

2.1 INTRODUCTION

This chapter discusses the methodology that was employed in the National Innovation Survey. On the whole, the National Innovation Survey adopted the recommendations that were laid out in the *Oslo Manual*. The questionnaire design also benefited from existing practices in the form of questionnaires that were used in various innovation surveys around the world.

2.2 THE OSLO MANUAL

The Oslo Manual is a document produced by the Organization for Economic Co-operation and Development (OECD) and the European Commission (EC) with the specific purpose of providing guidelines on data collection on technological innovation. The *raison d'être* for the document was the need for robust and internationally standardized methodologies that can be used in innovation surveys. The two objectives of the Oslo Manual are:

- to provide a framework within which existing surveys can evolve towards comparability; and
- to assist newcomers to collect and analyze innovation data.

Since the publication of the Oslo Manual in 1992, EC countries have utilized the manual and embarked on a series of innovation surveys. These surveys, called the *Community Innovation Surveys* (CIS), have been carried out in two waves, each corresponding to the first and revised versions of the Oslo Manual.

2.3 BASIC DEFINITIONS

For international comparability of its findings, the National Innovation Survey uses definitions of types of innovation and innovative activities that are

set out in the Oslo Manual. The basic criterion is that the product or process should be new or significantly improved to the firm:

“Technological product and process (TPP) innovations comprise implemented technologically new products and processes and significant technological improvements in products and processes.” (Oslo Manual, p.47)

In the above definition of TPP, products include both goods and services. The definitions were employed in the National Innovation Survey for the manufacturing sector.

“A technologically new product is a product whose technological characteristics or intended uses differ significantly from those of previously produced products. Such innovations can involve radically new technologies, can be based on combining existing technologies in new uses, or can be derived from the use of new knowledge.” (Oslo Manual, p.48)

“A technologically improved product is an existing product whose performance has been significantly enhanced or upgraded. A simple product may be improved (in terms of better performance or lower cost) through use of higher-performance components or materials, or a complex product which consists of a number of integrated technical subsystems may be improved by partial changes to one of the subsystems.” (Oslo Manual, p.49)

“Technological process innovation is the adoption of technologically new or significantly improved production methods, including methods of product delivery. These methods may involve changes in equipment, or production organization, or a combination of these changes, and may be derived from the use of new knowledge. The methods may be intended to produce or deliver technologically new or improved products, which cannot be produced or delivered using conventional production methods, or essentially to increase the production or delivery efficiency of existing products.” (Oslo Manual, p.49)

2.4 QUESTIONNAIRE DESIGN

A two-stage survey approach was employed for the survey. This approach is adopted to maximize the number of responses via the use of a simple questionnaire in the first stage and a more complicated one in the second stage:

- Stage I comprises a one-page questionnaire for firms to indicate whether they carried out innovation activities or not.
- Stage II comprises a more detailed questionnaire that was sent to only firms that indicated they carried out innovation activities in the first stage.

The definitions on innovation activities that were used in the Stage I questionnaire were based on the Oslo Manual and the CIS-2 (see Appendix B). For the second stage, the detailed questionnaire used was based on the questionnaire used in the CIS-2 (see Appendix C). Slight modifications were made to elicit more detailed responses.

2.5 SAMPLING METHODOLOGY

As far as possible, the sampling methodology used in the National Innovation Survey is based on the recommendations of the Oslo Manual.

(a) Target Population

The Oslo Manual is very explicit on the target population for innovation survey :

“It is therefore recommended that innovation surveys should primarily refer to innovation activities in market-oriented industries. These should include manufacturing industries as well as market-oriented service industries. As long as knowledge about innovation activities in service industries remains fairly limited, at this early stage of methodology development, a concentration on technology-intensive service industries is preferable.” (Oslo Manual, p.93)

The appropriate sectors (based on the International Standard Industrial Classification) are (ISIC Rev.3, Oslo Manual, page 66).

- Manufacturing,
- Electricity, gas and water supply,
- Construction, and
- Marketed services.

The economic sectors covered in some of the CIS-2 surveys include the entire manufacturing sector and selected industries in the services sector. Since, innovation surveys in the services sector is still at a nascent stage, the present National Innovation Survey focuses only on the manufacturing sector. Table 2.1 summarizes the types of manufacturing industries included in the survey.

(b) Sample Frame

The Oslo Manual recommends that the sample frame that is used for any innovation survey be based on comprehensive business establishment database that are maintained by national statistical offices:

“An ideal frame is an up-to-date official business register established for statistical purposes. Such registers are usually kept by national statistical offices. Other registers may be used as well, depending on their quality.” (Oslo Manual, p.95)

Following this advice, the sample frame for the manufacturing sector was obtained from the Department of Statistics, Malaysia.

(c) Sample Size

In the first stage, a total of 4,000 questionnaires were sent to the manufacturing sector. The experiences of countries that carried out the CIS-2 provided no guide on the appropriate number of questionnaires to be sent.

(d) Sampling Method

The National Innovation Survey (NIS) adopted the stratified sampling method based on recommendations from the Oslo Manual.¹

¹ “In almost all cases, innovation surveys are random sample surveys.” (Oslo Manual, page 98). “In the past, stratified sample surveys have proved to lead to reliable results.” (Oslo Manual, page 98).

A stratified random sample is one obtained by separating the population elements into non-overlapping groups, called strata, and then selecting a simple random sample from each stratum. The reasons for using the stratified sampling approach include:

1. Smaller bound on the error of estimation;
2. Lower cost per observation;
3. Ability to estimate population parameters; and
4. Proven usefulness in other innovation surveys.

(e) Sample Strata

The sample strata used in the survey is based on the recommendations of the Oslo Manual:

“It is therefore recommended that the stratification of the random sample innovation surveys should be based on the size and the principal activity of the units”. (OM, p.98)

Following the advice of the Statistics Department, the size of establishment was defined in terms of revenue size. This sampling approach emphasizes the contribution of firms to the economy in terms of revenue.

Four classes of size were used:

- Category 1: Turnover < RM1 million
- Category 2: RM1 million £ Turnover < 5 million
- Category 3: RM5 million £ Turnover < 10 million
- Category 4: RM10 million £ Turnover < RM100 million
- Category 5: Turnover ≈ 100 million

(f) Sample Data

At the time of the National Innovation Survey, the Department of Statistics’ registry of business establishment in the manufacturing sector was 20,584 firms.

Manufacturing

For the manufacturing sector, the 4,000 samples were drawn from the population of 20,584 firms in proportion to the turnover size in each sub-category (for example, industry code 311, turnover between RM1 million to RM5 million). The problem with this approach is that the large firms’ share of the total revenue in the manufacturing sector is very substantial but the number of these firms is very small. To overcome this problem, the allocation of the 4,000 samples was undertaken via three iterations. The rules adopted are as follows:

Step 1: A total of 4,000 samples were initially allocated to each sub-category (industry & size) in proportion to turnover contribution.

Step 2: When the size of allocated sample exceeds the number of available firms – the excess number is then re-allocated to the remaining sub-categories in proportion to their turnover contribution.

Step 3: The previous procedure (in Step 2) is repeated until all the 4,000 samples are allocated.

The sequence of sample allocation is summarized in Table 2.2.

As both the two largest class size (category 4 and 5) amounted to a census (100% coverage), the two size classes were merged.