beyond ready-made templates for development schedules, which can be used for each new development project. It is also different from mostly informal carry-over benefits from one project to the next. Standardization provides 'pivot points' which make similar experiences possible, even when the product changes. It allows a project to profit from past learning (capabilities) and to add its own learning (capability development). These systematic learning effects and the associated development of organizational capabilities are the main benefit of standardization. Some authors in project management literature associate this standardization with routinization of innovation. In fact, they describe a variety of 'routines' in the context of single-project, lean project, and multi-project management. Nevertheless, we maintain there is a significant difference between innovation activities as routinized in the I-Factory and as routinized in the I-Atelier and consider the first of higher degree of routinization as compared to the second.

D. Case study - Process design (I-Factory)

Having defined the scope of its I-Factory and its underlying VD-architecture, Cocoa Ltd. proceeded by designing the exploitative process of the I-Factory and the explorative process of the I-Atelier. The processes were designed accounting for their differences and to systematically reap the benefits associated with 'routinized innovation'. We limit our discussion to Cocoa Ltd.'s I-Factory, whose exploitative process is illustrated in Fig. IV.

I-FACTORY OF COCOA LTD

The following discusses the process architecture and the organizational set-up of the I-Factory of Cocoa Ltd.. The process architecture is established by matching the innovation sub-scopes and the innovation

process (Fig. V). Further, Cocoa Ltd. decided to adopt a process-based organization in line with the process architecture (Fig. VI).

A. Process architecture

Based on an analysis of the capabilities and resources required to exploit the innovation sub-scopes of the I-Factory, Cocoa Ltd. proceeded by grouping these sub-scopes into manageable and coherent clusters to be allocated to core processes of the I-Factory. The matching of scopes and processes thus produced the process architecture of the I-Factory shown in Fig. V. It consists of the core processes of marketing innovation, packaging innovation, recipe innovation and ingredients & fillings innovation. These are integrated by the overarching integration process of the I-Factory.

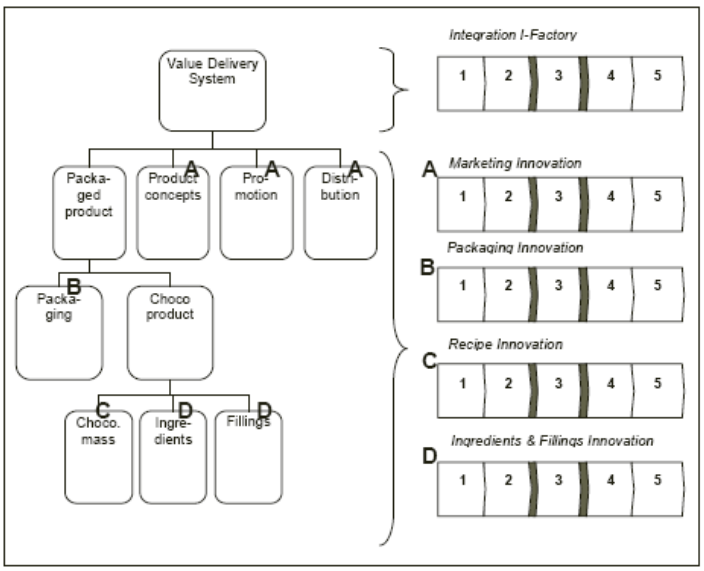

Fig. V: Matching Innovation scopes and processes (I-Factory)

B. Organizational set-up

Literature on Business Process Re-engineering (BPR) documents the advantages of the congruency between formal organizational set-ups and business processes. It is associated with lower levels of complexity in the organization, as evidenced by fewer interfaces among organizational units and less conflictual objectives. The formal organizational structure thus reflects the way in which the overall scope of the I-Factory is decomposed into modular sub-scopes. Based on the same principle, organizational units can be re-composed into its higher-level organizational unit, the I-Factory.

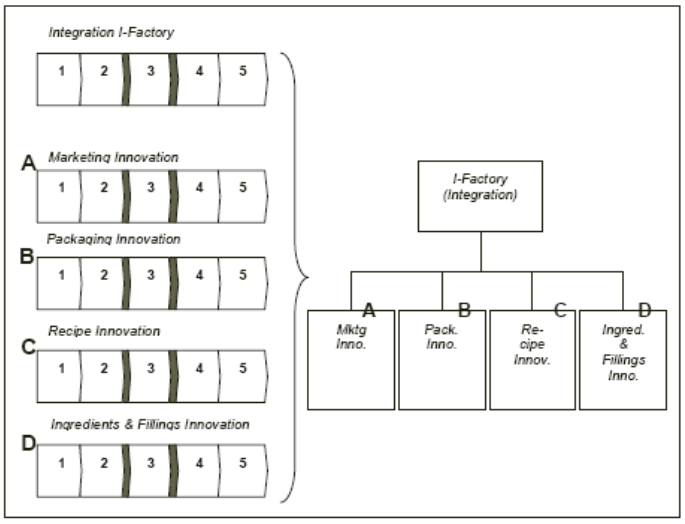

Fig. VI: Process-based organizational set-up

Cocoa Ltd. thus designed its formal organizational set-up based on the underlying process architecture. Organizational units are allocated a defined 'innovation sub-scope' and integrate into the I-Factory. The organizational units exploit their innovation scope based on an

innovation process which they can further detail based on their specific requirements in terms of process detail, capabilities, resources (such as human, technological, infrastructure) and other organizational requirements.

MECHANICS OF THE I-FACTORY OF COCOA Ltd

The following proceeds with a discussion of the mechanics of Cocoa Ltd.'s I-Factory. The integration of the core processes of the I-Factory is based on its Integration process, whose innovation scope is the company's current 'VD-system'. The Integration process has a dual function: it contributes to company strategy and ensures the compatibility of the I-Factory's activities with company strategy. To achieve this, the Integration process oversees and integrates the core processes of the I-Factory based on (1.) innovation cycles and (2.) portfolios of pre-, semi-, and final development outputs.

A. Innovation cycles and portfolios

The integration process of the I-Factory is in charge of steering and integrating the core processes to deliver a continuous flow of market-relevant innovations. Specifically, it details their innovation scopes based on company strategy and keeps their development activities in line with company strategy. This is achieved through a series of innovation cycles with associated portfolios (Fig. VII):

1) Cycle 1 - Trend monitoring

Within their dedicated innovation scopes, the core processes systematically identify and qualify the key trends. These collectively constitute the I-Factory's portfolio of 'qualified trends'. The Integration process then consolidates these trends from its perspective of the 'VD-

system' and scrutinizes them for compatibility with company strategy, relevance and feasibility. Subsequently, it identifies among the 'qualified trends' a series of 'promising trends'.

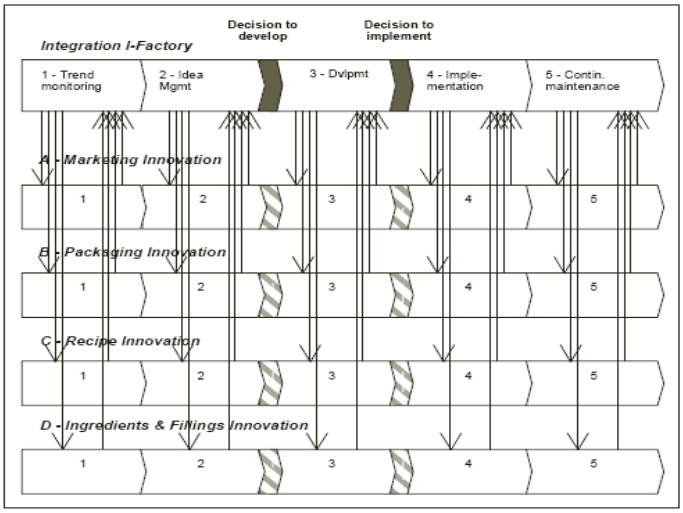

Fig. VII: Mechanics of the I-Factory

2) Cycle 2 - Idea management

The core processes (A to D in Fig. VII) develop and qualify ideas against the 'promising trends'. These constitute the I-Factory's portfolio of 'qualified ideas'. The Integration process combines these ideas from its perspective of the 'VD-system' into the I-Factory's portfolio of 'qualified ideas' and scrutinizes them based on medium-term market developments and company strategy. 'Promising ideas' are selected and a decision to develop is made.

3) Cycle 3 – Development

Subsequently, the core processes develop 'qualified concepts' against these 'promising ideas' and feed the I-Factory's portfolio of 'qualified concepts'. From a combined 'VD-system' perspective, the integration process determines the potential of these concepts in the view of specific short- and mid-term market opportunities and defines a selection of 'promising concepts', for which final development is undertaken.

4) Cycle 4 – Implementation

A launch plan is then established at the I-Factory level and further detailed at the level of each core process. After final development and integration of the 'promising concepts', these core processes are tested against the specific market opportunity to identify the 'winning concepts' that are subsequently launched. For the first 6 months after their launch, initiatives are considered as part of the portfolio of 'new initiatives'. Based on the initiative's reception by the market, they are scrutinized by the core processes to identify areas for improvement to be made to the new initiatives. As part of the management of the portfolio of 'new initiatives', the integration process reviews the identified 'areas for improvement' and decides how to proceed, i.e. either silently make the adjustments, plan for the subsequent launch of an upgrade, or in the extreme case withdraw the initiative from the market.

5) Cycle 5 - Continuous maintenance

An initiative is considered as part of the 'portfolio of in-market initiatives' beyond 6 months after launch. The core processes scrutinize these initiatives for maintenance and life-cycle requirements. This

includes replacing and/or upgrading some elements that approach the end of their lifecycle (e.g. for regulatory reasons), and extending proven concepts to other brands or product variants. Importantly, the portfolio of 'in-market initiatives' is managed by the integration process of the I-Factory from a 'VD-system' perspective. This includes decisions regarding product upgrades, new product variants, and discontinuation of a product.

B. De-coupled innovation processes

The following will present the concept of 'de-coupled innovation' as adopted in our I-Factory and subsequently highlight the differences between these concepts and the widely adopted concepts of 'multi-tasking' and 'parallel development' and its various forms.

1) De-coupled innovation at Cocoa Ltd.

The design of Cocoa's Ltd.'s I-Factory accounts for the different time horizons of the core processes by de-coupling these processes. In fact, processes follow each their own time horizon and generate innovative outputs for stock (i.e. the various portfolios at I-Factory level). Thus each of the core processes develops within its innovation scope a variety of 'qualified trends' and 'qualified concepts' for stock. For perspective, Marketing innovation develops and tests concepts for brands, upgrades, flankers and line extensions. Recipe innovation develops and qualifies a variety of partial or integral chocolate recipes. The qualified concepts are stocked for further reference. Similarly, nutritional engineers in charge of ingredients innovation continuously define technical specifications (e.g. compatibility, tolerance, consistence, durability) for a variety of ingredients. Additionally, 'qualified concepts' for a variety of fillings (e.g. alcohol-based liquids, fruit-based liquids, vegetable pastes) are developed. These include the definition of

their technical specifications. Cocoa Ltd. thus created a stock of readily available 'qualified ingredients' and 'qualified fillings' that can be referred to and quickly inserted into new offerings. The introduction of the I-Factory and the concept of 'de-coupled' innovation, allowed Cocoa Ltd. to reduce lead-times significantly from 24 months to 6 months on average.

2) De-coupled innovation vs. parallel engineering

Historically, Cocoa Ltd. adopted a 'unitary' project-based NPD process (see section 5) to undertake its innovation activities. The product development organization had introduced lean concepts such as multi-tasking and simultaneous development, however, its lead-times remained far off competitive benchmarks. The concept of 'de-coupled innovation' is different from the various concepts of parallel engineering. In 'multi-tasking' complex projects are structured into tasks, which are scheduled to allow critical resources to work on different projects alternately. Classical 'simultaneous engineering' defines tasks based on their time-dependence and aims at executing these tasks not in a sequential, but in a partially parallel manner. The I-Factory, however, goes beyond making a variety of tasks in parallel and de-couples its innovation activities. Innovation processes are not sequential and not even parallel, they are asynchronous to each other. Its core processes develop pre-, semi-, and final development outputs for 'stock'. These are combined by the integration process in line with the underlying 'VD-architecture'. We define this as 'de-coupled innovation' or 'asynchronous innovation'. In a variety of industries the de-coupling of innovation activities has produced significant reductions of lead-times. In the pharmaceutical industry molecule-concepts are qualified (i.e. qualification of physical characteristics and synthesis) and developed for the library (i.e. for stock). When product development needs a molecule, it refers to this

library to select target-molecules that are subsequently tested based on the specific product concept.

C. Planning of the I-Factory: "Keeping the beat"

Cocoa Ltd. adopted a cyclical approach to planning the activities of the I-Factory. This is based on the analogy with planning in manufacturing and sourcing management, where items are ordered at the latest possible time based on their sourcing lead-times. Longer lead-time items need to be sourced based on a forecast of 12 months or beyond, mid-term items can be sourced based on the rolling monthly forecast. The procurement of short-term items can be delayed until receipt of the actual customer order. Similarly, the activities of the core processes are not planned and initiated based on a defined project, but based on their allocated innovation scopes and their specific time horizons. In line with company planning, Cocoa Ltd. adopted also for its I-Factory the Master Planning (established once a year for the following 5 years), the rolling Development Planning (established every 3 months for the following 24 months), and the Launch Planning (established once a month for the following 12 months).

D. Benefits of the I-Factory at Cocoa Ltd.

A variety of benefits were associated with the introduction of the I-Factory at Cocoa Ltd. Within 36 months of introduction, the company had reduced its time-to-market from 24 months to 6 months and increased share of turnover of product news (less than 12 months) by 25 percentage pts. Importantly, awareness studies among users rated the company's brands highly for their innovativeness and suggested that Cocoa Ltd. succeeded in conquering back users. In some markets, the company achieved market leadership and innovation leadership. This was mainly driven by the seasonal collections the I-Factory

allowed the company to launch every quarter, each including 12 new product variants. The increased innovative capacity translated into higher market share, higher price levels, and higher margins. Separately, the I-Factory is seen today as a major contributor to the successful internationalization of the company's activities. In fact, in a food context driven by national and regional concepts, the I-Factory was able to develop a variety of new product concepts within very short lead-times.

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Efficiency Assessment of Road Project Delivery Models by Grey System Theory

Shih-Ching Lo
Chung Hua University
Hsinchu 300
Taiwan
Email: sclo@chu.edu.tw

ABSTRACT

In this study, four road project delivery models are analyzed by the grey relational analysis (GRA). The four models are design-bid-build (DBB), design-build (DB), construction management (CM) and design-build-maintenance (DBM). Evaluating road project delivery models is difficult because the projects differ from road to road, state to state and country to country. Thus, the evaluation data of project delivery systems are poor and lacking. Therefore, grey relational analysis and grey entropy weighting method are considered to compare the efficiency of the four road project delivery models. Grey system theory is a multidisciplinary and generic theory dealing with systems characterized by poor information and/or for which information is lacking. According to the result, DBM is the best model. DBB is the worst one and DB is better than CM. The results may provide public sectors to employ an adequate model so as to proceed with road construction project.

Keywords: *Road Project Delivery, Design-Bid-Build, Design-Build, Construction Management, Design-Build-Maintenance, Grey Relational Evaluation, Grey Entropy Weighting.*

INTRODUCTION

Historically governments and municipalities or cities have been responsible for designing, constructing and managing infrastructure assets. In both developed and developing countries, infrastructure sectors of road construction become more difficult because public financing is becoming more and more constrained and deficient as people are ageing, which drives up health care and pension costs (Global trends: 2015). Introducing private capital and increase competition to road construction become an important issue. Traditionally, a project is divided to planning, design or construction contracts, and then private sectors bid for each part of the project. However, dividing projects up and procuring different kinds of services via separate contracts are inefficient. Therefore, innovative delivery methods are increasingly used in infrastructure projects (Koppinen and Lahdenperä, 2004a, 2004b, Molenaar et al., 1999, Pakkala, 2002). The purpose of this study is to compare the performance of the different project delivery models of road construction.

The road project delivery (RPD) methods included in this research are traditional Design-Bid-Build (DBB), Design-Build (DB), Construction Management (CM) and Design-Build-Maintain (DBM and its variants Design-Build-Operate-Maintain, Design-Build-Finance-Build-Operate, Build-Operate-Transfer, Build-Own-Operate-Transfer, etc.). The depth discussion of financing issues and assessment of the societal affects of different project delivery methods are beyond the scope of this study. Data collection is a difficult problem for evaluation of road project delivery methods because each project differs from state to state and from road region to road region. In addition, employing the cost/benefit analysis will face a serious problem; that is, deciding the weight of each benefit and cost indicator.

Grey system theory is an effective method for lacking information (Deng, 1982, 1988, 1989). Grey system theory has already been widely used in many fields since 1982. Grey system provides multidisciplinary approaches for analysis and abstract modeling of systems for which the information is limited, incomplete and characterized by random uncertainty. Grey system theory typically deals with external boundaries but internal uncertainty or vagueness, while conversely fuzzy mathematics deals with systems, objects or concepts having a well-defined internal characteristics but not well defined boundaries (Liu and Lin, 1998). As other theories, grey system theory gradually developed from requirements for new methods to solve certain problems. Main contributions to grey system theory came from: grey systems and control, grey relational analysis (GRA) and grey modeling (GM). Similarly like fuzzy control, grey control enriches the domain of systems and control in addition to conventional methods (Liu and Lin, 1998, Yuan, 2007). GRA is used for system analysis, in contrast to traditional statistical methods. Statistical methods require a probability distribution. In some real world cases, a probability distribution cannot be determined due to limited availability of data. The research object of grey system theory is the system with "little sample" and "poor information", which is partly known and is partly unknown to outsider. However, we can obtain some valuable information by developing the known information, and know how the system runs and how to control the system.

In this paper, the grey relational analysis method is used to evaluate different road project delivery methods. Two kinds of data are employed to evaluate the efficiency of the four models. The first set of data only considers the cost effect of the RPD models and the second set of data considers performance of cost and value generation of the RPD models. Therefore, the second set of data is suggested to assess the efficiency of RPD models. Among the four models, DBM is the best

one and traditional DBB is the worst one. The remaining content is organized as follows. In Sec. 2, road project delivery models are introduced briefly. Grey evaluation model, which includes grey relational analysis and grey entropy weighting, is introduced in Sec. 3. Empirical study and discussion are presented in Sec. 4. Finally, conclusions are drawn in Sec. 5.

ROAD PROJECT DELIVERY MODELS

To overcome the shortcomings of traditional procurement, the concept of public-private partnership (PPP) is proposed. PPP refers to contractual agreements formed between a public agency and private sector entity that allow for greater private sector participation in the delivery of transportation projects. According to the concept of PPP, the construction industry has developed a large number of different project delivery systems (Koppinen and Lahdenperä, 2004a, 2004b, Molenaar et al., 1999, Pakkala, 2002). Among PPP models, CM, DBB, DB and DBM are four commonly used methods. Each of them will be introduced as follows (Koppinen and Lahdenperä, 2004a, 2004b, Molenaar et al., 1999, Pakkala, 2002). Construction management (CM) is a project delivery method based on the owner's agreement with a qualified construction firm to provide leadership and perform administration and management for a defined scope of services. Design-bid-build (DBB) is the traditional project delivery approach that was used for most of the 20th century to procure public works. In the design-bid-build model, a designer prepares complete construction documents for the owner. The owner then receives bids from contractors based on the design documents and awards a construction contract to the lowest responsive, responsible bidder. The contractor builds the project, and upon completion, the owner assumes responsibility for the operation and maintenance of the project. The owner provides all financing. Design-build (DB) is a project delivery

method that combines two, usually separate services into a single contract. With design-build procurements, owners execute a single, fixed-fee contract for both architectural/engineering services and construction. The design-build entity may be a single firm, a consortium, joint venture or other organization assembled for a particular project. The owner provides all financing. Design-build-maintain (DBM) combine a maintenance provision with DB model. The term is used here as a general term that covers all procurement methods that extend the contractors' responsibilities from pure design and construction to longer term maintenance liability, with or without other duties, such as operation and financing.

GREY EVALUATION MODEL

The grey relational analysis is a kind of method by which the related degree of every factor in the system is analyzed. The basic idea of this method is to judge the related degree by dynamic developing situation of the system. In this study, the evaluation the road project delivery models is regarded as a grey multi-objectives decision-making problem and a grey relational evaluation model is set up. Firstly, a $m \times n$ matrix $\mathbf{X}$ is set up, where m is the number of project delivery models, n is the number of indicators (or criteria). Thus, the element $x_i(k)$ of $\mathbf{X}$ means the value of the kth indicator of the ith project delivery model.

Usually, it is difficult to compare different kinds of indictors because of the different dimension. Therefore, the standardized transformation to these indictors must be done. Three formulas can be used to do this as follows:

$$x_i(k) = [x_i(k) - \min x_i(k)] / [\max x_i(k) - \min x_i(k)], \quad (1)$$

$$x_i(k) = [\max x_i(k) - x_i(k)] / [\max x_i(k) - \min x_i(k)], \quad (2)$$

$$x_I(k) = |x_I(k) - x_{obj}| / [\max x_I(k) - \min x_I(k)], \quad (3)$$

where x_{obj} is the objective value. Equation (1) is the transformation for the benefit-type indicator; Eq. (2) is the transformation for the cost-type indicator and Eq. (3) is the transformation for the optimization-type indicator. Next, the absolute difference of the compared series and the referential series should be determined by the following formula $\Delta x_I(k) = |x_o(k) - x_I(k)|$, where $x_o(k)$ is the element of referential series. Find the maximum and minimum of $\Delta x_I(k)$ and compute the grey relational coefficient $\gamma_o(k)$, which is defined by

$$\gamma_{oI}(k) = [\min \Delta x_I(k) + \zeta \max \Delta x_I(k)] / [\Delta x_I(k) + \zeta \max \Delta x_I(k)], \quad (4)$$

where ζ is the distinguishing coefficient of the grey relation. In practical application, $\zeta = 0.5$. Finally, calculate the relational degree by

$$\Gamma_{oI}(k) = \Sigma_k [w(k) \times \gamma_{oI}(k)], \quad (5)$$

where $w(k)$ is the weight of the kth indicator and $\Sigma_k w(k) = 1$. The result of Eq. (5) can be used to measure the performance of road project delivery models. To determine the weight of each indicator is a problem. Three weighting profiles are compared in this study. The first one is equal weighting profile, which considers the importance of each indicator is equal. If the total number of criteria is n, then $w(k)$ is equal to $1/n$. The second one is nested weighting profile, which is determined by the hierarchy of the indicator. In this study, the indicators are categorized into two levels. Let n_1 be the number of categories of the first level and n_{j2} be the number of indicators in the second level belongs to the jth category in the first level. If indicator k belongs to jth category in the first level, then $w(k)$ is equal to $1/(n_1 \times n_{j2})$.

The third one is the grey entropy weighting method. The concept is derived from Shannon's entropy (Shannon, 1948), which quantifies uncertainty associated with a set of information or data. The grey entropy weighting method combines the concept of "least information theory" with the grey system theory (Deng, 1989) and the concept of Shannon's entropy. Because the grey entropy weighting method (Bezdek and Pal, 1992, Wen and Wu, 1996, 1998,) determines the weight of each indicator by the uncertainty of its collected data, it is considered as an objective weighting profile. The grey entropy weighting method is described in brief as follows. Grey entropy weight of sequence $\boldsymbol{X}$ is defined by

$$e(k) = -\frac{\sum_{i=1}^{n} f_i(k) \ln x_i(k)}{\ln n}, \tag{6}$$

where $f_i(k) = x_i(k) \Big/ \sum_{i=1}^{n} x_i(k)$ is the weight of each element. To ensure Eq. (6) meaningful, let $\hat{x}_i(k) = \beta x_i(k) + (1-\beta)$, where β is an arbitrary constant. Generally, β is suggested to be 0.9. Thus, Eq. (6) is rewritten as

$$e(k) = -\frac{\sum_{i=1}^{n} \hat{f}_i(k) \ln \hat{x}_i(k)}{\ln n}, \tag{7}$$

where $\hat{f}_i(k) = \hat{x}_i(k) \Big/ \sum_{i=1}^{n} \hat{x}_i(k)$. Then the entropy weighting is given by

$$w(k) = \frac{1 - e(k)}{\sum_{k=1}^{m} 1 - e(k)}, \tag{8}$$

Next, the GRA with different weighting profiles is applied to analyze the four road project delivery models.

EMPIRICAL STUDY

Before analyzing the models, the background about the studying case of road construction is introduced. A set of secondary data, which is collected and estimated by Koppinen and Lahdenperä (2004a and 2004b), is employed. Since one road construction would be only delivered by one model, it is impossible to compare the four project delivery models by the same case. Besides, there is no project that can represent the typical road delivery project. Each project is unique in one way or another. Therefore, Koppinen and Lahdenperä collected data by interviewing clients (government officials), contractors, designers and consultants in five countries, which are Finland, United Kingdoms, United States of America, Australia and New Zealand. The five countries are chosen because of their experiences of road project delivery methods. There are 66 interviewees, which were selected through expert referrals, industry journals and databases, local road administrators' Web pages, and referenced articles. Table 1 gives the number and their nationality. The questionnaire involved gathering general performance information instead of detailed, case-specific time, and cost. Interviewees were asked to give 'average' estimates based on numerous projects or to give estimates based on one or a few cases, whereby the impacts of potentially unique circumstances were eliminated. Then, a real Finnish DB project is considered as a base

case. Its time and cost of each phase are derived from the interviews and literature review, which are listed in Table 2.

Table 1. The Number of Research Interviewees (Koppinen and Lahdenperä, 2004b).

Country	Client	Contractor	Designer	Consultant	Total
Finland	11	4	1	1	17
UK	5	2	0	1	8
Australia	12	4	1	4	21
New Zealand	1	1	1	2	5
USA	4	1	2	8	15
Total	33	12	5	16	66

Firstly, we assess the efficiency of the four models by the time and cost factors directly. According to the original data, CM has the best control of time, the design and construction cost of DB is the minimum, and the operation and maintain cost of DBM is the minimum. The evaluating indicators are classified into time and cost categories and each of the categories includes two indicators, which is shown in Table 2. Because the indicators in Table 2 are cost-type, Eq. (2) is considered to transform the original data. The minimal value of each indicator is considered as the element of the referential series; that is, (0.21, 4, 53122, 12568). The equal weight, nested weight and entropy weight are denoted by w_1, w_2 and w_3, respectively. The weights (w_1, w_2 and w_3) are given in Table 3 and the relational degree (Γ_1, Γ_2 and Γ_3) and the ranking of the four models are shown in Table 4. Because the indicators are classified into two categories and each category has two indicators, the profile of w_1 is equal to the profile of w_2. From Table 4, the ranking of the relational degrees is $\gamma_3 > \gamma_1 > \gamma_4 > \gamma_2$; that is, CM is

the best model, DBB is the worst one. DB is better than DBM. The ranking of Γ_1, Γ_2 and Γ_3 are the same.

Table 2. Time and cost information used of the base case (Koppinen and Lahdenperä, 2004b).

Time phase factor unit:[year]	Notation	DB	DBB	CM	DBM
Procurement	C_1	0.875	0.42	0.21	1.5
Design and Constructi	C_2	4.3	5.2	4	4.6
Total (time)		5.175	5.62	4.21	6.1
Cost factor unit:[1000e		DB	DBB	CM	DBM
Design and Constructi	C_3	62,856	73,664	66,794	53,122
Operation and Mainten	C_4	12,569	17,777	19,067	16,824
Total		75,425	91,441	85,861	69,946

Table 3. The Three Weighting Profile of the Time and Cost Indicators.

Time phase factor unit (year)	Notation	w_1	w_2	w_3
Procurement	C_1	0.25	0.25	0.278
Design and Construction	C_2	0.25	0.25	0.270
Cost factor unit (1000 euro)				
Design and Construction	C_3	0.25	0.25	0.237
Operation and Maintenance	C_4	0.25	0.25	0.215

Table 4. The Ranking of the Models Based on the Three Weighting Profiles.

	Γ_1	ranking	Γ_2	ranking	Γ_3	ranking
DB	0.668	2	0.668	2	0.653	2
DBB	0.451	4	0.451	4	0.461	4
CM	0.691	1	0.691	1	0.721	1
DBM	0.567	3	0.567	3	0.558	3

Measuring the efficiency by the time and cost factors directly may lose some crucial information. Therefore, Koppinen and Lahdenperä (2004b) propose twelve indicators, which are classified into four main categories: economic efficiency, development potential, potential efficiency and influence of the future business environment. The four categories are introduced briefly as follows. Public owners are constantly challenged to find the right combinations of cost, time, quality and other value determinants. Economic efficiency is considered to measure cost and value comprehensively. Economic efficiency is determined by the ratio of value generation to cost performance. The more value the project delivery system creates at a certain cost, the more economically efficient way it is to procure roads. Development potential is employed to assess the future performance of the project delivery methods. Two components are included: the project delivery method's inherent ability to develop and the available means of improvement. Both the cost and value generation of the inherent ability and available means are assessed. Development potential of the project delivery means the difference in value for money between traditional and more innovative project delivery methods. Also, the cost and value generation of development potential are assessed. The last one is the influence of the future business environment, which includes the influences of controlling factors, input factors, output

factors, mechanisms to success and operative factors. The description and weights of the items are listed in Table 5.

Table 5. Notation and Weighting Profiles of the Evaluating Indicators of Cost Performance and Value Generation.

Description		Notation	w_1	w_2	w_3
Economic efficiency	Cost performance of current economic efficiency	S_1	0.083	0.25	0.129
Development potential	Cost performance of inherent ability to develop	S_2	0.083	0.0625	0.070
	Value generation of inherent ability to develop	S_3	0.083	0.0625	0.084
	Cost performance of means of improvement	S_4	0.083	0.0625	0.083
	Value generation of means of improvement	S_5	0.083	0.0625	0.082
Potential efficiency	Cost performance of future potential	S_6	0.083	0.125	0.077
	Value generation of future potential	S_7	0.083	0.125	0.081
Influence of the future business environment	Future performance of controlling factors	S_8	0.083	0.05	0.025
	Future performance of input factors	S_9	0.083	0.05	0.106
	Future performance of output characteristics	S_{10}	0.083	0.05	0.096
	Future performance of mechanisms for success	S_{11}	0.083	0.05	0.088
	Future performance of operative factors	S_{12}	0.083	0.05	0.076

Also, three weighting profiles (w_1, w_2 and w_3) are compared. The original data of the indicators are shown in Table 6. The maximal value of each column is considered as the element of the referential series; that is, (1.6, 0.58, 0.92, 0.71, 0.62, 0.6, 0.7, 0.26, 1.33, 1.11, 0.71, 0.67). In this study, the indicators are benefit-type; therefore, Eq. (1) is employed to transform the original data. Finally, the relational degree and the order of two weighted profiles are given in Table 7.

Table 6. The Original Data of the Indicators (Koppinen and Lahdenperä, 2004b).

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}
DB	1.29	0.49	0.61	0.71	0.62	0.6	0.61	0	0.88	0.67	0.71	0.17
DBB	1	0	0	0.21	0.31	0.11	0.15	-0.07	0.44	-0.22	0.44	-0.17
CM	1.04	0.12	0.12	0.12	0.12	0.12	0.12	-0.04	0	0.44	0.04	0.5
DBM	1.6	0.58	0.92	0.57	0.48	0.58	0.7	0.26	1.33	1.11	0.53	0.67

According to Table 7, no matter which weighted profile is considered, the ranking of the four project delivery models is $\gamma_4 > \gamma_1 > \gamma_3 > \gamma_2$; that is, DBM is the best one and DBB is the worst one. DB model is better than CM model. The result is quite different from the result in Table 4. The major reason is that the twelve indicators focus not only the efficiency of cost but also the value generation. From Table 5, we can see the value generation and development potential are the major concern of the indicators. Therefore, DBM is considered the best.

Table 7. Ranking of the Relational Degrees Under Different Weighting Profiles.

	Γ_1	order	Γ_2	order	Γ_3	order
DB	0.681	2	0.583	2	0.692	2
DBB	0.355	4	0.277	4	0.196	4
CM	0.360	3	0.284	3	0.275	3
DBM	0.835	1	0.681	1	0.725	1

In our preliminary study (Lo and Chao, 2007), several evaluation methods are employed to assess the performance of the four models, such as the data envelopment analysis (DEA) and cost/benefit analysis. The result of cost/benefit analysis depends on the setting of weight. In some weighted profiles, DBM is the best, whereas, DB is the best. DBB is always the worst one. Although the analysis of DEA does not need to set the weight, the results are diverse. DB, DBM and CM are at the frontier of the envelop curve. CM has the efficiency of construction time. DB is efficient in maintenance and DBM is efficiency in design and construction. A serious problem of applying DEA is the number of indicators is much more than the number of the alternatives that will induce multiple solution of the problem. In this study, the grey relational analysis is employed to evaluate the performance of road project delivery methods successfully. The procedure of analysis may be a good method to assess the road construction models.

CONCLUSIONS AND PERSPECTIVES

In this study, four road delivery project models, which are CM, DB, DBB and DBM, are compared by the grey relational analysis with three weighting profiles. An empirical study is employed to determine the performance of the four models. Two kinds of data are employed and the results of ranking are quite different. If we only want to minimize the time and cost factors, CM is the best RPD model. If the cost performance, value generation and potential are considered, DBM is the best method. No matter which set of data is employed, the traditional method DBB is the worst. To assess the efficiency of RPD models, we suggest that the cost performance, value generation and potential should be considered at the same time. That is, DBM should be considered first. The conclusion could be a suggestion for initiating a road construction project. From the practical viewpoint, projects differ from each other. The project delivery methods are neither equal

effect nor equal results under all project conditions. Any one of the resulting processes may be the most effective one only under certain conditions. It is still often appropriate to use DBB, when projects are relatively small, simple, have well-defined end results, and offer no opportunities to innovate or to generate revenue. In addition, if politics is likely to lead to substantial changes during the project, the DBB is advantageous. However, the usage of DBB is likely to decrease in the future, but it will remain one of the road project delivery alternatives. On the other hand, DBM may involve political issues and induce time delay in procurement phase. Therefore, if a construction project is initialized, delivery model has to be chosen carefully based on characteristics of the project.

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Forty Winks: The Organizational Benefits of Reducing Employee Sleep Deficit

Pamela R. Johnson, Ph.D.
Department of Management
California State University
Chico, CA 95929-0031
USA
E-mail: pjohnson@csuchico.edu

Julie Indvik, Ph.D.
Department of Management
California State University
Chico, CA 95929-0031
USA
E-mail: jindvik@csuchico.edu

ABSTRACT

Americans are tired and instead of working to live they are living to work. Previously, the pace of life was dictated by nature, hours of sunlight, and the tides. Now, it is being dictated by economic necessity, and the boundaries between work and life are being blurred. In fact, 70 million Americans are sleep-deprived. Many companies are now beginning to address employee fatigue because they recognize that fatigue is behind on-the-job accidents, absenteeism, lower productivity, and higher health care costs. This paper will describe the causes of sleep deprivation, the costs to organizations, the benefits of power napping, what employees can do, what companies have done, and what other companies can do to help their workforce feel better while

improving productivity and at the same time reducing accidents and health care costs.

***Keywords**: Organizational Benefits, Employee Spleep Deficit, Sleep Deprivation, Costs to Organizations, Benefits of Power*

INTRODUCTION

"But I have promises to keep, and miles to go before I sleep, and miles to go before I sleep." Robert Frost

The human body has been taking a beating, sleep-wise, since 1879 and the invention of the light bulb. The invention of the light bulb and the Industrial Revolution changed everything (An eye-opener, 2001). Old diaries and letters suggest that people were logging about nine hours a night before 1913; then Edison invented the light bulb. Part of the reason he did was that he really felt people were using darkness as an excuse not to work and he wanted to increase our productivity (Kirkey, 2003). Now people sleep only about seven hours a night.

Americans, in large numbers, are tired. It shows up in lost productivity, depression, higher health-care costs, more car crashes, and tattered relationships. Sleep deprivation may kill concentration or cause behavior problems, mood swings, and memory lapses. We have a huge national sleep debt; and we are servicing that debt with high interest (Collins, 2006). We eat when we are hungry, and drink when we are thirsty, so why are people not sleeping when they are tired? Sleep, it seems, has become a luxury (Gordon, 2004). In addition, The National Sleep Foundation has said that Americans are getting both less sleep and less sex in the bedroom. Instead of working to live, Americans are living to work (Hatfield, 2001). Also, there is this notion somehow or another that if you sleep a lot, you are lazy and

useless. Add that to our frenetic lives, the growing numbers of harried, dual-income families trying to cope with the demands of work and home, the seductive all-night allure of the Internet, and it is little wonder we have become a nation of walking zombies (Kirkey, 2003). Not getting enough sleep makes people clumsy, stupid, unhappy and dead. We are a society that has ritualized the sleep deprivation that caused such disasters as the Exxon Valdez, Chernobyl, and the Challenger accidents. And, human beings are the only known organism that sleep deprives itself (Sandberg, 2004).
Margaret Thatcher claimed that she needed only four hours' sleep. Leonardo da Vinci is reputed to have slept 15 minutes every four hours. Napoleon advocated six hours' sleep for a man, seven for a woman and eight for a fool (Cromptom, 2003). Previously, the pace of life was dictated by nature, hours of sunlight, and the tides. Now, it's being dictated by economic necessity, and the boundaries between work and life are being broken. Many people go home from work, have their dinner, then start work again. So we spend more time in an aroused state, have less time to wind down, find it more difficult to fall asleep and find our sleeping patterns upset (Crompton, 2003). In fact, about 70 million Americans are sleep-deprived (McCall, 2004).

With employee health-related issues impacting the bottom line of many companies, management executives are addressing employee fatigue as a major factor behind on-the-job accidents, absenteeism, and lowered productivity, and they are looking at new ways to solve the problem (Atkinson, 2000).

Even folk wisdom contains truth: "Early to bed, early to rise, makes a man healthy, wealthy and wise." Aside from being a plea for the benefits of hard work, Benjamin Franklin was aware of our circadian rhythm, that 24 hour cycle biologically timed to daylight and nightfall. The first is our period of work, and the other our period of slumber, a

phenomenon we share with most, if not all, mammals (Coates, 2004). This paper will describe the causes of sleep deprivation, the costs to organizations, the health benefits of power napping, what employees can do, what companies have done and what companies can do to help their workforce sleep better while improving productivity and reducing accidents and health care costs.

CAUSES

"Blessed barrier between day and day." William Wordsworth

A National Sleep Foundation survey found that 68 percent of Americans get less than the recommended eight hours of sleep a night on weeknights, and 39 percent get less than seven hours (Barnes, 2004). Bedtime is getting later and the morning comes earlier all over the country. A comprehensive survey conducted by the Better Sleep Council found that 31 percent of employees surveyed admitted that lack of sleep affected their work, and 29 percent said they did not feel rested when they awoke before going to work. In addition, another survey found that 38 percent of employees admitted to napping at work. Most of them napped in break rooms, bathroom stalls, or in their cars in the parking lots so they wouldn't get caught (Atkinson, 2000).

There are numerous causes for this sleep deprivation. Technology adds to overworking. We are not just working 9 to 5 anymore. People are more overworked, because they are worried about job security. Terrorism warnings, war, and the economy are all folding into one perfect storm (Joyce, 2003). In addition, the challenges of advancing in careers, satisfying clients, reaching sales goals, rearing children, and maintaining homes have created a class of sleep-deprived workers. Finally, under pressure to raise efficiency and productivity, more

workplaces are operating around the clock. But the toll on employees' health and wellness can be considerable, including fatigue, increased risks of certain illnesses, and a diminished social and family life. Fatigue, sleep deprivation, and stress are all present (Schur, 2005). In fact, at least 50 percent of the American adult population is chronically sleep-deprived (Atkinson, 2000).

In addition, globalization has brought about the 24-hour business day. Thousands of companies have baton-passing rituals. Offshoring, or the migration of jobs to lower-cost countries such as India, China and Russia, has started this cycle. Cheaper labor and faster work flow have made offshoring a fact of life for many companies. This offshoring has resulted in longer, stranger hours for white-collar workers in the United States. Silicon Valley workers grumble that communicating with colleagues overseas requires midnight teleconferences, 6 a.m. video meetings and cell phones going off all night long. The 24-hour business cycle is extremely stressful. And today's long hours are less likely to result in windfall bonuses or stock options, and there is no end in sight (Konrad, 2005).

COSTS

"There is a time for many words, and there is also a time for sleep." Homer

The National Commission on Sleep Disorders recently reported that decreased productivity and accidents in the workplace cost the nation $150 billion a year (An eye opener, 2001). In simple terms, tired managers and employees cost an organization money. Among the expenses are increased workers' compensation costs from accidents and injuries; increased health care costs and absenteeism from increased illnesses, and reduced profits from lower levels of

productivity. Lack of sleep leads to drowsiness during the daytime, and drowsiness leads to decreased motor performance, cognitive performance and reaction time. Drowsiness also leads to reduced concentration, memory, communication skills, decision making skills and ability to handle complex tasks. Even minimal sleep loss over the period of a few days will make you stupid (Atkinson, 2000).

Shortened sleep can lead to reduced brain levels of leptin, the hormone that controls appetite. Get too little sleep and the brain signals us to eat complex carbohydrates, starches and sugars which make us fat. In addition, studies have found that people who sleep six hours or less a night have an increased risk of high blood pressure, heart attacks and stroke. Just one bad night can have a dramatic effect on alertness, concentration, and judgment, and chronic sleep deprivation can lead to anxiety and depression (Kirkey, 2003). Sleepiness has now surpassed alcohol and drugs as the greatest identifiable cause of accidents. If a person is up for 22 hours, the deficit in cognitive and motor skills is equivalent to having a .08 blood alcohol level which means the person is considered legally drunk in some states (An eye-opener, 2001).

Not surprisingly, sleeplessness is a growing problem in the United States as well as a growing business. A record 43 million prescriptions for sleeping pills were filled last year, resulting in more than $2 billion in sales for drug companies. Medication is one answer. Relatively new prescription drugs like Ambien and Lunesta are generally effective and pose a lower risk of dependency than earlier sleeping pills (Lazarus, 2006).

Another way to address sleeplessness is to take a "wake pill." Modafinil (sold as Alertec in Canada and Provigil in the United States) can keep you awake for 40 hours without the jitteriness, agitation, anxiety, and insomnia associated with other brain stimulants,

including caffeine. In fact, "wake-promoting" agents have become one of the hottest fields of drug research with a vast, mostly untapped, market potentially worth millions. People have always searched for ways to get by on less sleep. Coffee has become the second most commonly traded commodity in the world, next to oil. But now athletes, CEOs, college students, and everyone who wants to stay awake all day long with minimal sleep are asking their physicians for prescriptions for Modafinil (Kirkey, 2003).

POWER NAPPING

"Rest is not idleness . . . " Sir J. Lubbock

Napoleon did it on the battlefield. Brahms did it at the piano. Edison did it on his desk. Einstein did it between equations, da Vinci between paintings, and Winston Churchill throughout World War II. John F. Kennedy, Lyndon Johnson, Ronald Reagan, and Bill Clinton did it when they were president; they all took naps (An eye-opener, 2001).

The mechanics of the human body don't mesh very well with a 9-to-5 day. Researchers have found that when humans are fed at regular intervals and deprived of all sources of time, such as light and clocks, they have the greatest tendency to fall asleep during two periods of the day: between 1 a.m. and 4 a.m. and 1 p.m. and 4 p.m. These are natural dips in our biological clocks, or circadian rhythms, and the core body temperature drops along with a person's eyelids. In the afternoon, all these physiological and mental processes begin to go into a dip. This dip used to be thought of as a post-lunch dip. But it has been shown to occur when people eat or don't eat. In fact, from the moment you wake up in the morning, there is pressure driving you back to sleep (Sandberg, 2004).

Napping is an established part of the day in many cultures, including India, Italy and Mexico. But U.S. businesses overwhelmingly remain resistant to embracing the siesta culture. In fact, a survey by the National Sleep Foundation shows that less than one in five U.S. adults have napping privileges at work (Barnes, 2004). Strangely, most workplaces consider artificial stimulation more acceptable than true rejuvenation, when it comes to combating daytime sleepiness (O'Connor, 2004). Employers don't mind if their employees take a coffee or a smoke break, but if you take a nap, you will probably get fired. The problem is that many workers don't get breaks, and those who do don't have the time or place to nap (Barnes, 2004).

Yet, in this era of litigation, companies should not underestimate the danger of working employees to burnout levels. And, the good news is more and more companies are realizing that power napping can result in increased productivity, creativity and general alertness of their employees (An eye-opener, 2001). In fact at Firefly Communications, a "re-charge room" has been established where staff can power-nap for 20 minutes. It has comfortable chairs, dim lighting and earphones with music (Gordon, 2004).

WHAT CAN EMPLOYEES DO?

"Sleep is the best meditation." Dalai Lama

There are a number of things that employees can do to reduce their sleep-deprived condition:

- No caffeine late in the day
- Limit alcohol
- Lots of exercise but not before bedtime (Lazarus, 2006)
- Eat healthy snacks and avoid eating too much or too little

- Get enough rest; fatigue makes it harder to cope with stress situations
- Seek out positive people
- Meditate or pray
- Do volunteer work for a favorite cause or charity
- Go to a funny movie (Olsztynski, 2006).

WHAT SOME COMPANIES HAVE DONE

"Bored people, unless they sleep a lot, are cruel." Renata Adler

While nap rooms may sound a bit out there, there is a precedent for napping at Burlington Northern Santa Fe Railway. When trains are stopped, crewmen can nap as long as one remains awake, and maintenance workers can nap in their vehicles during breaks (Mandell, 1999). Guess provides its employees with pamphlets that focus on stress and fatigue management. Also, Guess has an on-site cafeteria that provides balanced meals and a zero-tolerance policy for alcohol in the workplace (Atkinson, 2000). In addition, British Airways allows pilots on transoceanic flights to catch a few winks so they will be more alert when landing. A number of Silicon Valley companies have set up nap rooms, complete with reclining chairs, blankets, alarm clocks, even piped-in classical music, for their employees. Nike is just doing it, too, and so is the U.S. Army, whose studies have convinced their top brass to allow officers a nod or two while on the job. Also, Pizza Hut International allows its employees nap time, and executives at companies such as AT&T, Metropolitan Life and McDonald's have at least participated in Power Napping workshops (An eye-opener, 2001).

Yarde Metals, headquartered in Bristol, Conn has built a "corporate facility leisure room." This room has a waterfall in the center and is surrounded by four smaller rooms. Yarde Metals' nap policy works

because the boss encourages it and sees its benefits. Senior management's thumbs-up to the idea can go a long way. It's not problematic, there is little cost, and there is a productivity gain (Fox, 2000).

WHAT OTHER COMPANIES CAN DO

"It is better to sleep on things beforehand than lie awake about them afterward." Baltasar Gracian

There are many things that companies can do to help their sleep-deprived employees. For example:

- Purchase furniture to suit office naps, including power nap executive chairs that recline, massage the head, and envelop it in darkness.
- Schedule regular rest periods. It is important to get the body used to napping at about the same time every day, for about the same length of time. Most people feel tired about eight hours after awakening (Fox, 2000).
- Consider replacing the common five-day, eight-hour shifts with four-day 10-hour shifts. This will give employees opportunities to catch up on sleep.
- If you require employees to work a great deal of overtime, provide transportation home or encourage them to take public transit. The chances of auto accidents are greatly multiplied if overtired employees drive themselves home.
- Maintain a temperature on the cool side.
- Provide a nap room. Short naps, 15-20 minutes long are better than longer ones because employees are less likely to awaken feeling sluggish (Mandell, 1999).
- Maintain good indoor air quality.
- Make the work environment ergonomically correct.

- Provide sleep resources such as the National Sleep Foundation at www.sleepfoundation.org, America the National Center on Sleep Disorders Research at www.aasmnet.org to your employees.

CONCLUSION

"Sleep perchance to dream" Shakespeare

Whether employers like it or not, employees are already catching up on their sleep in bathroom stalls or in their cars on lunch breaks. For many, it is the price paid for economic prosperity and an American work ethic that is in overdrive. We now work longer hours than any other industrialized country in the world, have longer commutes, and are connected to the office 24 hours a day through a variety of electronic communication devices. Napping might sound like a crazy idea, but it really is a natural extension of our current working climate. What companies will receive in return is lower absenteeism, lower health care costs, fewer cranky employees, and higher productivity. What's not to like about that?

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Capital Market Reaction to Additional Information of Chinese Share-Split Reform: Market Feedback versus Signaling Effect

Junli Yu
Shanghai Lixin University of Commerce
Shanghai
China
E-mail: jlyuchina@gmail.com

ABSTRACT

The relationship between information disclosure and capital market has long been thought as a potential research field of accounting and finance. Whether due to effective transfer of the future performance or market feedback by message itself is considered as one of the Puzzles. In this article, market reaction to additional (explicit, implicit) information has been verified by empirical models. Signaling effect is tested and interpreted by virtue of excess turnover rate. Additional information is found to burst market reaction after two competing hypotheses are tested. The first hypothesis is signaling hypothesis that assumes the insiders of information advantage to prevent market failure, and reduce information asymmetry. The second competing hypothesis assumes that the market transmits to users the valuation of the company. The main finding is to draw two conclusions. First, cumulative abnormal return is significantly related with explicit additional information rather than implicit information. Second, as for China market's unique system, it is hard to wholly compare two alternative hypotheses. Prior to the announcement, market feedback

effect probably exists, but the signaling hypothesis is superior to market feedback hypothesis in explaining the phenomenon.

Keywords: market feedback, signaling effect, additional information, market reaction

INTRODUCTION

The traditional theory thinks signaling effect as an important part of information economics. Under information theory, the insiders whose have information superiority more directly know internal situation, investment opportunities and profits of private information than external investors? As a result, it triggers the "adverse selection" problem then leads to market failures (Akerlof, 1970), external financing, capital costs, and other negative impacts. In fact, companies often use "signaling" to reduce the degree of information asymmetry.

At the same time, behavioral financial experts found financial market occurs significant positive trading feedback, these transactions will be to promote stock price away from its base value, thereby as a counter-examples of effective market (Jegadeesh, Weinstein and Welch (1993), Van Bommel (2002)). According to market feedback theory, feedback traders are non-rational investors, not on the basis of information and the intrinsic value of the securities, but the prices of short-term securities transactions, has extraordinary trading volume. This information would be revealed to them by the evolution of the stock price. If this information was of a positive nature, the managers would be encouraged to invest the firm and issue more stocks subsequently. Since the release of information, feedback transactions will have a certain market reaction.

As many have noted, voluntary disclosure is no strict rule so that firms have incentives to voluntarily provide information if the benefits exceed the costs. Furthermore, due to mandated or regulated disclosure restricted with management choice, the hypothesis to the market reaction is relatively mature. Information such as financial forecast is vaguer, broader and more flexible than mandatory disclosure. Based on the uncertainty of the information, users are rarely able to absorb and use the information to invest fully. Such information to better filter other mandatory disclosure feather is conducive to what additional information touched the market reaction, whether due to transfer the future performance effectively or market feedback by message itself ? Return on investment (ROI) or anticipated change is to prevent market failures and transmit some special signal, or the information content of their users is intercepted and then effective influences decision-making by actions. As a result, a “signaling cause market reaction or market re-action cause feedback effect" is in mystery. Misunderstanding the causality would make government, management and outsider users lack of theoretical support, so the ultimate impact on the scientific nature of the decision-making is obvious.

The rest of the paper is organized as follows. In next section, it follows by reviewing the global literatures on the issue, and then develops the hypotheses. Section 3 is research design. In Section 4, I discuss and interpret the empirical results. The final section summarizes and concludes.

REVIEWS AND HYPOTHESIS

Gibbins et al. (1992),Hoskin et al. (1986) and Thompson et al. (1987), and other scholars define financial disclosure as the dimensions of information content, organization form, information redundancy, information confidence, disclosure interpretation, disclosure media, the

timing of disclosure. Hirst et al. (2008), who extends their dimensions, by analyzing management financial information model, including management incentive, forecast news, and capital market reaction and so on. On the comparison of these variables, the model must contain a number of variables that involves investment value, takes a more scientific research method. I plan to build the system and analyze a theoretical model by China's securities market data, and unique institute.

(1) Literature Review: Empirical evidence from Additional Information

Forecast characteristics are involved in the disclosure of management financial forecast. Such as forecast news, forecast form, forecast classification, forecast attributes, the elements of additional information in the report are often ignored by reporting users, but with the incremental information content.

Although managers do not entirely control the news that their forecasts convey, they effectively create such control via their decision of whether or not to release an earning forecast. The news conveyed by a forecast falls into one of four categories. Good-news forecasts are those that exceed earnings expectations, bad-news forecasts fall below expectations, and confirming forecasts are those corroborate the market's expectations. Early studies reported that earnings forecasts pre-explicitly conveyed good news relative to market expectations (Penman, 1980; Waymire, 1984). For large earnings surprises—where the magnitude of the earnings surprise exceeds one percent of the stock price—Kasznik and Lev (1995) find that bad-news firms are more likely to issue earnings warnings relative to good-news firms.

Managers can release management forecast information in the form of point estimates, range estimates, minimums, maximums, or

qualitative forecasts. As range estimates, managers need to disclose "basis point (mean/median)". Although Baginski et al. (1993) report that point forecasts are more value-relevant, Pownall et al. (1993) and Atiase et al. (2005a) find no difference in stock price reaction conditional on the form of the forecast. Experimental evidence in Hirst et al. (1999) suggests a possible explanation for these conflicting results. They show that investors' reaction to point versus range forecasts (i.e., forecast characteristics) is contingent on prior forecast accuracy (i.e., a forecast antecedent). Therefore, I think that the management had decided, in the certain significance, the information form that company released, which tends to conservative qualitative or optimistic point value, the extremer estimate or the neutral range estimate?

Financial forecast varies in levels of disaggregation. That is, managers can release a forecast of the bottom-line earnings number. Alternatively, they can release earnings forecasts along with forecasts of other key line items in the income statement. The majority of forecasts only are in the income statement items (income, earnings), rarely has unifies three statements or surpasses the combination of income statement and balance sheet, extends from the earnings forecast to the own equity, from the income /expense to the assets/liabilities forecast.

Managers also often release forecasts that are accompanied by attributions, or explanations of the forecasted numbers. These explanations typically fall into one of two categories—internal and external attributions. Internal attributions refer to explanations of management's own behavior (e.g., "our increased earnings are due to our enhanced product development"), whereas external attributions refer to explanations outside of management's control (e.g., "our decreased earnings are due to the generally worsening economy").

Further, such additional and verifiable information only enhances the credibility of good-news forecasts, but not that of bad-news forecasts which appear to be inherently credible (Hutton et al., 2003).

Managers often issue forecasts to influence their firm's stock price (e.g., Nagar, et al. 2003), financing threshold and so on. Positive accounting when weight capital market reaction, mainly is viewed as cumulative abnormal return (CAR), thought the announcement has the information content, around re-leased the capital market already started to respond, the computation weighed the capital market to this kind of announcement reaction, but pro forma finance information itself has information content that will be helpful to the capital market anticipated adjusts the market to equilibrium. Another indicator of the market is ETR(Excess Turnover Rate), the trading volume is the most affected by investors' sentiment changes, Beaver's (1968) classic paper is the first to empirical testing of the trading volume reaction, but due to noise traders, the performance shares weaker than CAR(Kim & Verrecchia, 1997).

Hypothesis 1: Ceteris paribus, the additional information has investment value, and there was a significant relation with market reaction.

As users bias the capability to identify the information, market reaction differs significantly from the levels generated by information. From the identification of explicit additional information - forecast news and forecast form are relatively easy to capture and convey information content of the announcement. Implicit additional information - forecast classification and forecast attribute are more important information, due to the cost –benefit and internal and external effect, the users can hardly agree on the consensus, not "resultant force", so the market reaction has no significant relations.

Hypothesis 1a: Ceteris paribus, the explicit information has investment value, and there is a significant confident with market reaction.

Hypothesis 1b: Ceteris paribus, the implicit information has not investment value, and there isn't a significant confident with market reaction.

(2) Theory Deduction: Additional Information to market reaction

When the additional information generates incremental market reaction, there are two alternative hypotheses to explain. The first hypothesis is signaling hypothesis that assumes the insiders of information advantage to prevent market failure, sending a signal to reduce information asymmetry to achieve the return of intrinsic value, the information will be released by the window on the formation of price reaction; while the outsiders notice for a period of time issued before the expected market performance and future expectations in conflict with managers to enhance market expectations, with information superiority in the internal human to prevent market failure, by signaling to reduce the information asymmetry and the price level; the second competing hypothesis assumes that the market transmits to investors their valuation of the company. The market feedback action has the prospective in-depth study of price changes, and fluctuations in the price of arbitrage trading, the trading volume generates on the abnormal reaction.

Market feedback traders only focus on the changes of price, the release of information is not directly related with feedback transaction. Due to insiders' information leaks partially prior to date of announcement, it will cause fluctuations in market prices in advance. Market feedback traders don't clear under-stand the information content, and then take

feedback trading with the price fluctuations, turnover rate surges at the same time. After information issues, if the degree of market feedback (turnover rate) be less than CAR, market reaction will cause by signaling effect. If the excess turnover rate doesn't increase, CAR is significant influence with additional information, the phenomenon shows that the information is signaling effect; if the excess turnover rate surge, there be significant influence, which is market feedback effect.

Hypothesis 2(signaling effect): Other things being equal, after announcement, the additional information is a significant relation with cumulative abnormal return.

Hypothesis 3(market feedback effect): Other things being equal, as excess turnover rate surges, the additional information is a significant relation with cumulative abnormal return.

METHODS

Data and Sample Selection

As China stock market and financial database construction is late - the research period not to be overseas longer. In addition, the time period chooses from 2003 to 2007 year.

Table 1. Summary of the sample selection criteria

China listed firms samples years 2003-2007	2,239
Less: ST firms samples	503
Special firms samples(Finance & Insurance)	30
Qualified Firms samples for testing hypotheses	1,706

This test is based on pooled data. The sample selection procedure and its effects on sample are summarized in Table 3, reducing to 927 firms, and 1706 samples for the period 2003-2007. All data are from China Wind Financial Database. This paper tries to use missing value filling technology (common EMiterative algorithm) because of insufficient data.

RESEARCH DESIGN

This paper studies: (1) the difference of the market reaction to additional information, (2) explanative effect of market reaction. Therefore, I build this theoretical model to examine the hypotheses (see Figure 1).

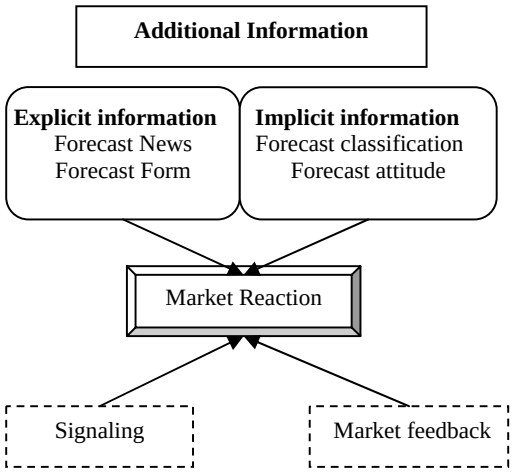


Figure 1 Additional information-effect model

With the requirements of hypotheses, I set up equations (1), (2) to verify:

$$CAR_{it} = \alpha + \beta_1 \text{Expl var} + \beta_2 Fvol + \beta_3 FErr + \beta_4 MInc + \beta_5 Size + \beta_6 Lev_{it} + \beta_7 Beta_{it} + \varepsilon_{it} \quad (1)$$

$$CAR_{it} = \alpha + \sum_{j=1}^{4} \beta_j \text{Expl var} + \beta_5 Fvol + \beta_6 FErr + \beta_7 MInc + \beta_8 Size + + \beta_9 Lev_{it} + \beta_{10} Beta_{it} + \varepsilon_{it} \quad (2)$$

DEPENDENT VARIABLES

CAR defines as a proxy of market reaction, according to market-adjust model. I choose that cumulative daily return less the size-deciles-matched CSRC value-weighted Index for twenty-trading-days windows starting ten trading days after the forecast release date; and Excess turnover rate(ETR)=∑(market turnover rate-company turnover rate).The definition of explanation variable is listed in Table 2.

Table 2. The definition of explanation variables

Variables	Definition
Forecast News(FNew)	Dummy variable: good news equals to 1, bad equals to 0
Forecast Form(FFor)	Dummy variable: accuracy(point or max/min) equals to 1,fuzzy(range or other) equals to 0
Forecast classification(FCom)	Dummy variable: stand-alone equals to 1,buddle equals to 0
Forecast Attribution (FAtt)	Dummy variable: external influence equals to 1,internal equals to 0

CONTROL VARIABLES

Forecast Volatility refers to the change times of forecast in certain period. Typically, volatility is also important regarding judging management ability. Suitable volatility is better, however too frequency is as bad as not enough, needs to grasp "reasonable degree", avoids irresponsibly unceasingly issuing and repeatedly revising which creates the capital market confusion. Forecast error influences market reaction, recent evidence suggests an intentional, pessimistic bias in management's forecasts (Richardson et al. 2004; Hutton 2005; Ke and Yu 2006).

Table 3. The definition of control variables

Variables	Definition
Forecast Volatility (FVol)	The times of adjust or other change in forecast period
Forecast Error(FErr)	(Actual EPS-forecast EPS)/Pre-release stock price
Management Incentive(MInc)	Fit from all Director &Executives and Top 3 compensation
Corporate Size(Size)	Logarithm total assets last year
Financial leverage(Lev)	Debt ratio Pre-release period
Systematic Risk(Beta)	Systematic Beta value

This pessimistic bias is attributed to managers' desire to guide analysts' earnings forecasts. Managers tend to issue optimistically-biased forecasts around equity offerings, hoping to take advantage of any market mispricing (Rogers and Stocken 2005).An overwhelming proportion of managers claim that they issue voluntary disclosures to

develop a reputation for accurate and transparent reporting (Graham et al., 2005). A recent study by Mercer (2005) may explain this counterintuitive result. Specifically, she shows that while transparency yields short-term credibility benefits, these benefits may not be sustainable over longer periods. Nagar et al. (2003) argue that managers with greater levels of equity-based compensation will issue more frequent forecasts to avoid equity mispricing that could adversely impact their wealth. The paper adds two variables: financial leverage and systematic risk, to control certain influence

EMPIRICAL RESULTS

Descriptive statistics

One-Way means test

Table 4 provides descriptive statistics for the sample used in our analysis in this Section. In this section, there are 12 core variables. Table 5 lists the market performance difference test by groups of single-factor (cumulative abnormal return and excess turnover rate), and Figure 2 to 5 were listed in the map additional information's different market performance. I find while release the information, excess turnover rate over continues to rise, to reach the summit till the release date, then slowly decline, while cumulative abnormal return was just the opposite, that is, cumulative abnormal return continued to drop, to reach the bottom on the date, trading in the market weakened. From the table below indicates that forecast news, forecast form that belongs to explicit information produce significantly relation with market reaction, but forecast classification, forecast attribute is not significantly related correlation .One-Way means test verify hypothesis 1. On before and after the announcement, the market reaction after is more significant.

Table 4. Descriptive statistics of samples used in the analysis

	N	Mean	Std.	Skewness	Kurtosis
CAR(-10,10)	1706	-4.764	16.825	4.240	77.319
CAR(-10,1)	1706	-3.131	10.620	0.516	6.763
CAR(-1,10)	1706	-2.513	13.357	7.798	187.612
ETR(-10,10)	1706	6.406	33.072	2.051	9.079
ETR(-10,1)	1706	4.136	20.923	2.717	18.424
ETR(-1,10)	1706	3.044	17.405	1.958	10.475
FNew	1706	0.70	0.455	-0.871	-1.225
FFor	1706	0.39	0.488	0.450	-1.800
FCom	1706	0.96	0.200	-4.594	19.131
FAtt	1706	0.70	0.456	-0.898	-1.196
FErr	1706	0.07	0.258	3.089	20.937
FVol	1706	1.31	0.698	8.306	135.541

In addition, excess turnover rate shows that make a trend - surging before and declining after announcement. So there may exist market feedback before issuing, I need to verify whether CAR yields a significant correlation with additional information. Similarly, CAR is opposite to ETR- a different trend - declining before and surging after announcement. This is because management caused opportunistic motives to publish voluntary disclosure, of users lead to extreme pessimism prior to announcement. Market investors have different estimates in advance of expectations, two sides take game enthusiastically. After the publication of information, investors began to adjust their expectations, market occurs to a "reverse-adjust" situation.

Table 5 market performance differences test by single-factor groups

Market Reaction (%)		CAR (-10,1)	CAR (-1,10)	CAR (-10,10)	ETR (-10,1)	ETR (-1,10)	ETR (-10,10)
Panel A Group by Forecast News							
Means	Good	-2.990	-2.145	-3.768	4.241	3.664	6.822
	Bad	-3.573	-3.195	-6.921	4.115	1.720	5.932
T-test		-1.025	-1.472	-3.527***	0.113	-2.095**	-0.503
Panel B Group by Forecast Form							
Means	Fuzzy	-2.873	-2.040	-5.872	4.193	3.102	5.515
	Precision	-3.535	-3.253	-3.034	4.046	5.641	7.796
T-test		1.256	1.831*	3.410***	0.142	1.287*	1.390*
Panel C Group by Forecast Classification							
Means	Alone	-3.141	-2.523	-4.631	4.060	3.052	6.502
	Buddle	-2.901	-2.278	-7.830	5.878	2.841	4.192
T-test		0.186	0.151	1.569	0.717	0.100	0.576
Panel D Group by Forecast Attribute							
Means	Inner	-3.068	-2.172	-5.160	4.439	3.328	6.125
	Outer	-3.281	-3.327	-3.821	3.412	2.365	7.077
T-test		0.378	1.630	1.500*	0.925	1.043	0.543

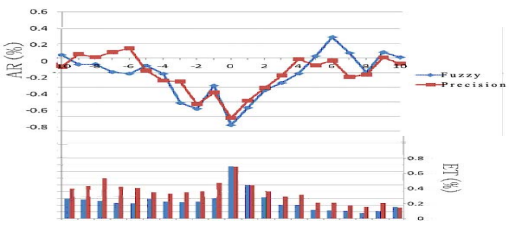


Figure 2. Market performance group by Forecast News

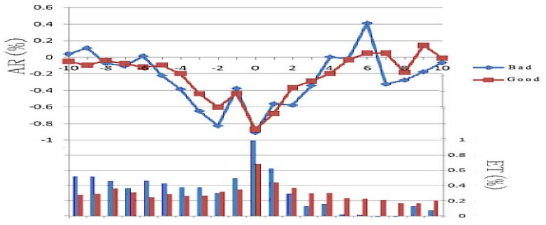


Figure 3. Market performance group by Forecast Form

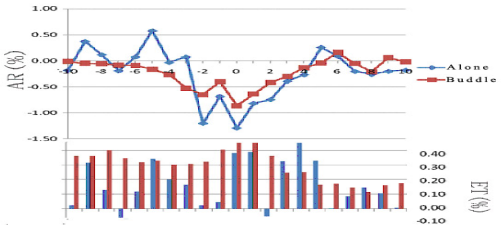
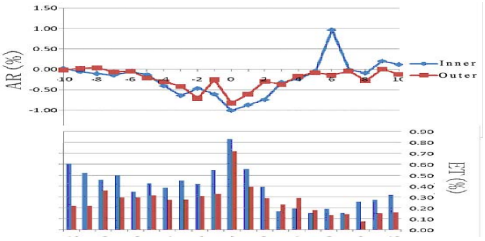


Figure 4. Market performance group by Forecast Classification



Firure 5. Market performance group by Forecast Attribute

Multiple regression test

To prevent the impact of extreme values, the regression process eliminates three times variance in the sample. In controlling the variables (such as the forecast error, forecast volatility) and the company features(such as company size, leverage ratio, etc.), respectively regression by an additional information and all additional information, significant additional information yields a linear regression (see table 6).

By White (1980) Heteroscedasticity after the adjustment of variables t-test, explicit information variables mostly pass, but implicit information variables hardly pass. The result indicates investors, including additional information users only center on the explicit information for decision-making; the value of implicit ones to decision-making has been questioned.

The test to market reaction can be found: After release the market is relatively significant, I find when excess turnover rate surges –prior to release date, feedback effect hypothesis is not the obvious explanation affecting the market reaction; the signaling hypothesis is better.

Table 6 empirical result of multiple linear regression

Var	CAR(-10,10)					CAR(-10,1)		CAR(-1,10)	
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)
(Contan	-13.028**	-10.102***	6.383	9.706	-16.381***	-7.311*	-7.175*	3.938	3.213
	(-1.912)	(-2.522)	(0.557)	(0.889)	(-2.801)	(-1.873)	(-1.747)	(1.033)	(0.814)
FNew	4.074***				3.898***	0.346	0.351	1.133*	1.166*
	(4.303)				(4.118)	(0.583)	(0.591)	(1.612)	(1.650)
FFor		2.388***			2.142***	-0.720	-0.717	-1.402**	-1.394**
		(2.893)			(2.567)	(-1.400)	(-1.389)	(-2.259)	(-2.245)
FCom			2.598		3.603*		-0.287		-0.157
			(0.798)		(1.785)		(-0.257)		(-0.131)
FAtt				-0.899	-1.236		0.202		1.143*
				(-0.511)	(-1.401)		(0.372)		(1.816)
FVol	2.997***	2.532***	0.638	0.609	2.866***	-0.527*	-0.530*	0.401	0.403
	(5.133)	(3.461)	(0.765)	(0.731)	(4.887)	(-1.868)	(-1.883)	(1.201)	(1.223)
FErr	-1.827	0.395	-4.781*	-4.706*	-1.868	0.473	0.474	0.074	0.044
	(-1.098)	(0.302)	(-1.599)	(-1.573)	(0.261)	(0.362)	(0.363)	(0.063)	(0.038)
MInc	0.284	0.266	0.066	0.058	0.304	-0.141	-0.145	0.603**	0.590**
	(0.691)	(0.727)	(0.079)	(0.069)	(0.459)	(-0.570)	(-0.587)	(2.228)	(2.181)
Size	0.062	0.040	-0.177	-0.183	0.066	0.273*	0.272*	-0.306*	-0.306*
	(0.260)	(0.249)	(-0.371)	(-0.383)	(0.781)	(1.586)	(1.585)	(-1.804)	(-1.808)
Lev	1.702	1.699	2.122	2.053	1.669	-0.023	-0.009	-0.354	-0.275
	(0.893)	(0.923)	(0.538)	(0.521)	(0.410)	(-0.018)	(-0.007)	(-0.227)	(-0.175)
Beta	-0.641	-0.759	-0.257	-0.262	-0.463	-1.081**	-1.079**	-0.542	-0.533
	(-0.821)	(-1.034)	(-0.194)	(-0.198)	(0.553)	(-2.264)	(-2.256)	(-0.998)	(-0.980)
Ind	control	control	control	control	control	control	control	control	control
year	control	control	control	control	control	control	control	control	control
Adj_R^2	0.021	0.015	0.001	0.001	0.026	0.003	0.002	0.003	0.003
DW	2.074	2.082	1.904	1.906	2.102	1.901	1.900	1.984	1.983
F value	6.138	4.632	0.542	0.520	5.551	1.600	1.300	1.975	1.971

Notes: the impact in the year and the industry is unspecified in above table; data for White (1980) Heteroscedasticity adjusted value of the t-test, ***, **,* were expressed statistically significant at 1%, 5% and 10%, DW is Durbin - Watson statistics.

Robustness test

The overall goodness-of-fit is not ideal, the model explanation is limited, mainly because China's capital market data is not optimal, overall poor results, many regressions are not good –the goodness always be between 1% -20% (Cheng, 2006); secondly, the regression cannot expect a clear explanation of all variables. DW value is around 2.00 (dl <d <du), show that there is no first order autocorrelation, cannot lead to bad statistical consequence, need not to take special processes. Empirical analysis shows that indeed in the information window there are signaling effect and market feedback, but that before market performance doesn't incur from additional information, mainly from investors to predict the diversity and other operations; Furthermore, additional information does exist signaling effect, that will cause significant market reaction.

As many means, even the same way, there may be "coincidence" of the situation significantly. To ensure that the conclusions from this interference of other factors in differences, from the following aspects of the empirical models take sensitivity analysis: (Ⅰ) geographical expansion test; (Ⅱ) different standards in selected variables (such as industry adjusted) expansion test. As China is a unitary country, each province (municipalities and autonomous regions) is a unified application of political, legal and economic systems. Although different regions exist, the impact is weaker, geographical factor is not significantly different. The sensitivity test of different standards see table 7, the model is significant that doesn't varies with the former test.

SUMMARY AND CONCLUSIONS

Since China's capital market is facing the "emerging & transition" development environment, as the share-split structure reform is gradually improving, the confidence of investors of listed companies is

Table 7. Change in CAR with industry-adjusted

Var	CARi(-10,10)					CARi(-10,1)		CARi(-1,10)	
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(1)	(2)
(Contant)	-21.078*** (-4.368)	-18.776*** (-3.794)	-21.274** (-4.130)	-17.474** (-3.520)	-24.329*** (-4.937)	-17.124** (-4.091)	-17.145*** (-3.886)	0.803 (0.262)	0.745 (0.235)
FNew	3.305*** (3.717)				3.158*** (3.485)	-0.308 (-0.529)	-0.298 (-0.511)	0.537* (1.830)	0.559* (1.859)
FFor		2.140*** (2.754)			1.942** (2.463)	-0.635 (-1.231)	-0.631 (-1.222)	-0.930* (-1.617)	-0.920* (-1.600)
FCom			3.183* (1.923)		3.124* (1.936)		-0.252 (-0.206)		-0.569 (-0.545)
FAtt				-0.735 (-0.978)	-0.658 (-0.875)		0.360 (0.668)		0.825 (1.426)
FVol	2.656*** (3.540)	2.264*** (3.182)	2.454*** (3.479)	2.419*** (3.321)	2.537*** (3.533)	-0.383 (-1.429)	-0.385 (-1.437)	0.305 (1.037)	0.300 (1.008)
FErr	-1.993* (-1.413)	-0.196 (-0.150)	-0.207 (-0.157)	-0.119 (-0.091)	-2.039* (-1.444)	0.637 (0.492)	0.632 (0.488)	-0.564 (-0.508)	-0.574 (-0.514)
MInc	0.159 (0.474)	0.143 (0.424)	0.182 (0.539)	0.168 (0.497)	0.171 (0.510)	-0.101 (-0.375)	-0.107 (-0.395)	0.723*** (2.837)	0.710*** (2.789)
Size	0.026 (0.124)	0.008 (0.039)	0.019 (0.087)	0.012 (0.053)	0.030 (0.144)	0.305* (1.641)	0.304* (1,643)	-0.280** (-2.03)	-0.280** (-2.045)
Lev	1.550 (1.008)	1.552 (1.005)	1.517 (0.982)	1.457 (0.944)	1.551 (1.016)	-0.551 (-0.425)	-0.527 (-0.406)	0.411 (0.283)	0.467 (0.319)
Beta	-0.271 (-0.394)	-0.348 (-0.482)	-0.545 (-0.772)	-0.549 (-0.782)	-0.106 (-0.151)	-0.940* (-1.994)	-0.937** (-1.983)	0.243 (0.514)	0.249 (0.528)
Ind	control	control	control	control	control	control	control	control	control
year	control	control	control	control	control	control	control	control	control
Adj_R^2	0.016	0.012	0.001	0.009	0.020	0.002	0.001	0.001	0.001
DW	2.044	2.045	2.025	2.031	2.058	1.872	1.871	2.024	2.023
F value	4.989	4.071	3.406	3.117	4.464	1.329	1.306	1.690	1.600

Notes: the impact in the year and the industry is unspecified in above table; data for White (1980) Heteroscedasticity adjusted value of the t-test, ***, **,* were expressed statistically significant at 1%, 5% and 10%, DW is Durbin - Watson statistics.

slowly restored. Therefore, improving and perfecting information disclosure of listed companies be one of the most important tasks to restore the credibility and revive the market. From this article about prospective financial information, market reaction to (explicit\implicit) additional information had been verified using regression model. By virtue of excess turnover rates, it aims to analyze, test and interpret signaling effect. Additional information is found to burst market reaction while two competing hypotheses to explain this reaction. The first hypothesis is signaling hypothesis that assumes the insiders of information advantage to prevent market failure, and to reduce information asymmetry. The second competing hypothesis assumes that the market transmits to investors their valuation of the company. The main contribution is to identify two conclusions: first, that cumulative abnormal return was significantly related with additional (explicit) information rather than implicit information. Second, as for China market's unique system, the two alternative hypotheses cannot be fully compatible, but no absolute exclusion. Before the announcement market feedback effect is probably existed, but the signal hypothesis is superior to market feedback hypothesis to support the phenomenon.

However, because of different development situations, it lack of a support in the field of finance, sociology, and other related disciplines of empirical studies, coupled with China's younger securities market, internal structure and the rapidly changing external environment. Of course, measurement not only is difficult to define, but also has its own methodology. In order to better measure the role of additional information, it comes mainly through voluntary disclosure. Mandatory disclosure such as annual reports and other information, its broad applicability will "greatly reduced" and the effect to explain the market reaction of mandatory information is still Hotpoint of future research.

As we know, discrimination whether the market is caused by signaling or market feedback effect isn't easy, often intertwined with two effects. If signaling is a major role, the supervisory authority is regulating managers' information disclosure, and improving capital market effectiveness. But if market feedback plays a major role, the first and foremost task is to correct investors' ideas of investment value, improving investors' trading codes. According to above analysis, "market feedback" is not absolutely comparative with "signaling". In the accounting report, it will not harm "signal transmission", while it can provide users with the needs of accounting information to enhance the effectiveness of the information disclosure. From voluntary disclosure effect can be seen, investors expect an adjustment price. The authority should focus on standardizing management information disclosure regulations to make the capital market healthy and sound.

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