

# Design-Led New Product Development in Chinese SMEs

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## Abstract

*Design-oriented new product development (NPD) has been recognised as beneficial for company growth; however, there is limited reporting on the understanding of its effectiveness in a real-world context especially in Chinese SMEs. This paper aims to explore issues related to the implementation of designer-led NPD in a Chinese SME.*

*An experiment was setup whereby two NPD teams were assigned to conduct NPD concurrently. One of the teams carried out the conventional NPD process model used by the company, and the other adopted the designer-led NPD process model. A metrics tool was built in the form of questionnaires for obtaining the views of the participants.*

*Results indicate that design-led NPD is perceived to be more inclusive of team members' views, even if the effectiveness of designer-led NPD in Chinese SMEs requires further investigations.*

**Keywords:** Product Design; Design-led; Chinese SMEs; New Product Development; Global Markets, Global Competition

## 1. Design-Oriented New Product Development

Design has received increasing attention by researchers exploring the management of New Product Development (NPD). Kristensen (1998) suggests that design should be institutionalised into the firm's strategic orientation, and that the firm's core values be infused by design ideas; while Perks et al. (2005) emphasise that design should be seen as process leader throughout the NPD process. Roper et al. (2012) discovered that companies where NPD strategy incorporates design-leadership characteristics have better economic performance. These studies represent the increasing importance of design in NPD and suggest companies develop new product by implementing design-oriented NPD.

Design-oriented NPD is considered to be beneficial for company growth and survival (Perks et al. 2005; Roper et al. 2012, Brondoni 2012). There appears to be potential benefit in bringing design-oriented NPD strategy to Chinese

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manufacturing Small and Medium Enterprises (SMEs). However, there is no consensus among researchers as to what constitutes design-oriented NPD. For example, Perks et al. (2005) thought it would be totally designer-led, and emphasis is placed on expanding designers' actions and skills set; while research conducted by the UK design council (2008) indicates the importance of design engaged pre-NPD work such as team building and internal competition. Whereas, Jang et al. (2009) proposed that design-oriented NPD should engage expert designers and use design to push technology development; yet, Acklin (2010) thought design-oriented NPD in SMEs should integrate design and other management efforts, and involve stakeholders in the NPD process.

Chinese SMEs are typically fragmented and adopt a rather immature approach to NPD strategy (Siu et al. 2006), and have less resources when compared with large corporations. These existing design-oriented NPDs, as outlined above, cannot be incorporated directly into Chinese SMEs, because these NPD strategies, having been initiated in the main by large companies, may not be appropriate for Chinese SMEs' NPD practice. Serious financial constraints (Wang, Yao 2002) determines that Chinese SMEs cannot afford in-house training for designers as suggested necessary by Perks et al. (2005) or the securing of expert designers, high quality external design consultancies to facilitate collaboration (Jang et al. 2009);

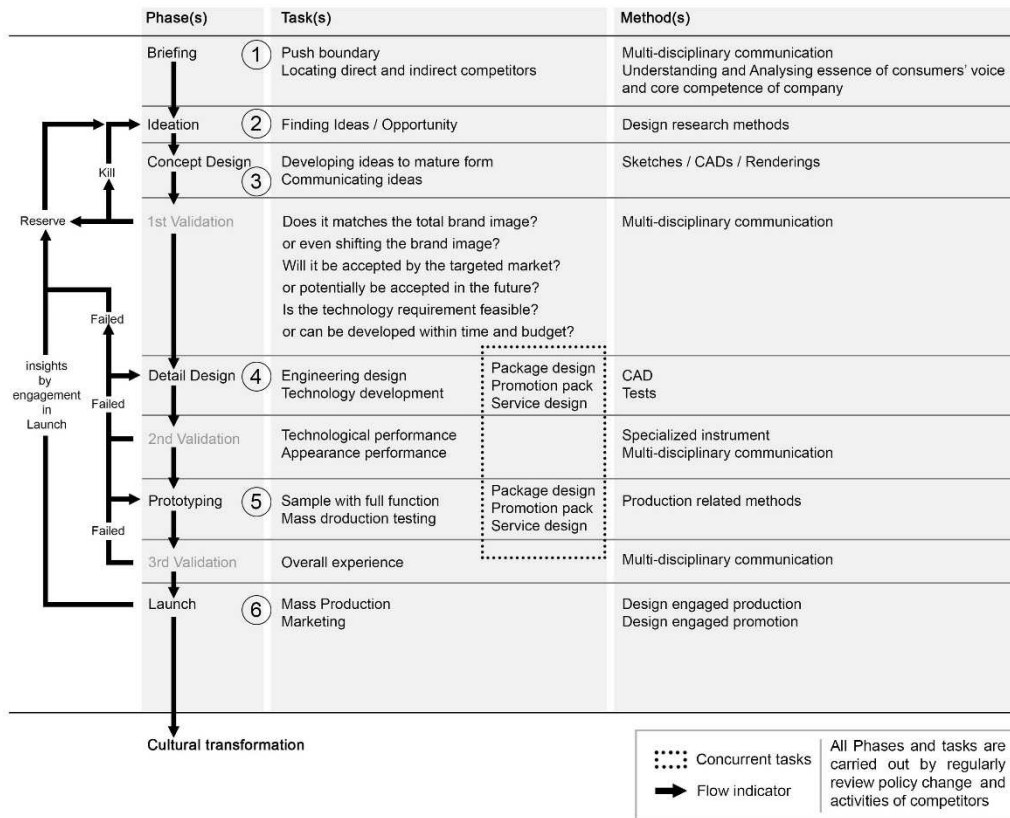
They also have to face a competitive market environment with 'shanzhai' (counterfeit or imitation) behaviour (China Daily 2009, Brondoni 2013). They are therefore unlikely to invest heavily in designs which have the potential to be duplicated, or dedicate sufficient time to internal competition as recommended by the Design Council (2009).

Lou et al (2013) synthesized the impact of factors specific to Chinese SMEs such as counterfeiting and financial issues and their impact on the NPD process. Their research proposed a design oriented NPD strategy model specific to Chinese SMEs. To derive this design oriented NPD model, the research explored factors such as product characteristics, market orientation, speed and cost. The aim of the conceptual designer-led NPD process is to shift Chinese SMEs' NPD strategy to include design-oriented aspects (Figure 1).

Distinct from existing NPD process models, this conceptual designer-led NPD process model evolved from the design process model commonly implemented in Chinese SMEs.

The Briefing phase was incorporated to offer an opportunity for designers to get involved in pre-NPD activities and work closely with the management team (see Figure 1, Phase 1). In the Launch phase (see Figure 1, Phase 6), designers are 'permitted' to engage in production and marketing activities. The idea is to provide designers with an increased control of the overall new product quality and also providing them with an opportunity to gain insights of how design is mass produced. Also, the concurrent tasks, such as package design, service design etc. (see Figure 1, Phases 4 & 5) would run after engineering design, and concurrently with technology development and prototyping. The reason for this is to reduce the product development time. The next section will discuss process of testing the conceptual designer-led NPD process model and whether it can deliver advantages.

**Figure 1:** *Conceptual Designer-led NPD Process Model (Lou et al., 2013)*



### 1.1 Company Selection

Owing to the nature of unknown and potential risks of making changes, personal contacts were used to select a company to undertake the research. However, the following characteristics were considered when selecting the target company. First, the selected company needed to be a small or medium size Chinese manufacturer and produce a product with their own brand: a number of Chinese SMEs are running as Original Equipment Manufacturer (OEM), they do not directly sell products to consumer but are contracted by other companies to manufacture products. Generally, it is the contracting company which is responsible for NPD process. Thus a company that is also responsible for the NPD process was essential. Companies producing products with their own brand would most likely undertake NPD. Second, a company that has experience of work with designers: SMEs which do not have experience of using designers would imply that this type of companies may see design as not important. It is hard to directly introduce the designer-led NPD to those companies and it may take a long time for them to incorporate design into their structure and processes. Thus, a suitable company that sees design as useful and better to have in house design team is essential. Third, company that has wants to make growth and willing to take associated risks: a conceptual model is mainly generated by synthesizing knowledge from literatures and theories, although

there are some empirical data for constructing the conceptual model; however, it cannot assure its perfection, potential risks may be contained and especially for the first time application, such as overestimate designers capability and contribution, unexpected mistakes etc. Fourth, NPD projects within appropriate complexity: the selected company must have NPD plan and not doing too complicated NPD project or too simple project. The complexity of NPD project may be reflected by developing time. An appropriate NPD project time cost is up to 6 months. Fifth, a company that agrees relevant information to be published in the way of literature. This is an academic research project, hence writing a report is a primary work of any academic researcher, and it is inevitable that the research information and data will be disclosed to others in academic purpose.

Three companies were deemed to be suitable for this research project. The one was a vehicle manufacturer and the other two manufactured vehicle accessories. All three were using designers within their NPD projects. However two of the companies hesitated to take part as they were unable to accommodate the research project schedule. The company left was seeking a new way of product expansion and accepted to cooperate and support the research project.

The selected company is a small enterprise located in one of the most manufacturer intensive cities, Shenzhen, in China. It started as Original Equipment Manufacturer (OEM) since mid-2000s. In 2011, with the increase of national salary and decrease of profit margin, it registered a new trademark and the company transformed to become OBM (Own Brand Manufacturer). On one hand, they play the role of supplier for other companies by providing moulding services and adaptor related technology consultant services, this accounts for about 87.4% of overall income in 2012. On the other hand, they sell products with their own brand since later 2011, which accounts for 12.6% of total income in 2012. There are about 55 permanent employees, while the moulding team takes over three fifths of all staff.

## 1.2 Metrics

New product performance, for example the sales in comparison of former product and return on investment (ROI), is convictive evidence for company to understand the effects of NPD process by results. However, proper data of sales cannot be gained at this stage; therefore, before having the data of annual sales, effectiveness of the NPD process can be understood by three aspects. Table 1 summarizes factors that applied in this research.

**Table 1:** *Factors for Metrics*

New Product success factors	NPD process factors	Internal Factors
Product Advantage	Time	Employee productivity
Meet customer needs	Investment	workload
Technological sophistication	Risks & iterations	

Relevant NPD success factors were calculated for having the metrics. Product characteristic, market orientation, speed of development (Cooper 1993; Cooper 2001; Henard, Szymanski 2001; Evanschitzky et al. 2012; Parry, Song 1994), and top management involvement, voice of the customer, well-planned and adequately

resourced launch (Ledwith 2000; Cooper, Kleinschmidt 1995) are important for NPD success. However, some of these factors have almost no impacts for NPDs in one company with shared resources; therefore, these factors are separated into new product success factors and NPD process factors. The three items show in new product success factors are represented by the three aspects: (i) Product advantage is for gaining direct views towards the new product, (ii) meet customer needs is for gaining views in the eye of consumers, (iii) technological sophistication is for understanding the views in the point of competitors. NPD process factors are all for understanding objective factors, such as developing time cost, investment cost and iterations made in NPD process. Meanwhile, Staff commitment is critical for NDP success (Ernst 2002; Brown et al. 2002), and this can be reflected by understanding staff productivity and workload.

## 2. Methodology

There was about 16 weeks on investigating the implementation of the proposed designer-led NPD process model in the selected Chinese SME and evaluate its effectiveness in a practical context. The main method was making comparison with their current NPD process model in company. There were three stages of this research. The first stage was to develop an understanding of the current NPD process model of the selected company. At this stage, an interview was used to obtain initial information from the top manager about the NPD process used. The information was then correlated with archived information of a recently developed product coded as 'IG'.

During the second stage the conceptual NPD process model was optimised by seven staff members. These members were invited to a group discussion, four of them who were invited to optimise the conceptual model and then were selected to test the optimised designer-led NPD process model.

During the third stage the two NPD models were run in parallel. Two NPD teams were assembled with members having similar backgrounds and work experiences. One of the teams carried the current NPD process model (conventional NPD team) and the other team adopted the optimised designer-led NPD process model (Designer-led NPD team). The execution of the two NPD processes was done in parallel and the two teams were kept separate to avoid any possible cross-contamination of ideas. An overall schedule, objective and techniques in each stage are summarised in table 2 below.

**Table 2:** *Objective and Techniques at Different Stage*

Time	Objective	Techniques
Week 1-2	Understanding the current NPD process model	Interview with top manager Retrieve archive
Week 2-3	Conceptual Model Optimisation	Group discussion Recording
Week 4-13+	Concurrent Application	Observation Access internal documents

For further understanding the internal performance of the optimized designer-led NPD process model, members from two NPD teams were asked to contribute

towards developing a post NPD measurement tool. The tool incorporated eight questions; each question in the tool incorporated a five likert scale, with -2 indicating negative and number 2 indicating positive score (Table 3).

**Table 3:** *Questionnaire as Metrics Tool for Understanding the Effectiveness of Two NPDs*

Product Advantage	Will the new product be competitive against competitors' products?				
	-2 (No)	-1	0	1	2 (Very much)
Meet customer needs	Will the developed product meet customers' needs?				
	-2 (No)	-1	0	1	2 (Very much)
Technological sophistication	How difficult will it be for competitors to copy?				
	-2 (Easy)	-1	0	1	2 (Difficult)
Time cost	Did the process take the time expected?				
	2 (Less)	1	0	-1	-2 (More)
Investment spent	Does the developing cost meet expectations?				
	2 (Less)	1	0	-1	-2 (More)
Risks & iterations	How much iteration was required in the development process?				
	2 (Little or none)	1	0	-1	-2 (Much)
Productivity	Has your contribution been as expected?				
	-2 (Less)	-1	0	1	2 (More)
workload	Have you spent more hours on the project than expected?				
	-2 (Less)	-1	0	1	2 (More)

The questionnaire were used as metrics tool to collect views of members in two NPDs teams; for avoiding insufficient understanding of NPD project, members from each team only fill questionnaires in judge of their own work in their own perspective.

### 3. Current NPD Process Model

According to Siu et al. (2006), the NPD process in Chinese SMEs has four stages: ideas generation, prototype development, market analysis and testing, and commercialisation. Similar to their finding, the NPD process in the selected company had four stages, starts from ideation, for finding an idea or opportunity (see item 1, Figure 2); however, it was not conducted by a NPD team, but purely by insights of top manager or project manager. The second stage is development, there are four sub-stages in development process, firstly to investigate technological feasibility by reviewing existing technology and making tests, and then creating appearance and style by in-house designer or design consultancy. While the appearance assured, engineering design started by using Computer Aided Design (CAD) tools, and finally use production related methods for prototyping (see item 2, Figure 2);. The third stage is validation, to value the overall experience. Similarly to ideation, manager's perspective determines whether it can be processed to launch stage (see item 3, Figure 2). In launch stage, product firstly be mass produced, and then the in-house designer contribute a package design to wrap the product before phoning distributors and doing online advertisement (see item 4, Figure 2).

**Figure 2:** *Current NPD Process Model in Selected Company*

Phase(s)	Task(s)	Methods(s)
① Ideation ↓	Finding Ideas / Opportunity	<b>Manager's accidental insight</b>
② Development ↕	Technological Feasibility <i>Appearance &amp; Style</i> Engineering Design Prototyping	Review Existing Technology & Tests <i>Inhouse Designer / Design Consultancy</i> CAD Production related methods
③ Validation ↓	Overall experience	<b>Personal perspective of Top Manager</b>
④ Launch	Mass Production <i>Package Design</i> Marketing	Production related methods <i>Inhouse Designer</i> Phoning Distributors / Online Advertisement

There is no failure of their current NPD process, because of top manager and project manager always set ‘safe objective’ with almost no risks: make little changes based on mature solutions. Bold writings in Figure 2 are activities executed by people from management; italic writings are activities undertaken by industrial designers. Industrial designers were only responsible for the appearance styling and package design. There is a review section while the appearance model/prototype was delivered to the project manager. However, the review focused only on the technical flaws. If any flaws were discovered then the design was returned to the development phase (stage 2). Top manager provided the following reasoning:

*We produce power adaptors related products, functionality is much important than appearance*

Document of a former developed product coded as ‘IG’ was reviewed to understand their current NPD process (Figure 3). In the first ideation stage, top manager had an idea that to replace the non-transparent material inside the USB ports by transparent or translucent material, for having better vision of build-in LED. It was recognised as the upgrade version of car charger products in company, and then assigned a project manager to deal with this. Moulding technician within days’ tests and successfully replaced the material (see item 1, Figure 3). Product designer made a rendering image, and passed it to engineering designer to accomplish the inside structures (see item 2, Figure 3). A functional prototype then was delivered to a manager, who tried and was satisfied with the product (see item 3, Figure 3) it then moved to package making and promotion phase (see item 4, Figure 3).

In their current NPD process model and product development process, management plays a key role and to some extent is autocratic. The management contributes ideas, and validates the outcome of ideas. Capability of design is limited to only styling, and package design are not seen as important for validating the overall experience. However, this way of doing NPD is comparatively low risk, because most actions in their current NPD process rely on previous experiences and offer little or no challenges.

**Figure 3: The 'IG', a Recent Developed Car Charger Product**



#### 4. Conceptual Model Optimisation

For further applying the designer-led NPD process model, the conceptual model was introduced and optimised. Seven staff members were invited to a group discussion, these included: the top manager, one project manager, and two engineering designer, two technology specialists and one industrial designer.

**Figure 4: Modifications of the Conceptual Designer-led NPD Process Model**

	Phase(s)	Task(s)	Conceptual Method(s)	Optimised Method(s)
	Briefing	① Push boundary Locating direct and indirect competitors	Multi-disciplinary communication Understanding and Analysing essence of consumers' voice and core competence of company	Multi-disciplinary communication Understanding and Analysing essence of consumers' voice and core competence of company <i>Design engagement of production process</i>
	Ideation	② Finding Ideas / Opportunity	Design research methods	<i>Secondary Research / Empathy</i>
	Concept Design	③ Developing ideas to mature form Communicating ideas	Sketches / CADs / Renderings	<i>CAD Renderings</i>
	1st Validation	Does it matches the total brand image? or even shifting the brand image? Will it be accepted by the targeted market? or potentially be accepted in the future? Is the technology requirement feasible? or can be developed within time and budget?	Multi-disciplinary communication	Multi-disciplinary communication
	Detail Design	④ Engineering design Technology development	CAD Tests	<i>ID-supervised CAD</i> <i>ID-supervised Tests</i>
	2nd Validation	Technological performance Appearance performance	Specialized instrument Multi-disciplinary communication	Specialized instrument Multi-disciplinary communication
Prototyping	⑤ Sample with full function Mass production testing	Production related methods	Production related methods	
3rd Validation	Overall experience	Multi-disciplinary communication	Multi-disciplinary communication	
Launch	⑥ Mass Production Marketing	Design engaged production Design engaged promotion	<i>Production related methods</i> <i>Award(s) Participation</i>	

Based on the conceptual designer-led NPD process model proposed by Lou et al. (2013), the conceptual model has been optimised; however, only elements associated with methods were modified. These modifications in Figure 4 are highlighted in italic writing.

Design engagement in production process was moved from the launch stage to the briefing stage (see item 1, Figure 4). The rationale for having design engaged in production was to find insights for future NPD projects, and to increase control of the product quality (Lou et al. 2013). However, practitioners suggested that permitting designer involvement in the production process, in a quality control role,



would not be practical. They argued that the technicians already try their best to fulfil the proposed tasks; and that the only benefit for designers engaging in production was to provide them with insights relating to the manufacturing process. Practitioners pointed out that design can contribute to production, such as good design proposals, or work with engineering designers to simplify the production process; hence, detailed design activities were changed to be supervised by industrial designers (see item 4, Figure 4). The Top manager stated that only low cost ideation methods are accepted, because of the limited budget. Therefore, ideation methods were limited to secondary research and empathy (see item 2, Figure 4). The manager also pointed out that sketches from industrial designers are sometimes hard to understand without designers providing verbal explanation. They suggested that designers communicate ideas and/or concepts so that technicians and engineering designers are able to understand these from the drawings. Therefore, it was suggested that only CAD renderings should be accepted for concept designs (see item 3, Figure 4) and design engaged in marketing activities and promotion were changed to awards participation (see item 6, Figure 4). They proposed that designers engaged in promotion or marketing was unnecessary, as there are already specialists able to deal with consumer services. They suggested that the best way for design involvement in marketing is to prepare documents for awards, and win prizes.

## **5. Concurrent Application**

Execution of the two design processes were undertaken in parallel by two independent NPD teams. These two teams were kept separate to avoid any possible cross-contamination of ideas. One of the teams carried the 'Current Conventional NPD' process (Conventional NPD team), and the other team adopted the 'Optimised designer-led NPD' process model (Designer-led NPD team).

### **5.1 Team assembling**

Each team consisted of four staff, having different expertise. The teams included: a project manager, a technologist, an engineering designer and an industrial designer. The aim for team assembling was to assure that each team would have members with similar backgrounds and work experiences (Table 4).

Each team included a project manager with a marketing background, dealing with general NPD issues, such as: time management, sourcing of required parts, managing funding etc. Both technology specialists had over 6 years' experience on producing adaptor solutions, and the two engineering designers had over 10 years' experience and were familiar with the production process. The Industrial designers in the company were comparatively less experienced. One had been with the company for 18 months and the other for one year, but both had over 3 years' experience on electronic devices design. The industrial designer assigned to designer-led NPD was permitted to co-manage the NPD project with the project manager as it was designer-led. This meant that the designer in the designer-led NPD team had priority to make decisions and set plans.

**Table 4: Members' Expertise and Backgrounds**

Title	Conventional NPD team		Designer-led NPD team	
	Tasks	Experiences	Tasks	Experiences
<b>Project Manager</b>	General management	6+ years' experience on marketing	Co-management	6+ years' experience on marketing
<b>Senior Engineering Designer</b>	Engineering Design, Prototyping	10+ years in manufacturing industry	Engineering Design, Prototyping	10+ years in manufacturing industry
<b>Technology Specialist</b>	Technical Solution	6+ years' experience on power adapter solutions	Technical Solution	6+ years' experience on power adapter solutions
<b>Industrial Designer</b>	Design	BA Industrial Design, 3+ year experience on electronics product	Design / Co-management	BA Industrial Design, 3+ year experience on electronics product

## 5.2 Schedule

Given the fast-pace culture, both teams had a very compact schedule for developing new products. The conventional NPD team set a 5 week fixed plan from having a goal to preparing for mass production. Similarly, the designer-led NPD team had the same plan until the industrial designer in the team requested more time to adapt to the model. Consequently, the development time was extended and set with flexibility (Table 5).

**Table 5: Timetable of Two NPD Teams**

	Conventional NPD team	Designer-led NPD team	
	Week1	Setting Goal	Find Goal
Week2	Design Concept Ready	Internal Resources Reviewing	
Week3	Engineering & Technology Ready	Design Concept Ready	
Week4	Product Prototyping		
Week5	Preparation for launch	Engineering & Technology Development	Package & Promotional Files
Week6+		Preparation for launch	

## 5.3 Practical Implementing Process

Two NPDs were carried out with different NPD models. These two models were reflected by two different practical processes. For the Conventional NPD team, they held seven steps; this can be seen in Figure 5. In the ideation stage, there was no method for obtaining ideas from team members, but only personal insights of the project manager. The project manager tried hard to 'think what should be improved as a user', and concluded 'a car charger with two USB ports, having different lighting colours' as the aim for the NPD project. The development stage included all processes to materialise the idea: concept design, technological design, engineering design and prototyping. The design concept was a one-time work, with no iteration and rework, and successfully obtained satisfaction from the project manager. In the process of technology development, the technology specialist proposed a solution, based on a previous Printed Circuit Board (PCB) and upgraded the processor unit. Similarly, the engineering design was also a previous design

work with few modifications. A prototype then was fulfilled by combining the above. The validation stage had two steps. Firstly, the prototype was accepted by project manager, and then it was passed to the top manager to make further decisions: schedule for mass production or lay aside.

**Figure 5:** *Conventional NPD Team Practical Application Process*

	Practical Process	Contents
Ideation	Project Manager Setting Goal	A car charger with 2 USB ports and having different lighting colour
Development	Concept Design	
	Project Manager Review	Personal Satisfaction
	Technical solutions	Referring previous materials and making changes
	Engineering Design	
	Prototyping	
Validation	Management review	Management satisfaction and willingness for mass production


The conventional NPD was effective and, given that most time-cost tasks were based on previous mature solutions, savings were made in development time. Therefore, the conventional NPD team successfully accomplished the aim within the scheduled time. On the other hand, most decisions were determined by the project manager and top manager's intervention at validation stage was crucial.

In contrast to the conventional NPD team, the designer-led NPD team firstly reviewed the production process for obtaining internal knowledge (Figure 6), and all members in the team were gathered together to explore ideas that could potentially compete with competitors' products. An idea that 'Design for precision' was proposed by reviewing the production process in a meeting. Also, the designer mentioned that the new product should be much more powerful than competitors', and raised an idea of 'dual core'.

A gapless concept with dual core was proposed by the industrial designer with the consulting technology specialist in terms of the feasibility of a dual core. The industrial designer was therefore permitted to co-manage the project and also make decisions without obstruction from others. He expressed a willingness to present his work to other team members and obtain feedback. Consequently, changes were made during the group review of the design concept: an extension was added for realising the dual core power. In the technology development process, although the technology specialist in the team acknowledged the 'dual core' concept could be possible, there would be a time cost associated with functional realisation. Meanwhile, the engineering designer was trying to accomplish the gapless appearance without previous experience. The packaged design was in process while

other functions were working. As for the concept review, the prototype in package was presented to all members and also the top manager was invited for making comments.

**Figure 6:** *Designer-led NPD Team Practical Application Process*

	Practical Process	Contents
Briefing	Acquire Internal knowledge	Review production process
Ideation	Setting Goal	Group discussion for objective, design for precision, dual core
1st Validation	Feasibility	Consulting technology specialist for feasibility
Concept Design	Design Concept	
2nd Validation	Feedbacks	
Detailed Design	Engineering Design Technology Development	
Prototyping	Prototyping	
3rd Validation	Overall Experiences	Presenting prototype in package to all members in team

However, although there were concurrent processes for doing difficult tasks such as the dual-core PCB and gapless body development, the time cost exceeded even the expected amount, from a scheduled 6+ weeks maximum time to about 10 weeks. The ‘gapless’ and ‘dual core’ ideas were generated in the first week, the concept design was ready in the 2<sup>nd</sup> week, while there were changes made, consequently the finally concept was produced by the 4<sup>th</sup> week. The other 6 weeks were mostly used for experiments on creating the gapless body and combining two process units using one compact PCB. Although the final outcome satisfied the stated project aims, the team experienced conflict between different members. For example, during the prototyping phase, the engineering designer complained that the proposed high quality standards, specified by the industrial designer, required changes such as amending CAD files and adjusting the draft angles. The industrial designer required high performance but in a compact space, this resulted in more tasks for the technology specialist to redesign the PCB. The project manager considered that it had taken too long for a new product and cost too much by paying material and testing bills. However, both the engineering designer and technology specialist thought this product would be unprecedented. The ‘dual core’ for car charger was successful in the application for a certificate of patent.

## 6. Results by Metrics Tool

Result of the metrics tool were collected and shown in Figure 7 (-2 to 2 means from very negative to very positive). It shows that the overall score of designer-led NPD team is lower than the conventional NPD team. This is mainly because of extended time and cost on tests (Time cost, investment spent and risks & iterations are all marked below 0). Aside from that, it can be seen that staff in the designer-led NPD team spends more efforts (Employee productivity, workload all marked more than 1) in NPD process and achieved a product that seems to satisfy all members in the team (Product advantage, meeting customer needs, technological sophistication all marked to max).

**Figure 7:** Result of Metrics Tool Questionnaires

Project Manager	0	0	2	2	2	0	2	1		
Project Manager	2	1	-1	-2	-2	2	2	2		
Technology Specialist	0	0	0	2	2	1	1	1		
Technology Specialist	2	2	-2	-2	-2	2	2	2		
Engineering Designer	0	0	2	2	2	0	1	1		
Engineering Designer	2	2	-2	-2	-2	2	2	2		
Industrial Designer	0	0	2	2	2	0	1	1		
Industrial Designer	1	2	-1	-2	-2	2	2	2		
			Workload	Employee productivity	Risks&iterations	Investment spent	Time cost	Technological sophistication	Meeting Customer needs	Product Advantage

■ Conventional NPD team  
■ Designer-led NPD team

The current NPD process (conventional NPD) in the company seems unable to realise the full potential of team members (employee productivity, workload all marked 0 as usual), and indeed, members in the conventional team once finished their job for the NPD and immediately moved to new assigned tasks. In contrast, members in the designer-led NPD team contributed all their working time on the single project, and even needed to extend the scheduled timetable. Iterations have implied associated risks. In this study, there were almost no iterations in the conventional NPD process, thus accelerating the development process and saving developing time; however, no iterations are needed since they hold an ‘incremental’ view.

## 7. Discussion and Conclusion

Both of the two new products developed by different processes were accepted by the top manager and added to the production queue. Although the two teams followed different NPD models, the practical application process were similar to some extent. This related to the nature of developing new products, having an idea, develop the idea and market the idea (Kahn 2001). In comparison of two NPD projects so far (Table 6), the conventional NPD team started with an idea from the

project manager, and the outcomes were only validated by the management. Fewer people were engaged in the decision making process. This demonstrates the fragmented and immature nature of most Chinese SMEs as stated by Siu et al. (2006), and the decision making was an autocratic process to some extent. In contrast, group discussion took place several times in the designer-led NPD team, because the industrial designer in the team was permitted to co-manage the project. This partly borrowed from Perks et al. suggestions to extend designers' actions to management level, and the designer in the team wanted feedback from others during the decision making process. This then becomes a relatively democratic process. Members in the conventional NPD team conducted tasks mostly based on previous cases and experiences, thus the risk of NPD failure decreased significantly; rather than the designer-led NPD team, setting challenging goals, spending much effort and funds to achieve their goals. This confirms the perspective of developing new products proposed by Jang et al. (2008), which is to use design to push technology development. The conventional NPD method, inherently autocratic in nature, involved less communications between members and consequently resulted in less learning and interactions between members. Unlike the conventional NPD team, the designer-led NPD team had many communications and discussions because the industrial designer requested feedback on their own work; meanwhile, they grappled with challenging objectives requiring co-operation and collaboration between members.

**Table 6:** *Differences of two NPDs in Practical View*

<b>Conventional NPD</b>	<b>Designer-led NPD</b>
Autocratic	Democratic
Experience Based	Aim for Challenge
Low risks	risky
Less internal impacts	Great Internal impacts

The current NPD process model in the company is time saving, cost saving and it is a mature process for the company to create incremental products relying on previous experience. However, the success of any new product relies much on the vision of people in management roles. Design in this type of NPD, where changes of styling alone predominate, result in reduced contributions and impacts on overall product. This is in keeping with findings by Siu et al. (2006). Additionally, package design was seen as unimportant and even omitted from the NPD process. This approach to NPD appears to limit the opportunities of making radical products. The introduction of designer-led NPD process brought a democratic atmosphere within the company where team members experienced the benefit of cross functional communications and faced challenges with passion; meanwhile, there were increased opportunities to arrive at radical new products and like larger companies, to find challenges, face them and overcome them. Potentially, this may result in the company NPD culture transition as proposed by Jang et al. (2008). There are, however, drawbacks. Designer-led NPD is a relatively time-consuming way for developing new products. Consequently, the extra time cost generates additional expenditure. Staff members involved in designer-led NPD would have limited time for doing other work, because the workload is relatively high. It appears that the proper way for SMEs to develop new products is mixing the two processes:

applying the conventional NPD process for developing incremental products, while using the designer-led NPD for generating radical innovations.

This research partly confirmed the findings of Perks et al. (2005), but mainly in the context of shifting the designer's actions range. Consequently, designer's decisions were supported by other functions, not only technological aspects, as proposed by Jang et al. (2009), but also manufacturing techniques. The designer-led NPD process required a larger amount of time, exceeding the estimated additional allowance. Therefore, having internal competitions, as suggested by the Design Council (2008) and involving stakeholders for NPD as proposed by Acklin (2010) are not possible in the current NPD practice in Chinese SME process at this stage.

Two new products were added to the production queue, thus both outcomes were internally successful. External evidence is needed for making further comment on these two NPD projects, such as marketing data of the two products. In addition, participating in competitions and awards are also a way to assess the outcomes of these two NPDs. It was suggested in the designer-led NPD process model as a way for design to engage in marketing. Furthermore, it is worth pursuing further actions within the company regarding their next NPD, after the design oriented NPD strategy has been introduced. Their continuing NPD behaviour could provide the best evidence for understanding the company's NPD culture transition.

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