# PRODUCT INNOVATION ACTIVITIES IN AUSTRALIAN MANUFACTURING INDUSTRY*

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*Australian manufacturing industry needs to pay more attention to introducing innovative products if it is to be more competitive in the international marketplace. This paper reports some results of an investigation of new product process activities of Australian manufacturing firms. The aims of the study were to determine the sorts and forms of activities undertaken, their proficiency of execution and the sorts of improvements needed. The result have implications for more informed managerial decision-making to promote successful product innovation.*

Keywords: new product process activities, Australian manufacturing industry, product innovation management.

Whatever the traditionally perceived comparative advantages in production Australia might have over others, its future rate of economic growth will depend importantly on the ability of its domestic industry to develop new products which are competitive in the international marketplace. Australia has tended to rely too heavily on high-bulk low value-added commodity exports rather than high value-added technology based goods and services most capable of contributing to economic development. The revitalisation of the nation's manufacturing industry will depend crucially on the ability of firms to produce quality products which are valued on world markets. In view of the high level of product obsolescence expected for the next few years in the mature product markets in which Australia competes with the rest of the world, its domestic industry needs to pay more attention to producing new materials, products and devices and improving current product offerings[1].

The success rate of new industrial products following commercial launch is around two-thirds[2]. New product development has long been recognised as one of the riskiest activities of business enterprises and factors such as shorter product lifecycles, capital shortages, government restrictions, fragmentation of markets, changing competitive environments, and rapid technological change, continue to keep risks at high levels[3].

If the riskiness of new product development is to be reduced there needs to be greater understanding of the determinants of success and

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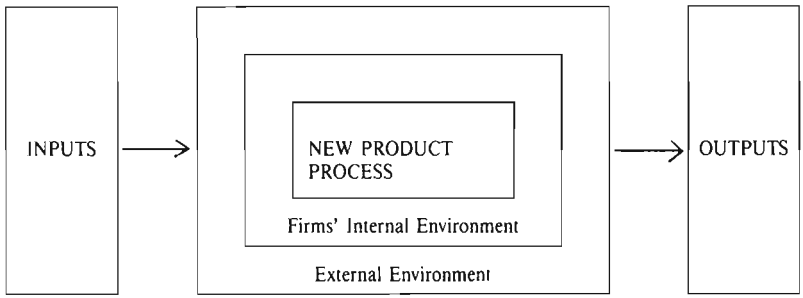
failure in this endeavour and continuing efforts to apply such knowledge in product innovation management. One area in need of more intensive investigation is the new product process.

## THE NEW PRODUCT PROCESS

An important recent overview of innovation theories and models[4] points out that a number of major features have characterised model construction during this decade. One such feature of the new perspective is a shift away from general or abstract models of innovation towards more complex models which provide a central role to the firm in the innovation process. As the authors note "the sources of innovation vary across industries and time — there is no general model. Innovation is centrally an organisational and managerial issue and this is the context in which it should be understood"[5]

One area where a general model has outlined its usefulness concerns the new product process. A conceptual model of the relationships between inputs to and outputs of new product development is depicted in figure 1.

**FIGURE 1**




Inputs to new product development include the level of R&D activity resource base and skills of the firm etc. The outputs of the process are the new products which are commercialised. Performance variables includes success, failure and "kill" rates, sales by new products as proportion of firms aggregate sales etc. The new product process occurs in the context of two environments — an external and an internal environment. The former refers to the nature of the marketplace in which the firm operates. Elements of the external environment capable of influencing new product project outcomes include current economic conditions, government macroeconomic and microeconomic policies, regulations and standards, industrial relations, the legal framework, as

well as aspects of the competitive situation such as size of the market, potential for growth, level of technological understanding, product offerings of competitors. The internal environment refers to factors more under the control of the firm's management such as management's attitude to innovation, organisational structures with the firm, the risk taking posture of the firm, its financial condition etc.

Until recently the new product process itself has, by and large, been neglected by researchers. The accepted view has been that the new product process comprises the set of activities that move the product from idea to launch, viz. new product strategy, exploration, screening, business analysis, development, testing, commercialisation[6].

One problem with the accepted model is that it is overly general, with each nominated stage itself comprised of distinct activities. Lacking guidance as to the specific tasks which must be undertaken within each stage, the model as such is of limited usefulness to the new product manager who wishes to adopt 'best practice'. In an attempt to specify in more detail the sort of activities which comprise the new product process following the strategy development and idea exploration stages, Cooper and Kleinschmidt have identified and defined thirteen separate activities. Derived from both normative models and empirically-based descriptions of the new product process these activities are:— initial screening, preliminary market assessment, preliminary technical assessment, detailed market study/market research, business/financial, analysis, product development, in-house product testing, customer tests of product, test market/trial sell, trial production, pre-commercialization business analysis, production start-up, market launch. We concur with these authors that such activities form a reasonable "skeleton" of the new product process, and more clearly define the various steps involved in new product development[7].

There are still large gaps in our knowledge of what firms actually do in the steps between the evaluation of an idea for a new product and the commercial launch of a product incorporating the new idea, their proficiency in performing various activities and scope for improvement. More information is needed on the quantity and quality of the activities performed by firms in the same industry, in different industries and in different countries. Only on the basis of such information can we determine the extent of deviations from the standard new product process model and begin to analyse their significance. Given the importance of product innovation for firms' growth and profitability, and Australia's industrial competitiveness in world markets, more research into the new product process is needed to inform policy-making both at firm and governmental level.

## AN INVESTIGATION OF AUSTRALIAN FIRMS

In March 1989 following telephone contact to explain the nature of the study, a pre-tested questionnaire was sent to a sample of 180 medium-

large firms listed in the Directory of Research & Development in New South Wales. The firms in the sample were in general located in Sydney. For each firm the person listed as the contact person in the Directory was invited to complete two questionnaires regarding new industrial products launched in the last five years — one for a typical or representative project judged to be a commercial success, the other for a project judged to be a commercial failure. Those who preferred to fill out one questionnaire only could do so.

Three specific research questions guiding the investigation were as follows:[8]

- What activities are undertaken in the new product process?
- How proficiently are these activities undertaken?
- What improvements are needed?

With respect to these research questions, the thirteen activities previously identified as comprising the new product process were used to help respondents structure their answers. The same four questions were asked of each activity: Was the activity performed?If so, what form(s) did it take? How proficiently was the activity performed? In hindsight, what improvements were needed in performing the activity?

The format emphasised close-end questions with respondents invited to elaborate as regards 'other' where none of the alternative answers provided under 'suggested improvements' adequately captured the firm's experience.

**Table 1**
**INDUSTRY CLASSIFICATION OF NEW PRODUCT PROJECTS**

| Industry Classification | No. of New Product Projects | Percentage of Total |
|---|---|---|
| Industrial Machinery & Equipment | 16 | 17 |
| Photographic, professional & scientific equipment | 15 | 16 |
| Chemicals | 13 | 14 |
| Appliances & electrical equipment | 12 | 13 |
| Food, beverages | 9 | 9 |
| Transport equipment | 7 | 7 |
| Paper products | 2 | 2 |
| Wood products | 2 | 2 |
| Clothing & footwear | 2 | 2 |
| Non-metallic mineral products | 2 | 2 |
| Metal products | 1 | 1 |
| Rubber products | 1 | 1 |
| Other manufacturing | 13 | 14 |
| | 95 | 100 |

Seventy-five firms responded to the questionnaire, (a 42 per cent rate) providing information on the activities involved in developing 95 new products. Sixty-one new products were regarded as successful, thirty-two were failures and in two cases it was too early to tell[9]. The firms

were generally multi-product firms and all conduct R&D. Twenty per cent are foreign-owned. Eighty-five per cent of the respondents were R&D managers and the rest were either marketing managers or technical directors. All had intimate knowledge of the activities involved in developing the nominated products. The industries covered in our sample of new projects are set out in Table 1[10].

The types of new products nominated by respondents are set out in Table 2. Forty of the products (42 per cent) are exported. The export markets of the nominated products were, in descending order of importance, New Zealand and the Pacific, South East Asia, Europe, North America and the rest of the world.

**Table 2**

**TYPES OF NEW PRODUCTS**

| Type of New Product | No. of Products | Percentage |
|---|---|---|
| Improved Product: a product offering improved performance to customers. | 12 | 13 |
| Product-Line Extension: a product that is new to the firm but 'fits' with existing product lines | 38 | 40 |
| New Product Line: a product new to the firm and which allows it to enter markets in which it has no previous experience | 27 | 28 |
| Real Innovators: a product new to both the firm and the world. | 18 | 19 |
| | 95 | 100 |

As Table 2 indicates, the sorts of new products which comprise the sample do not represent mere cosmetic modifications or style changes to existing products. The new product process activities under investigation are relevant to products offering improved performance to customers and/or are new to each firm.

## ACTIVITIES UNDERTAKEN: FREQUENCY, COMPLETENESS, PROFICIENCY

The main source of the idea for each new product is set out in Table 3. In 37 per cent of projects the new product idea can be regarded as 'market driven' (e.g., as a result of customer requests, customer surveys, sales force or distributor initiatives), while in 25 per cent of projects the idea can be regarded as 'technology driven' (generated from the R&D or Engineering/Design department). In the case of ideas from other sources we can expect elements of both to be present. While the 'market driven' *vs* 'technology driven' distinction is not entirely precise it does seem that customer needs have played a substantial role in generating the ideas for the nominated new products[11].

**Table 3**

**MAIN SOURCE OF IDEA FOR NEW PRODUCT**

| Source of Idea | No. of Products | Percentage |
|---|---|---|
| R&D department | 18 | 19 |
| Customer request | 18 | 19 |
| Management | 13 | 14 |
| Competitors product | 12 | 13 |
| Sales force | 10 | 11 |
| Customer survey | 6 | 6 |
| Engineering/Design Department | 6 | 6 |
| Creativity session (Brainstorming) | 4 | 4 |
| Scientific/commercial publications | 1 | 1 |
| Distributor | 1 | 1 |
| Other (eg consultants, parent company products) | 6 | 6 |
| | 95 | 100 |

The frequency of new product process activities is set out in Table 4. The most frequently performed activities were product development, preliminary technical assessment, production start-up, and preliminary marketing assessment, while the least frequently performed activities were Test/Market/Trial Sell, Detailed Market Research and Pre-Commercialisation Business Analysis. These results support the findings of the study of Canadian firms. The very same activities seem to be performed most frequently and least frequently by firms across two continents.

**Table 4**

**FREQUENCY OF NEW PRODUCT PROCESS ACTIVITIES**

| Activity | No. of products Featuring the Activity | Frequency (%) |
|---|---|---|
| Initial screening | 75 | 79 |
| Preliminary Marketing Assessment | 85 | 90 |
| Preliminary Technical Assessment | 87 | 92 |
| Detailed Market Research | 48 | 51 |
| Business/Financial Analysis | 68 | 72 |
| Product Development | 88 | 93 |
| In-House Product Testing | 76 | 80 |
| Customer Tests of Product | 70 | 74 |
| Test Market/Trial Sell | 31 | 33 |
| Trial Production | 62 | 65 |
| Pre-commercialization Business Analysis | 49 | 52 |
| Production Start-up | 86 | 91 |
| Market Launch | 74 | 78 |

It is also of interest to determine the number of new product process activities undertaken by firms in connection with particular projects. Table 5 provides information on the completeness of the new process.

**Table 5**

**COMPLETENESS OF NEW PRODUCT PROCESS**

| Number of Activities Performed | Number of Projects | Frequency (%) | Cumulative Frequency (%) |
|---|---|---|---|
| 1 - 4 | 0 | | |
| 5 | 2 | 2 | 2 |
| 6 | 6 | 6 | 8 |
| 7 | 10 | 10 | 18 |
| 8 | 14 | 15 | 33 |
| 9 | 14 | 15 | 48 |
| 10 | 20 | 21 | 69 |
| 11 | 10 | 10 | 79 |
| 12 | 12 | 13 | 92 |
| 13 | 7 | 8 | 100 |
| | 95 | 100 | |

No project involved less than five activities, while seven projects (8 per cent) involved all 13 activities. Almost half (48 per cent) of the projects involved nine activities or less, while one-third (34 per cent) involved eight activities or less. Comparable statistics from the Canadian study were 72 per cent and 51 per cent respectively. Australian firms typically executed more activities in new product development than did the overseas firms.

Respondents were also asked to rate the proficiency with which each activity was performed along a scale from 1 (very poor) to 9 (excellent), with 5 as satisfactory. The mean proficiency rating for each activity is set out in Table 6.

**Table 6**

**MEAN PROFICIENCY RATING FOR EACH ACTIVITY**

| ACTIVITY | MEAN PROFICIENCY RATING | PERFORMANCE OF PROJECTS % | |
|---|---|---|---|
| | | Better than Satisfactory | Less than satisfactory |
| In-house Product Testing | 6.64 | 72 | 13 |
| Product Development | 6.48 | 71 | 15 |
| Trial Production | 6.39 | 62 | 11 |
| Preliminary Technical Assessment | 6.15 | 65 | 20 |
| Test Market/Trial Sell | 6.10 | 61 | 16 |
| Customer Tests of Product | 5.99 | 58 | 24 |
| Detailed Market Research | 5.68 | 62 | 29 |
| Production Start-up | 5.62 | 49 | 29 |
| Preliminary Marketing Assessment | 5.52 | 44 | 29 |
| Business/Financial Analysis | 5.51 | 46 | 29 |
| Market Launch | 5.39 | 49 | 34 |
| Pre-Commercialization Business Analysis | 5.38 | 51 | 30 |
| Initial Screening | 5.16 | 38 | 35 |

While one must be cautious in interpreting these rating values, it is interesting to note that the activities which respondents considered to have been performed less proficiently are 'up front' or pre-development activities, initial screening and preliminary market assessment, together with pre-commercialization business analysis. The activities rated as most proficient involved activities of a technical or production oriented sort such as in-house product testing, product development and trial production. While no activity was regarded as performed in a less than satisfactory manner on average, no activity stands out as very proficiently performed on average.

Table 6 also reveals that for each of the activities initial screening, preliminary marketing assessment, detailed market research, business/financial analysis, production start-up and market launch were considered to register better than satisfactory performance in less than half of the projects. Although proficiency ratings are essentially subjective it is revealing to compare relative ratings for the Australian and Canadian studies. In the latter study also, the pre-development activities were rated least proficiently performed on average.

**TABLE 7**

**FORMS OF ACTIVITIES**

| **Initial Screening:** | % |
|---|---|
| •a specific departmental group decision | 31 |
| •multidepartmental group decision, informal | 27 |
| •multidepartmental group decision, formal | 23 |
| •individual decisionmaker, informal | 14 |
| •individual decisionmaker, formal | 5 |
| **Preliminary Market Assessment** | |
| •direct contact with customers | 66 |
| •review of domestic competitor products | 53 |
| •discussions with sales force | 25 |
| •review of overseas competitor products | 19 |
| •internal assessment | 15 |
| •access secondary/published data | 11 |
| •small sample phone surveys | 8 |
| **Preliminary Technical Assessment** | |
| •product design, model development | 56 |
| •product specifications | 53 |
| •engineering assessment | 53 |
| •production feasibility | 47 |
| •capability/feasibility analysis | 43 |
| **Detailed Market Study** | |
| •assessment of competitors | 73 |
| •study of domestic customer needs | 48 |
| •study to determine market size | 35 |
| •study to determine market size | 35 |
| •concept tests | 31 |
| •study of foreign customer needs | 17 |
| •study to determine potential market size | 15 |
| **Business/Financial Analysis** | |
| •cost and sales forecast | 84 |
| •return on investment analysis | 32 |
| •payback period/break even analysis | 32 |
| •informal, quick and dirty | 19 |
| •discounted cash flow analysis | 16 |
| **Product Development** | |
| •development of sample product | 53 |
| •construction of prototype | 51 |
| •use of pilot plant | 15 |
| •computer simulation | 3 |

| **In-house Product Testing** | % |
|---|---|
| •prototype testing | 74 |
| •Specifications check | 70 |
| •operating tests under real-life conditions | 64 |
| **Customer Tests of Product** | |
| •providing sample of product | 89 |
| •requiring customer verbal response | 30 |
| •bringing customer to company premises | 24 |
| •requiring customer written questionnaire | 7 |
| •field tests at customers premises | 6 |
| **Test Market/Trial Sell:** | |
| •sell to selected sample customers | 55 |
| •sell in limited geographic area | 32 |
| •trade shows | 29 |
| •free trial | 6 |
| •reduced price/rental scheme | 3 |
| **Trial Production** | |
| •test of product integrity/specifications | 82 |
| •test of production equipment | 61 |
| **Pre-commercialization Business Analysis** | |
| •cost review; distribution, production and marketing | 51 |
| •detailed financial analysis | 47 |
| •review marketing information only | 39 |
| **Production Start-up** | |
| •changes to production facilities | 41 |
| •no changes to production facilities | 31 |
| •acquisition, commission new equipment | 30 |
| **Market Launch** | |
| •trade advertising, training of sales force | 31 |
| •trade advertising, strong prom effort | 28 |
| •trade advertising, weak prom effort | 18 |
| •very limited effort | 16 |

While these results yield insights into the strengths and weakness of the new product process, they assume crucial importance once it is determined that the frequency, completeness and proficiency of the activities are linked to project outcomes[12].

We shall now undertake an analysis of each activity. The major forms which each activity took are set out in Table 7. Suggested improvements for each activity are shown in Table 8. Closer examination of each activity reveals insights into firms' assessments of their product development efforts.

**Table 8**

**SUGGESTED IMPROVEMENTS FOR EACH ACTIVITY**

| **Initial Screening:** | **Frequency %** |
|---|---|
| •better assessment of market criteria | 37 |
| •more detailed evaluation procedures | 25 |
| •better interdepartmental communication | 19 |
| •more top management commitment | 16 |
| •more external input | 13 |
| •greater consistency with corporate objectives | 3 |
| **Preliminary Market Assessment:** | |
| •more attention to the product concept | 28 |
| •allocation of more time and effort | 24 |
| •sharper market definition | 20 |
| •more attention to customer needs | 20 |
| •better liaison with technical function | 18 |
| **Preliminary Technical Assessment:** | |
| •more attention to product attributes | 33 |
| •more application oriented | 33 |
| •more formal documented procedures | 20 |
| •better organisation | 20 |
| •more time and effort | 15 |
| •cross functional appraisal | 6 |
| **Detailed Market Research** | |
| •better market definition | 33 |
| •more time and effort | 27 |
| •better marketing — technical liaison | 21 |
| •clearer objectives | 15 |
| •better product definition | 10 |
| **Business/Financial Analysis** | |
| •better market information | 40 |
| •more formal evaluation procedures | 29 |
| •more time and effort | 21 |
| •more multidisciplinary, multidepartmental inputs | 15 |
| **Product Development** | |
| •more attention to technical issues | 34 |
| •more resources (human and capital) | 26 |
| •more formal procedures | 20 |
| •better project definition | 17 |
| •more time and effort | 17 |
| •greater top management commitment | 16 |
| •nomination of product champion | 8 |

| **In-house Product Testing** | **Frequency %** |
|---|---|
| •more formal testing procedures | 39 |
| •more time and effort | 26 |
| •better technical-production staff liaison | 20 |
| **Customer Tests of Product** | |
| •more control over customer tests | 36 |
| •more thorough testing programme | 34 |
| •more input from technical and production staff | 10 |
| •greater emphasis on foreign customers | 9 |
| **Test Market/Trial Sell:** | |
| •sharper market definition | 29 |
| •better measures of test market results | 26 |
| •more input from technical staff | 3 |
| **Trial Production:** | |
| •more control over production system | 35 |
| •better measures of production system reliability and product integrity | 29 |
| •better interdepartmental co-ordination | 27 |
| •better trained production staff | 24 |
| **Pre-Commercialization Business Analysis:** | |
| •better market information | 43 |
| •more effective multi-departmental input | 29 |
| •revision and update of all data | 14 |
| •total 'start from scratch' review | 10 |
| **Production Start-up:** | |
| •more resources (time, money, people) | 43 |
| •more formal procedures, documentation | 31 |
| •better co-ordination | 26 |
| •better management | 23 |
| •better qualified personnel | 14 |
| **Market Launch:** | |
| •more advertising and promotion | 41 |
| •clearer marketing objectives | 35 |
| •better co-ordination among departments | 26 |
| •better sales force training | 26 |
| •greater top management commitment | 14 |

## ANALYSIS BY ACTIVITY

### *Initial Screening*

Initial screening, involves the initial go/no go decision when it was first decided to allocate funds to the new product idea. Table 7 reveals the informality of the screening process. In 41 per cent of projects nominated, the screening process did not involve any formal techniques, scoring/rating procedures or formal checklists of criteria, although initial screening did tend to involve a group rather than an individual decision. In 31 per cent of the projects the activity was performed by members of a specific department such as R & D or Marketing.

It is interesting to note that the majority of suggested improvements as set out in Table 8 relate to technical and market evaluation procedures. Possibly the degree of informality in the modes of screening which are used has impeded the proficiency of the activity. In less than half of the firms did top management encourage staff to develop expertise in analytic project evaluation and control techniques and in less than one-fifth of firms was there any extensive use of management science techniques and decision aids. Some respondents indicated that initial screening was undertaken in ignorance of the existence of comparable products overseas. Others, that more account should have been taken of the potential diverse uses of the product in different markets. A number suggested that the implications of product development for the purchase of production equipment as well as possible production problems should have received more attention at this stage.

Better communication between personnel in different departments and more commitment and support from top management were also suggested as improvements to initial screening activity. The need for better communication channels between different departments reinforces the interdisciplinary nature of new product development and the importance of providing opportunities for different functional specialists to provide input to the process at an early stage.

### *Preliminary Market Assessment*

Preliminary market assessment involves an initial non-scientific appraisal of the market acceptance for the new product. The majority of firms made contact with potential customers either directly or by discussions with their salesforce. Some firms commissioned surveys by market research firms, while others used market statistics and other information provided by an Industry Association. Review of competitor products in both domestic and foreign markets is an important form of preliminary market assessment, although the emphasis was clearly toward the offerings of rivals in the domestic rather than the international marketplace. The attention to both existing product offerings and customer needs would seem to be a very sound strategy in the early stages of the new product process. A smaller number of

projects assumed prior knowledge of market needs and relatively little use was made of secondary/published data.

The suggested improvements indicate respondents' recognition of the importance of a clear perception of the attributes of the product — what benefits it will deliver and how it will be positioned in the market, as well as a sharper, more focused definition of the market and customer. The more emphasis is placed on both technical and marketing criteria, the more likely is the project to garner the degree of inter-departmental support required to sustain enthusiasm for the project over the subsequent activities comprising the new product process.

*Preliminary Technical Assessment*

Preliminary technical assessment involves an initial appraisal of technical merits and difficulties. The suggestions in Table 8 indicate the perceived importance of detailed attention to the product's attributes, features, specifications and requirements and the linking of these attributes with customer needs. Responses indicate that technical assessment needs to be application-oriented and focused as to the sorts of benefits which customers are expected to derive from product use. A lesser percentage of respondents suggested that cross functional appraisal of the project is appropriate during this activity. Suggestions that preliminary technical assessment should have been better organised, with more qualified personnel, highlight the importance of appropriately skilled staff and organisational structures which facilitate new product development. In hindsight, some respondents would have more thoroughly checked the technical capabilities of sub-contractors used in manufacturing.

*Detailed Market Study/Market Research*

Detailed market research involves a reasonable sample of respondents, a formal design and a consistent data collection procedure. Table 7 reveals that firms emphasised the standard dual strategy of market research involving an assessment of competitors' products, prices, costs, technologies, production capacities, marketing strategies, together with a study of customer needs and sources of dissatisfaction with existing products. For the nominated new products, however, firms were more inclined to focus upon competitors' circumstances rather than on customer needs. Where customer needs were analysed, the focus was on the needs of domestic rather than foreign customers. In less than one-third of the projects did this activity include concept tests, i.e., studies of customer reactions to sketches, diagrams, models or descriptions of the proposed new product.

The suggested improvements reinforce the importance of a clearly focused process involving precise specification of markets and market segments targeted for investigation and better definition of the product

and technology prior to research. The suggested improved liaison between the marketing and technical functions illustrates the importance of organisational structures which promote cross functional co-operation and consultation and which facilitate the resolution of interdepartmental conflicts and rivalries. A number of respondents indicated the need for clearer information objectives in market research. In some projects the detailed market assessment was focused on a narrow market segment, neglecting the window of opportunity which the product opened on other markets.

*Business/Financial Analysis*

Business/financial analysis, leads to a go/no go decision *prior* to product development. Table 7 reveals that the form of financial analysis most preferred was that of costs and sales forecasts. These were performed in 84 per cent of the projects. Other techniques were employed in less than one-third of cases. It is interesting to observe that in 16 per cent of projects business/financial analysis was variously regarded as superficial, informal, quick and dirty, involving rough guesses and estimates. Overall, the activity was not considered to be very proficiently performed and this may reflect the low level of use of certain standard financial techniques as well as the high percentage of informal analyses.

Suggested improvements relate both to the need for more information about the market, particularly input from potential customers and the use of more formal evaluation procedures. In general, respondents indicated concern with the degree of informality in business/financial appraisal and the quality of the data used in financial appraisal. Respondents expressed their concern regarding poor estimates of production costs and costs of raw materials, deficient sales forecasts, inadequate account of likely competitor responses and their effect on sales, and neglect of the effect that sales of the nominated new product had on sales of the firm's other products. These sorts of responses indicate the importance of multi-disciplinary input into data collection and evaluation. They also reflect adversely on the quality of the market research prior to business/financial appraisal. The organisational structures in which new product process activities take place should be such as to facilitate multi-departmental input into financial appraisal prior to product development.

*Product Development*

Product development involves the actual design and development of the product resulting in prototype or sample product. Regarding suggested improvements, while it might be expected that respondents would generally desire more resources for product development, there was expressed concern as to the quality of facilities and personnel available for this effort. Concern was also expressed about the degree of inter-

departmental communication and co-ordination relevant to this activity. Of particular interest, however, was the large number of suggestions that product development could be improved by better project definition beforehand (i.e., more attention to the target market, customer needs, product attributes and expected benefits from its use) as well as more attention to technical problems during the development phase. These suggestions highlight the interdependence of technical and marketing factors in the new product process. Once again, they reinforce the importance of cross functional liaison between different departments and organisational structures and systems which facilitate the required collaboration and co-ordination.

*In-House Product Testing*

In-house product testing takes place in the laboratory or under controlled conditions. In-house product testing took the standard forms. The mean proficiency rating of the activity was 6.64, the highest for all 13 activities. it also had the highest percentage of satisfactory performance (72 per cent) and the second lowest percentage for below satisfactory performance (13 per cent).

Despite its high proficiency rating, respondents felt there was little room for improvement of in-house product testing. Some respondents indicated that it is sometimes difficult to simulate 'real life' conditions in-house.

*Customer Tests of Product*

Customer tests of the product take place under real life conditions, with customers and in the field. In cases where trials were conducted at customer premises, whether supervised or unsupervised, respondents indicated that these tests proved to be extremely useful in clarifying product specifications and the sorts of benefits expected to be derived by the customer in using the product.

A number of respondents suggested that a more thorough testing programme (more tests undertaken at more test sites and at more representative sites) could have led to greater proficiency in the execution of this activity. While resource constraints inevitably limit the scope for testing, indications are that in circumstaces where the product has been tailored to the needs of a small number of customers, the more detailed the customer tests, the more likely they are to uncover features of the product which are unsuitable to customers. Since it is in the interests of both manufacturer and customer to detect such problems as early as possible, proficiency in this activity can result in substantial cost savings at a later time. The advisability of testing foreign customers as well as domestic customers also becomes evident. Conducting trials at the premises of overseas buyers can help to detect problems connected with different specifications, regulations, standards, etc., which may not

have been previously recognised. While 42 per cent of the nominated new products are exported, the relatively low concern with testing foreign customers is consistent with the domestic market orientation reflected in response pertinent to other activities.

*Test Market/Trial Sell*

Test market/trial involves selling to a limited set of customers. Suggested improvements included more objective and better measures of the test results and more input from technical staff. Once again, we found a desire for sound evaluation techniques and interdisciplinary input to the evaluation process. it is interesting to note that suggestions involving better/sharper definition of the test market customers is consistent with 'sharper, more focused definition of the market' suggested to improve preliminary market assessment and 'better definition of specific markets and segments as the target of investigation' in detailed market study.

*Trial Production*

Trial production involves a test of the production facilities. Suggested improvements reflect a concern involving the co-ordination of different functional specialists and a concern with the quality of production staff. The desire for better measures of the reliability of the production system and the integrity of the product may also reflect an adverse view of the levels of skill of staff who perform the tests. Improvements in both the quality of technical staff and the available resources for testing can facilitate resolution of processing problems arising from laboratory scale up to pilot plant and result in more precise specification of the attributes of the item produced.

*Pre-Commercialistion Business Analysis*

Pre-commercialisation business analysis involves financial appraisal following product development but prior to full scale launch. Table 7 reveals that pre-commercialisation business analysis took a detailed form in only 47 per cent of the projects. In the majority of cases it consisted of a cost review, and over one-third of the projects (39 per cent) took the form of a review/integration of marketing information only.

Respondents again indicated a desire for better quality information and appraisal. The focus of their concern was on the accuracy of the market studies which had been undertaken prior to this activity. Their suggested improvements, especially for better sales projections, call into question the types of market research conducted in their firms. A number of respondents suggested revision and update of all data and a total 'start from scratch review' as means of improving pre-commercialisation business analysis. As for business/financial analysis discussed earlier, the concern was not over the techniques used in evaluation but with

the quality of the data used in the analysis. The desire for multi-departmental input into evaluation and appraisal has been emphasised by respondents in every instance where appraisal techniques were considered. Their suggestions again reinforce the importance of organisational structures which facilitate interdisciplinary collaboration.

*Production Start-Up*

Production start-up refers to the start-up of full scale production. Table 7 indicates that in 41 per cent of projects, production start-up involved changes to existing production facilities and in 30 per cent of projects it involved acquisition and commissioning of new equipment. In 29 per cent of projects the activity did not imply any changes to existing production facilities. In some cases, sub-contractors were used for this activity.

The suggested improvements relate to a range of different problems. The desire for better co-ordination among the personnel involved in the new product process has been expressed by respondents in connection with a number of activities and implies that changes are needed to organisational structures. The need for more detailed documentation and procedures regarding production start-up relates to the systems in place for controlling this activity. The need for better management, more resources and top-level commitment to the factory indicates that changes in management style are warranted in some cases. The desire for better quality staff seems to be common to a number of activities. A number of respondents indicated that better machinery would have improved this activity and some indicated design problems with newly acquired production equipment.

*Market Launch*

Market launch involves an identifiable set of marketing activities specific to commercialisation of the product. For a number of projects, winning the contract to supply the product took the place of market launch. In other cases, the launch was left to selected customers who had responsibility for its distribution.

Regarding suggested improvements, a number of respondents would have preferred larger stock holdings at the time of product launch. Others also indicated that the launch occurred prematurely, while the manufacturing equipment was still not fully tested or proven. Some respondents expressed concern over the choice of distributors and marketers of the product.

The preference for more resources to be expended on advertising and promotion of any product is a natural one. The question arises as to the cost effectiveness of any additional promotional effort, however. The problem of co-ordinating the efforts of personnel in different departments once again arises as a barrier to proficient execution of

a new product process activity. So too, does the problem of finding staff with the required level of expertise. A number of respondents suggested that more commitment and involvement from top management is important, even in this final activity stage. The need for clear marketing objectives from the earliest stages of the new product process has already been stressed. It appears that marketing objectives remain unclear for some projects, even up to the market launch stage.

## IMPLICATIONS FOR MANAGEMENT

While numerous suggestions were made as to how the proficiency of various new product process activities could be improved some stand out as relevant to a number of different activities. We can draw out some implications of the information contained in Table 8, with reference to data on firms' organisational and other characteristics which respondents also provide[13].

### *More Clearly Defined Technical and Market Evaluation Criteria*

Clearer evaluation criteria were considered to be required in improving the proficiency of: initial screening, preliminary market assessment, preliminary technical assessment, detailed market research, business financial analysis, test market/trial sell, pre-commercialization business analysis. The suggestions indicate the importance of detailed attention to the product's attributes, features, specifications and requirements and the linking of these attributes with customer needs. Response revealed emphasis on the needs of domestic rather than foreign customers, suggesting an inward-looking marketing orientation. Technical assessment needs to be application oriented and focused on the sorts of benefits which customers are expected to derive from product use. Those who suggested that cross functional appraisal would have improved a number of the above activities appeared to recognize this. *A priori,* sound new product process practice indicates that marketing assessment without technical assessment is *empty* while technical assessment without market assessment is *blind.* Suggested improvements indicate that respondents generally held this view. With respect to financial appraisal the suggested improvements relate to the quality of the technical and market information on which the evaluation is made, rather than to the quality of the techniques used. There is indicated a need for firms to more clearly identify the strategic roles that new products are to play in achieving corporate objectives.

### *Greater Use of Management Science Techniques and Decision Aids*

In less than half of the firms (49 per cent) top management encouraged staff to develop expertise in analytic project evaluation and control

techniques; moreover only a small number of firms (19 per cent) made extensive use of management science techniques and decision aids. Responses suggest that this may have resulted in a less proficient execution of a number of new product process activities. Particularly noteworthy was the relative neglect of scoring and/or rating procedures for screening new product ideas despite their diagnostic capabilities. Suggested improvements also refer to the need for more sophisticated technical and market evaluation procedures in the early stages of new product development, e.g., evaluation procedures relating to the product's technical features, its degree of innovativeness relative to competitor products and sales forecasting techniques. More formal evaluation procedures were also suggested to improve business/financial analysis. There was also a concern regarding the sophistication and objectivity of the measures employed in in-house product testing and in test market/trial sell as well as those used to determine the reliability of the production system and product integrity at the trial production stage.

*Better Qualified Personnel*

Responses reveal some dissatisfaction with the quality of staff involved in new product development particularly in technical or production related activities. Over and above the general and understandable preference for more resources to be allocated to new product processes respondents suggested that better qualified technical personnel were required for preliminary technical assessment, product development, trial production and production start-up. Additional training for sales staff was recommended at the market launch stage. The quality of the entire product development effort depends on the qualify of the personnel who perform the required tasks. Deficiencies in internal capabilities may well reflect either a paucity of trained technical personnel or inadequate determination of company specific strengths and weaknesses in formulating the new product strategy.

*More Commitment and Involvement From Top Management*

Although in most firms (84 per cent) top management was generally perceived as supportive of new product development and promotive of the value of growth and innovation (85 per cent) the extent of this support was often questioned when the new product processes is analyzed activity by activity. Management commitment was questioned in each of the activities: initial screening, product development, production start-up and market launch. Sometimes top management was considered not to be alert to either competitive threats or opportunities and sometimes alert only to threats implying a defensive or reactionary style. In 22 per cent of the firms top management was regarded as indecisive in allocating resources to ideas having expected commercial benefits. Resource constraints were considered to have

affected the performance of such activities as preliminary market assessment, business/financial analysis, product development, in-house testing, customer tests of the product, production start-up and market launch.

### *Better Inter-Departmental Liaison*

In the majority of the firms sampled, organisational structures appear to be conducive to product innovation. In 71 per cent of cases the organisational structure was considered to facilitate the creative co-operation and collaboration of cross functional teams and task forces while in 63 per cent of firms it was regarded as facilitating the resolution of interdepartmental rivalries and conflicts. When each activity is considered in turn, however, indications are that the firms' organisational structures present barriers to interdisciplinary teamwork and have impeded proficient execution of ten activities (excepting product development, test market/trial sell, trial production). It appears that existing organizational structures have impeded the effective cross functional appraisal of projects prior to and following product development. The suggested improvements to each of these activities highlight the importance of fruitful interaction between different functional specialists and procedures for conflict resolution while at the same time indicating the difficulties of achieving harmonious inter-departmental co-operation in the product development process.

### *More Formal, Better Documented Procedures*

The firms' understanding of 'best practice' new product development is underlined by the frequency of performance of each of the thirteen new product process activities and the general 'completeness' of the new product process in terms of the number of activities performed. And yet, only just over half of the firms (54 per cent) have formal procedures in place for controlling and co-ordinating new product projects as they progress through various stages. Respondents often called for more formal and better documented procedures in undertaking certain activities, viz.: preliminary technical assessment, business/financial analysis, product development, in-house product testing, customer tests of product, trial production, production start-up. The responses suggest that these activities which include many of a technical or production related sort could have been more proficiently executed if more attention had been paid to the systems in place for co-ordinating and controlling the relevant activities. The suggested improvements reflect the need for detailing standard activity plans to be employed to render procedures more systematic and, hopefully, more proficient in their execution.

## CONCLUSIONS

This paper has presented some findings of a study of the new product process activities of Australian manufacturing firms. It has indicated the sorts and forms of activities undertaken, their proficiency of execution and the sorts of improvements needed. The study has implications for business managers[13]. A number of suggested improvements were common to various activities. These included — more clearly defined technical and market evaluation criteria, greater use of management science techniques and decision aids, better qualified personnel, more formal, better qualified personnel, more commitment and involvement from top management, better inter-departmental liaison and more formal, better documented procedures. Further research into new product development in Australia is required to determine the representativeness of our sample of mainly Sydney-based firms. The more we know about what new product process activities are being undertaken, their proficiency and suggested improvements, the greater the scope for initiatives to improve product innovation management in Australian industry.

## NOTES AND REFERENCES

1. See Department of Industry, Technology & Commerce *Innovation for the 1990's: New Challenges for Technology Policy & Strategy,* AGPS, November 1988.
2. Merle C. Crawford, *New Products Management,* Richard D. Irwin, Illinois, 1987.
3. E. Yoon and F. Lilien, 'New industrial product performance: the effects of market characteristics and strategy' *Journal of Product Innovation Management,* 2, (3), 1985, p.p.134-144.
4. Department of Industry, Technology and Commerce, *op. cit.*
5. *op. cit.,* p.79.
6. Booz, Allen and Hamilton Incorporated, *New Products Management for 1980s,* Chicago, 1982.
7. See R. G. Cooper and E. J. Kleinschmidt, 'An investigation into the new product process: steps, deficiencies and impact', *Journal of Product Innovation Management,* 3 (2), 1986, pp.71-85.
8. These three research questions also guided the study of Canadian firms by Cooper and Kleinschmidt, *op. cit.* The present study also sought to determine the impact of new product process activities on commercial success and failure and the effect of the organisational characteristics of firms' product development efforts on project outcomes. The Canadian study did not address the latter issue. The Australian study revealed statistically significant associations between organisational characteristics, the frequency, completeness and proficiency of the activities and commercial success/failure. Space limitations preclude more detailed discussion here. See L. Dwyer and R. Mellor, *New Product Process Activities of Australian Manufacturing Firms* Studies in Product Innovation Research Report 89/1, School of Business & Technology, University of Western Sydney, Macarthur, 1989. Copy available upon request.
9. The present paper concerns which activities are undertaken in the new product process, how proficiently they are undertaken and the improvements required for all projects whether successful or not. Interesting and statistically significant differences between successful and unsuccessful projects are discussed in detail in L. Dwyer & R. Mellor, *op.cit.*

10. Based on Australian Standard Industrial Classification two digit code. Firms were classed by the authors based on information about the nominated new product provided by each firm. To date, no analysis has been undertaken to determine whether or not there are significant inter-industry differences regarding activities undertaken and their impact on new product project outcomes. The issue must await further analysis of the survey responses.
11. The 'technology push' *v* 'demand pull' distinction has been displaced by new forms of analysis emphasising the *process* of innovation. (See Department of Industry, Technology & Commerce, *op.cit.*, p.1). We employ the distinction here simply to categorise the source of ideas for the nominated new products. Since the projects were nominated by the respondents we cannot infer that this proportion of 'market derived' to 'technology derived' ideas represents some industry aggregate. It is interesting to note however, that even in a sample of respondents dominated by R & D managers, a large proportion of the projects originated from the marketplace.
12. For the majority of activities there are statistically significant associations between activities undertaken and overall project succes/failure. Some activities were undertaken significantly more often in successful than in unsuccessful projects. Successful projects also featured significantly more activities than did failures. That is, successful projects tended to feature a more complete new product process. The proficiency with which activities are undertaken is also closely associated with project success. The mean proficiency rating was higher for successful than unsuccessful projects for all activities with the strongest associations involving 'up front' or 'pre-development' activities (see L. Dwyer & R. Mellor, *op. cit.*, pp.41-48.
13. As indicated, the survey sought to determine if there were links between firms' organisational characteristics and the outcomes of new projects. To investigate this question the survey employed the McKinsey 7S framework (strategy, shared values, style, structure, staff, skills, systems) to structure responses. For details, see L. Dwyer and R. Mellor, *op. cit.* Some of the information provided by respondents has useful implications for management and has been incorporated in this section.
14. A study of new product process activities of manufacturing firms in England and Belgium reveals remarkable similarities in the problems facing new product managers and their action implications. See L. Dwyer, 'Proficiency of new product development activities in U.K. manufacturing firms', *Management Research News,* 12, 6, 1989; L. Dwyer and R. Mellor, 'New product process activities and project outcomes'' *R&D Management* (forthcoming).