4 How firm managers understand innovation: implications for the design of innovation surveys

Anthony Arundel, Kieran O'Brien and Ann Torugsa

1. INTRODUCTION

Data on the innovation activities and outputs of firms have been collected through both object-based methods and subject-based surveys for several decades. Object-based methods collect information on specific innovations, generally through announcements in trade journals and other media (Kleinknecht and Reijnen 1993; Santarelli and Piergiovanni 1996). The advantage of this method is that the researcher can use the information in the media report and from other sources to classify the innovation by type. The fact that the innovation is advertised also ensures a level of novelty, since firms are unlikely to advertise minor differences in their products compared to competitors. The disadvantage of the object-based approach is that it collects little information on the innovation strategies used by firms and it is likely to miss many process and organizational innovations that the firm does not intend to sell and therefore does not advertise.

Subject-based innovation surveys, such as the EU Community Innovation Survey (CIS), can cover all types of innovations and collect a wide variety of information on innovation activities of use to both economic analysis and policy (Colecchia 2007; Freeman and Soete 2009; Bloch 2005; Arundel 2007). This includes information sourcing and collaboration strategies, revenues from innovative products, workforce characteristics, innovation investments, innovation objectives and factors that impede innovation. The *Oslo Manual* (OECD/Eurostat 2005) provides extensive guidelines on the types of questions that are worth asking. The disadvantage of subject-based surveys is that they usually obtain very little information on the characteristics of different categories of innovations. As an example, the CIS can show whether a firm has introduced both a good and a service innovation, but it provides only limited information on the characteristics of these innovations.

Data on the characteristics of specific innovations are of value because of the enormous differences in the effort required to develop innovations. The multiplex cinema and early versions of the ubiquitous roller suitcase required no research and development (R&D) and very little creative effort to develop, other than the initial idea. Conversely, the Trent jet engine and synthetic insulin required hundreds of millions of euros and many years to bring to the market. Object-based surveys can readily identify such differences in the creative effort, finance and capabilities required to innovate, but subject-based surveys are designed to provide general data, such as investments in all innovation activities.

The CIS has been criticized for a lack of consistency and comparability of data across countries, due to differences in survey methodology, survey questions and design, and to data quality problems associated with particular survey questions (Archibugi and Pianta 1996; Bordt 2008; Kleinknecht et al. 2002; Mortenson 2008). These concerns over the reliability and comparability of the CIS data have gradually been addressed through steps to improve survey methodology and questions. Many national statistical offices that are responsible for the CIS have implemented best practices in survey methodology, such as better follow-up of non-respondents and routines to contact enterprises to clarify unexpected responses, particularly for interval-level data on innovation expenditures. In addition, since CIS 2006, Eurostat has supported cognitive testing of all new or altered questions in the standard CIS questionnaire. The goal of cognitive testing is to ensure that each question is understood as intended, by all respondents, and that all respondents can provide a reasonably accurate answer to each question (Collins 2003; Willis 2005). These practices have improved the quality of the results for many of the CIS questions and reduced the percentage of respondents that do not answer specific questions.

However, there has arguably been insufficient research into how respondents interpret the basic concept of innovation itself. Innovation surveys based on the *Oslo Manual* (OECD/Eurostat 2005: 46) define innovation as products, processes, marketing methods or organizational methods that are, 'at the minimum, *new (or significantly improved) for the firm*'. It is often assumed that all survey respondents should understand each of the definitions of product, process, organizational and marketing innovation in the same way, even though interpretation of what is 'new or significantly improved' to the firm is subjective. Different respondent interpretations of this concept of novelty may be a source of variation in responses across countries, sectors or firm size.

A lack of data on the characteristics of innovations can produce curious and contradictory results for international comparisons. For example,

Arundel and Hollanders (2005) demonstrate the limitations of a simple interpretation of CIS results. They note that, between 1998 and 2000, 46 per cent of Portuguese firms are innovative compared to 45 per cent of Finnish firms, a questionable result given the superior innovation performance of Finland across a number of other innovation indicators, including R&D expenditures and patenting activity. Some of these problems with comparability and interpretation can be improved through better analysis, for instance by developing indicators for how firms innovate (Frenz and Lambert 2009) and by improving the design of survey questions.

National differences in how firms interpret the concept of innovation could substantially affect comparability across countries. For example, it is known that the percentage of self-reported innovative firms varies by country in unexpected ways. For instance, CIS 2008 finds that between 2005 and 2007 the percentage of innovative firms was almost twice as high in Germany (78.9 per cent) compared to the Netherlands (44.9 per cent) and the UK (45.6 per cent). Although the pre-eminence of Germany might be expected if most CIS respondents were manufacturing firms, this is not the case, with the majority of respondents drawn from the service sectors. The recent 2009 NSF survey for the USA reports a much lower percentage of product innovative firms compared to many European countries.[1] Although there are several possible causes for these differences, such as different industrial structures, an alternative possibility is national and firm size differences in how respondents interpret the concept of 'innovation'.

In 2011 and 2012, the OECD and several countries that participate in the CIS Task Force conducted cognitive testing to determine how firm managers understand the basic concept of innovation. Preliminary results from the CIS Task Force interviews show that firm managers often view an innovation as requiring substantial creative effort by the enterprise or it must substantially increase sales. Managers from large firms also tend to reject the *Oslo Manual* definition of an innovation as needing only to be new to the firm. The result is that one interviewee's example of an innovation could be considered a minor change by another respondent.

The disadvantage of cognitive testing is that it is costly and therefore feasible only for a small number of interviews. An alternative approach to cognitive testing of the concept of innovation is to combine a feature of the object-based method with innovation surveys by including an open-ended survey question on the firm's most important innovation. This can provide useful data on how firms understand innovation for hundreds or thousands of respondents. The method is particularly useful when little is known about the types of innovation that are common. For this reason, open questions have been included in several of the recent subject-based exploratory surveys on innovation in the public sector (NAO 2006; Bugge

et al. 2011). The description of the innovation can be used in several ways, for instance to determine the type of innovation that firms or public sector organizations consider their most valuable innovation or to assess the novelty of the innovation (how much creative effort was required). Once coded, this type of information can also be used to check if respondents are correctly interpreting the definitions of different types of innovations.

Open questions have been asked in several innovation surveys based on the *Oslo Manual*. A 2010 UNU-MERIT survey of national statistical offices from 32 countries that participate in the European CIS asked if they had ever included an open question on the enterprise's most important innovation in their CIS questionnaire (Arundel et al. 2010). The study also obtained similar information for Canada, New Zealand, Australia and South Africa, all of which conduct subject-based innovation surveys. National statistical offices from ten European countries responded that they had included such a question in at least one CIS survey.[2] In addition, Statistics Canada included an open-ended question on the firm's most important innovation in three innovation surveys.

Only three of these 11 countries have ever coded the responses for further analysis and of these three countries none has conducted a systematic analysis of the results. The open question has been used either as a focusing device to encourage the respondent to think of their most important innovation (Canada) or to assist the national statistical office to become acquainted with the variety of innovation activities within their country. One European country, if in doubt about the innovation status of the described innovation, would contact the enterprise for more information. Most national statistical offices do not code the results to this open question because of the high cost. As noted by a staff member from Statistics Canada, 'it takes considerable time [to code the results] . . . and analysis of this question was not a priority at the time and so resources were assigned to other activities'.[3]

In this chapter we provide the coded results of an open question on the respondent firm's most important innovation from a subject-based innovation survey in Australia. We first use the results to examine the importance of different types of innovations to the firm, and the relationship between creative effort and the firm's most important innovation. Second, we use the data to examine errors in the interpretation of the concept of innovation. The data do not provide information on differences across countries, but they do provide some clues as to how innovation can be interpreted differently across sectors and firm sizes. The results shed light on possible sources of respondent and measurement error that should help to improve innovation measurement, data quality, indicator development and related research and analysis.

2. METHODOLOGY

The data are from a 2007 Innovation Census in the Australian state of Tasmania, which had a population of 500 000 and a per capita state product of approximately €24 000 in 2006 at the time covered by the census. The Tasmanian economy is more dependent on natural resources and manufacturing than other Australian states, with proportionally fewer firms from knowledge-intensive business services. Most manufacturing firms in Tasmania can be characterized as 'low tech', but there are also several clusters of advanced manufacturing firms.

The 2007 Tasmanian Innovation Census is a subject-based innovation survey that follows the *Oslo Manual*. All 2807 Tasmanian enterprises from the business sector with five or more employees were contacted by phone and asked to answer a series of questions on their firm's innovative activities in the previous three years, using a computer-assisted telephone interview (CATI) method. One advantage is that the definitions of innovation and of different types of innovation were read aloud to all respondents, avoiding the problem of respondents not reading instructions and definitions. Many of the questions are similar or identical to the standard fourth CIS questionnaire, but the Tasmanian question on process innovation did not provide full descriptions of three types of process innovations, as in the fourth CIS. Instead, the definition is limited to 'the use of new or significantly improved methods for the production or supply of goods or services'. This may have created problems for the correct interpretation of process innovations, as discussed below.

Responses were obtained from 1591 Tasmanian firms, for a response rate of 57 per cent. A follow-up survey of non-respondents found no statistically significant differences in the rate of innovation among survey respondents and non-respondents. As the study is a census with no significant differences between respondents and non-respondents, the statistical significance of differences in the results is not calculated.

Following the CIS structure, the interview began with questions on four types of innovations introduced by the enterprise (product, process, organizational and marketing), plus a range of other questions on the firm's innovative activities, expenditures and outputs. The final interview question was open-ended and asked respondents to 'briefly describe your most important innovation in the past three years'. The responses were recorded as text by interviewers and usually consisted of one or several sentences. The question was asked of both firms that replied elsewhere in the questionnaire that they had introduced an innovation (self-reported innovators) and of firms that did not report any innovations

to other survey questions (self-reported non-innovators). The appendix provides the questions on innovation types that were used in the telephone interviews.

The open-ended text responses to the most important innovation question were analysed and coded independently by three experts and took four person-months. In order to prevent bias, the experts did not view other survey information on whether or not the firm had introduced a product, process, organizational or marketing innovation. Discrepancies in the coding were identified and discussed until a consensus was reached.

The coding assigned each most important innovation to one of five mutually exclusive innovation status categories:

1. Met the requirements for an innovation by implementing a new or significantly improved product, process, organizational or marketing method.
2. Not an innovation: the respondent stated that they had no innovations. This was most common for self-reported non-innovators.
3. Not an innovation because it was an extension of existing activities (purchase of more of the same type of equipment etc.) or the firm described something that did not meet the *Oslo Manual* definitions of an innovation.
4. Not an innovation because it was not yet on the market or in use by the firm.
5. Insufficient information was provided to determine innovation status.

If the example was an innovation, it was further classified into one of four types of innovations (product, process, organizational, marketing). These categories were not mutually exclusive. An innovation could be assigned to more than one category based on its characteristics. For example, it could be both a process and an organizational innovation.

The responses were also coded to three different levels of creative effort required by the firm to develop or implement the most important innovation: (1) mainly acquired externally or required minimal in-house effort to develop; (2) some in-house development likely; and (3) major in-house development likely. Although the amount of information provided can be used with a reasonable level of accuracy to determine innovation status, there is a much higher level of subjectivity in determining the level of creative effort required for valid innovations, largely due to the limited amount of information provided for these innovations.

Table 4.1 The innovation status of the most important innovation for self-reported innovators and non-innovators

	Self-reported innovators		Self-reported non-innovators	
	Number	%	Number	%
The most important innovation is an innovation	1028	80.8	84	**35.3**
The most important innovation is *not* an innovation	245	**19.2**	154	64.7
Total	1273	100.0	238	100.0

3. RESULTS

Among the 1591 respondent firms, 55 did not provide enough details to code and classify their responses to the open-ended question on their most important innovation[4] and 25 reported activities to develop an innovation that had not yet been implemented. These respondents were excluded from the results. This left 1511 eligible firms for analysis. Of these, 1273 were self-reported innovators and 238 were self-reported non-innovators, based on other questions in the survey.

Table 4.1 provides the distribution of innovators and non-innovators by the innovation status of their most important innovation. Of 1273 innovators, 1028 gave a description of a valid innovation in response to the question on their most important innovation, while 19.2 per cent did not. For non-innovators, 64.7 per cent stated that they did not introduce an innovation or described something that was not an innovation. Conversely, over a third, 35.3 per cent, described a valid innovation.

Table 4.2 gives the distribution of the different types of most important innovations reported by self-reported innovators and non-innovators. The results are limited to valid innovations. Fifty innovations have the characteristics of more than one innovation type, resulting in 1212 observations. Among innovators, 39.4 per cent reported a product innovation as their most important innovation. Of these, service sector innovations were more frequently reported than goods innovations (22.4 per cent versus 16.9 per cent respectively). Process innovations were the second most frequently reported most important innovation (38.0 per cent), followed by marketing methods (11.4 per cent) and organizational innovations (11.2 per cent). These results confirm the importance of including survey questions on organizational and marketing innovations, as 22.6 per cent of innovators cited one of these as their most important innovation over the previous three years.

Table 4.2 Type of most important innovation reported by innovators and non-innovators

	Innovators, number	%	Non-innovators, number	%	Total number	%
Products	442	39.4	21	23.6	463	38.2
Goods	*(190)*	*(16.9)*	*8*	*(9.0)*	*198*	*(16.3)*
Services	*(252)*	*(22.4)*	*13*	*(14.6)*	*265*	*(21.9)*
Process	427	38.0	40	44.9	467	38.5
Organizational method	126	11.2	16	18.0	142	11.7
Marketing method	128	11.4	12	13.5	140	11.6
Total	1123	100.0	89	100.0	1212	100.0

Notes: Innovators and non-innovators identified on the basis of other survey questions. The counts exceed the total number of valid innovations reported by innovators (1028) and non-innovators (84) because several most important innovations were coded to more than one innovation type, for example both an organizational method and a process, or both a product and a process innovation.

The distribution of the reported most important innovations is very different for non-innovators, who consist of firms that erroneously reported that they did *not* innovate in other closed survey questions. These firms were much less likely to report a valid product innovation as their most important innovation, but were considerably more likely to report an organizational method (18 per cent versus 11.2 per cent for innovators), and more likely to report a marketing innovation (13.5 per cent versus 11.4 per cent) or a process innovation (44.9 per cent verses 38.0 per cent). Therefore one of the main causes for error among non-innovators appears to be a perception that changes to processes, organizational or marketing methods do not count as innovations. This will lead to under-reporting of these types of innovations.

Table 4.3 gives results for the amount of creative effort required for the firm's most important innovation for innovators and non-innovators. Of interest, 59 per cent of the most important innovations reported by innovators were mainly acquired from external sources, with little creative effort required by the firm itself. Only 8 per cent were likely to require major in-house development. Conversely, a much higher percentage of the most important innovations reported by non-innovators, 82.1 per cent, were mainly acquired from external sources. This suggests that an important confusion among non-innovators over what constitutes an

Table 4.3 Distribution of most important innovations by creative effort

Creative effort required	Innovators		Non-innovators	
	Frequency	%	Frequency	%
Mainly acquired externally	607	59.0	69	82.1
Some in-house development likely	339	33.0	14	16.7
Major in-house development	82	8.0	1	1.2
Total	1028	100.0	84	100.0

Table 4.4 Creative effort required for the most important innovation by R&D status: technological innovators only

Creative effort for the most important innovation	R&D status								Total	
	No R&D		R&D but no data on R&D intensity		Low R&D intensity (< 1%)		High R&D intensity (>= 1%)			
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
Low (mainly acquired from external sources)	216	69.7	61	61.6	128	55.4	122	42.7	527	56.9
Medium (some in-house development)	82	26.5	30	30.3	81	35.1	125	43.7	318	34.3
High (major in-house development)	12	3.9	8	8.1	22	9.5	39	13.6	81	8.7
Total	310	100.0	99	100.0	231	100.0	286	100.0	926	100.0

Note: *N* = Number of MII innovators by level of creative effort and self-reported R&D status.

innovation could be due to these firms erroneously thinking that an innovation must require substantial in-house development.

Table 4.4 gives the distribution of the most important innovations by creative effort and by R&D intensity. The latter is an independent measure of each firm's creative capabilities using other innovation survey questions. The results are limited to firms that are self-reported technological innovators because the survey questions on R&D refer only to product or process innovations.[5] A higher percentage of firms that do not perform R&D report a most important innovation that was mainly

acquired from external sources. For instance, 69.7 per cent of firms that do not perform R&D gave an example of a most important innovation that was probably acquired from external sources, compared to 42.7 per cent of firms with an R&D intensity of 1 per cent or higher. Conversely, the percentage of firms that report a most important innovation that was likely to require major in-house development increases with the R&D intensity of the firm.

Interestingly, 42.5 per cent of technologically innovative firms with an R&D intensity of 1 per cent or higher reported a most important innovation that was mostly acquired from external sources. If we assume that 'most important' to the firm equates to the most economically important (the evidence from the descriptions of the most important innovation suggests that this is in fact the case), then this result indicates that the innovations of most value to the firm are not always those with the highest level of creative effort on the part of the firm. This implies that it is very important for innovation surveys to capture these 'minor' innovations.

Errors of Interpretation

The results of Table 4.1 show that respondents can make two types of error when reporting their firm's most important innovation:

1. A respondent from an innovative firm reports a most important innovation that is *not* an innovation (e.g. an activity such as a refurbishment of existing premises or an extension of existing operations).
2. A respondent from a non-innovative firm reports a most important innovation that *is* an innovation. Or, a respondent from an innovative firm reports a specific type of most important innovation (product, process, marketing, organizational), but failed to report this specific type of innovation earlier in the interview.

Both Type 1 and 2 errors indicate that the respondent did not fully understand the concept of an innovation, as defined elsewhere in the questionnaire. As shown in Table 4.1, the Type 1 error rate is 19.2 per cent. Type 1 errors do not indicate that the firm failed to innovate, since it may have introduced other varieties of valid innovations.

Type 2 errors can be made by either non-innovative or innovative firms. In the former case (Type 2a), the firm does *not* innovate based on responses to other survey questions,[6] but it reports a valid innovation in response to the question on the most important innovation. Table 4.1 gives a Type 2a error rate of 35.3 per cent. This shows that innovation surveys could be

Table 4.5 Type 2b error rates: percentage of innovators that report a most important innovation that is not reported elsewhere in the questionnaire

Innovation type	MII Innovation	MII reported but this type of innovation is not reported elsewhere	% (row)
Products	442	32	7.2
Goods	*(190)*	*26*	*13.7*
Services	*(252)*	*31*	*12.3*
Process	427	69	16.2
Organizational method	126	20	15.9
Marketing method	128	29	22.7

Note: Only innovators were included in these calculations.

significantly underestimating the true rate of innovation, since 35.3 per cent of respondents from non-innovative firms described a valid innovation in response to the question on their firm's most important innovation.

A Type 2b error occurs when a respondent from an innovative firm reports a valid most important innovation, but fails to report this variety of innovation elsewhere in the questionnaire. For instance, the respondent describes a valid product innovation as the most important innovation, but does not report a product innovation in the other closed survey questions. Table 4.5 provides the Type 2b error rate for innovative firms by the type of innovation. For example, of 442 innovative firms reporting a most important innovation that was a product, 32 (7.2 per cent) did not report a product innovation previously in the questionnaire. The results show that inaccurate reporting is lowest for product innovations such as goods or services and highest for marketing (22.7 per cent) innovations, with intermediate error rates for process (16.2 per cent) and organizational innovations (15.9 per cent). These results suggest that innovation surveys could lead to greater under-reporting of marketing, process and organizational innovations by innovators.

The error rate for products in Table 4.5 is lower than for goods and services separately, because each most important product innovation is also classified as either a good or a service. For example, a firm could report a goods innovation earlier in the questionnaire but not a services innovation. If this firm then reported a services innovation as its most important innovation, the results for services in Table 4.5 would be classified as an error. However, as both services and goods are classified as products, this would not classify as an error for product innovators, so

Table 4.6 Type 2b error rates for innovative firms by sector

	Total innovators	Most important innovation is not a valid innovation	Error rate (%)
Industry	200	32	16.0
Manufacturing	267	30	11.2
KIBS	278	36	12.9
General services	528	147	27.8
Total	1273	245	19.2

Notes:
Limited to 1273 firms that reported, in response to other survey questions, that they had introduced an innovation between 2004 and 2006.
'Industry' includes agriculture, forestry and fishing, mining, electricity, gas, water and waste services, and construction. 'KIBS' includes information, media and telecommunications, financial and insurance services, rental, hiring and real-estate services, professional, scientific and technical services, and administrative and support services. 'General services' includes all services except KIBS.

Table 4.7 Type 2b error rates for innovative firms by number of employees

	Number of innovators	Most important innovation is not a valid innovation	Error rate (%)
5–9 employees	457	111	24.3
10–19 employees	364	67	18.4
20–49 employees	267	47	17.6
50+ employees	185	20	10.8
Total	1273	245	19.2

Notes: Limited to 1273 firms that reported, in response to other survey questions, that they had introduced an innovation between 2004 and 2006. Employment is in full-time equivalents.

the error rate for product innovators in Table 4.5 is much lower. The fact that the error rate for goods and services is higher than that for products shows that some firms find it difficult to differentiate between a good and a service innovation.

Table 4.6 gives the distribution of Type 2b errors among innovative firms by sector, while Table 4.7 gives error rates by firm size. The error rate is lowest for manufacturing firms, at 11.2 per cent, and for knowledge-intensive business sector (KIBS) firms, at 12.9 per cent. The highest error rate is for general services (retail, wholesale, accommodation etc.), where 27.8 per cent of innovative firms report a most important

innovation that is not a valid innovation. These results indicate that the main survey questions on innovation are better understood by manufacturing firms than by general service sector firms. This has been a concern for innovation surveys since CIS 3, when service sector firms were added to the sample. In addition, as shown in Table 4.7, the error rate decreases with firm size, from 24.3 per cent for the smallest size class of firms (5 to 9 employees) to 10.8 per cent for firms with 50 or more employees. These results suggest that including firms with fewer than ten employees in innovation surveys will increase errors. Many surveys currently exclude these firms, though some countries such as Australia have recently widened the scope to include micro firms.[7]

Table 4.8 provides the Type 2b error rates for each type of innovation by sector, while Table 4.9 provides these results by firm size.[8] The error rate for service innovations is higher for manufacturing (15.8 per cent) and industrial firms (15.4 per cent) than for KIBS (12.7 per cent) and general services firms (11.3 per cent). Higher error rates for service innovations by manufacturing and industrial firms could be expected, as these firms focus on the production of goods and primary products. Knowledge-intensive business services and the industrial sector show the highest error rates for goods innovation (20 per cent and 19.4 per cent respectively). Industrial and manufacturing firms also have the highest error rates for marketing innovations (30 per cent and 29.2 per cent respectively), while general services has the highest error rate for organizational innovations (26.1 per cent).

The smallest error rates across sectors were for product innovation, indicating a more consistent understanding of this type of innovation. Knowledge-intensive business services have the lowest overall error rate (average across innovation types), indicating that respondents in this sector have a better understanding of the concept of innovation than respondents from other sectors.

The Type 2b error rate generally declines by firm size for product, goods, services and organizational innovations, as shown in Table 4.9. However, there is no notable trend for process or marketing innovations. Two of the largest declines in the error rate by firm size are for product and service innovations, with only 2.4 per cent of innovative firms with 50 or more employees describing a service innovation as their most important innovation failing to report service innovations elsewhere in the questionnaire. This suggests that larger firms may be more aware of these types of innovations because their relevance increases with firm size (e.g. with more product lines), with questions more often misunderstood by smaller firms.

Error rates do not show consistent differences by the categories of creative effort for the development of the most important innovation (no table

Table 4.8 Type 2b error rates for innovative firms by sector (MII = reported a most important innovation of this type)

Innovation type	Sector group											
	Industrial			Manufacturing			Knowledge-intensive business services			General services		
	MII reported	*N*	%	MII reported	*N*	%	MII reported	*N*	%	MII reported	*N*	%
Product	44	3	6.8	113	6	5.3	109	9	8.3	176	14	8.0
Goods	*31*	*6*	*19.4*	*94*	*9*	*9.6*	*30*	*6*	*20.0*	*35*	*5*	*14.3*
Services	*13*	*2*	*15.4*	*19*	*3*	*15.8*	*79*	*10*	*12.7*	*141*	*16*	*11.3*
Process	101	20	19.8	108	20	18.5	78	8	10.3	140	21	15.0
Organizational	19	2	10.5	14	2	14.3	47	4	8.5	46	12	26.1
Marketing	10	3	30.0	24	7	29.2	31	7	22.6	63	12	19.0

Note: *N* = number of firms for which an MII was reported but this type of innovation was not reported elsewhere in the questionnaire.

Table 4.9 Type 2b error rates for innovative firms by firm size (MII = reported a most important innovation of this type)

Innovation type	Firm size											
	5–9 FTE			10–19 FTE			20–49 FTE			50 + FTE		
	MII reported	*N*	%	MII reported	*N*	%	MII reported	*N*	%	MII reported	*N*	%
Product	153	14	9.2	126	11	8.7	83	5	6.0	80	2	2.5
Goods	*60*	*9*	*15.0*	*55*	*7*	*12.7*	*37*	*5*	*13.5*	*38*	*5*	*13.2*
Service	*93*	*13*	*14.0*	*71*	*12*	*16.9*	*46*	*5*	*10.9*	*42*	*1*	*2.4*
Process	132	19	14.4	123	18	14.6	104	22	21.2	68	10	14.7
Organizational	37	6	16.2	39	9	23.1	23	3	13.0	27	2	7.4
Marketing	53	10	18.9	31	8	25.8	32	8	25.0	12	3	25.0

Note: *N* = number of firms for which an MII was reported but this type of innovation was not reported elsewhere in the questionnaire.

provided). For example, the error rate for product innovations is 6.8 per cent for firms that acquired them from external sources, 7.8 per cent when some in-house development was likely and 6.7 per cent when major in-house development was likely. For process innovations, the error rates for these three categories of creative effort are 16.0 per cent, 15.9 per cent and 21.1 per cent, with the last rate based on data for only 19 firms.

4. CONCLUSION

This chapter uses a unique data source on the most important innovation reported by firms. The results are of relevance both to research on the relative importance of different types of innovation and for how survey respondents interpret the concept of 'innovation'.

For all respondents, approximately 38 per cent reported that a product or process innovation was their firm's most important innovation, while 11.7 per cent reported that their most important innovation was an organizational method and 11.6 per cent a marketing method. This supports the inclusion of questions on these types of non-technological innovations in innovation surveys, which has been the subject of ongoing debate. The value of process innovations to firms suggests that a lack of questions on the outputs of process innovation is an important limitation of innovation surveys.

Of interest, 59 per cent of respondents from innovative firms reported that their most important innovation was mainly acquired externally, with little creative effort required by their firm. Furthermore, 42.7 per cent of technological innovators with a high creative capacity (as measured by an R&D intensity of 1 per cent or higher) reported that their most important innovation needed little creative effort by their firm. These results highlight the value of using a broad definition of innovation that includes 'minimal' innovations, rather than focusing only on innovations that require substantial creative effort.

An unexpected result was the high percentage of self-reported non-innovators, 35.3 per cent, that described a valid innovation in an open question. This suggests that innovation surveys could fail to correctly identify a substantial number of innovative firms. In addition, a notable share of respondents for innovative firms report a type of most important innovation that was not reported earlier in the interview. These errors appear to be caused by two factors. First, self-reported non-innovators could fail to correctly understand the questions on specific types of innovations or they could erroneously assume that in-house creative effort is required in order to be an innovator. This could be partly due to the

problem, in all *Oslo Manual* innovation surveys, of defining an innovation as either new or 'significantly improved'. The highly subjective aspect of this definition could be leading to inconsistent responses.

Second, the results show that many innovative firms do not have a clear understanding of the definitions for specific types of innovation, particularly for non-technical marketing and organizational innovations. These problems are greatest among smaller firms, with respondents from larger firms having a better understanding of innovation. Innovative firms active in KIBS have the best understanding of the concept of innovation. However, a higher percentage of innovative firms that are active in industrial and general services sectors misunderstand differences in innovation types. Organizational innovation is misunderstood the most in general services, while marketing innovation is less well understood by firms in industrial sectors. Conversely, product innovations are relatively well understood by all types of firms, although there is some confusion over the difference between a good and services innovation for industrial firms and services innovations are least understood by firms in manufacturing.

The higher error rate for process compared to product innovations could partly be due to the short definition of a process innovation used in the Tasmanian Census. The more extensive definition of process innovations that was introduced in the fourth CIS questionnaire could reduce possible error rates.

These results have important implications for survey design and indicator interpretation. They suggest that careful attention needs to be given to the design of innovation survey questions on marketing, organizational and process innovations. Many firms might be misinterpreting the required level of novelty for an innovation, so the concept of 'new to the firm' needs to be carefully explained. If possible, it may be better to remove 'significant' from the definition of an innovation, and include other measures for capturing the creative effort expended by firms.

In addition, the results suggest that standard survey questions might be inadequate for capturing innovation in general services or industrial (low-tech) sectors, which showed higher error rates. A possible solution is to develop different question modules for specific sectors or for smaller firms, although this option faces practical constraints for the administration of large surveys.

With respect to international comparability, limiting the analysis to indicators with low error rates could provide a more accurate benchmark. For instance, a benchmark indicator could rely on product innovation rates among larger firms in the manufacturing sector, as these enterprises had the lowest error rates in our study.

In conclusion, this chapter demonstrates the value of including an open-

ended question on the firm's most important innovation in innovation surveys. The results both provide valuable information on the types of innovations that firms find of value as well as data that can improve indicator reliability and usage. For larger surveys, this type of analysis could be limited to a sub-sample to reduce the time required to code textual information.

NOTES

1. See Boroush (2010). In the NSF BRDIS survey, covering activities between 2006 and 2008 inclusive, only 9 per cent of all companies with five or more employees reported a product innovation, although the percentage is higher for manufacturing companies, at 22 per cent. One explanation for the low percentage of innovators is because BRDIS includes firms with 5–9 employees, while the CIS only covers enterprises with 10 or more employees. However, it would be surprising if this were the only cause of the difference. The closest comparison group with the CIS is for SMEs with between 10 and 49 employees. Using the CIS 2008, 19.8 per cent of all German firms with 10 to 49 employees were product innovators.
2. Results of the November 2010 MERIT survey of 32 European NSOs.
3. Personal communication from Susan Schaan, Statistics Canada, in an email dated 13 April 2010.
4. This was most common for service sector firms, who would give an answer such as 'general improvement in quality of services'.
5. Technological innovators include all firms that reported implementing a new or significantly improved product (good/service) or process in the closed innovation survey questions. R&D intensity is calculated as 2005/2006 expenditure on R&D as the percentage of 2005/2006 turnover.
6. They did not report the introduction of any new or significantly improved product, process, organizational or marketing innovation over the survey period.
7. Since 2006–2007 the national innovation survey in Australia has included very small firms with zero or more employees, and debate has been ongoing regarding expanding the CIS scope to include firms with fewer than 10 employees.
8. Due to small counts, we do not provide the error rates by industry groups or firm size for non-innovators.

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APPENDIX: TASMANIAN INNOVATION CENSUS 2007 QUESTIONS ON TYPES OF INNOVATION

The Next Section is about New or Improved Goods or Services at [Business Name]

When we say that, we are talking about the market introduction of a good or service that is new or significantly improved.

That could mean that the good or service is completely new and different to goods or services previously produced by the enterprise.

That can also mean that the good or service is significantly improved in terms of quality, functions or intended uses; or significantly improved through changes in materials, components, design, or other characteristics that enhance performance.

For example, we would exclude superficial changes (such as new colours or patterns on a label), but include new packaging that improves shelf-life, or reduces costs.

The new good or service does not need to be new to your market, only to your enterprise, and it does not matter if the new good or service was originally developed by your enterprise, or by other enterprises.

We don't include the simple resale of new goods purchased from other enterprises.

Q4. During the past three calendar years, 2004, 2005 and 2006, did your enterprise introduce:

	Yes	No
a. New or significantly improved goods	❑	❑
b. New or significantly improved services	❑	❑

The Next Section is about Process Change

*A New Process is the use of new or significantly improved **methods** for the production or supply of goods and services. Purely organizational or managerial changes should not be included – these will be covered shortly.*

The new process must be new to your enterprise, but it does not need to be new to your industry. Again, it does not matter if the new process was originally developed by your enterprise or by other enterprises.

Q8a. During the three calendar years 2004 to 2006, did your enterprise introduce any new or improved processes for producing or supplying goods or services?

Yes ❑
No ❑ ⟶ Question 9

Organizational and Marketing Changes

In this next section we ask about new forms of organization, business structures or practices aimed at improving efficiency, or new approaches to markets and customers. The question asks for a 'yes' or 'no' response to a number of answer categories.

Q21. During the three calendar years 2004 to 2006, did your enterprise make major changes in the following areas of business structure and practices?

Please cross one box for each category

	Yes	No
a. Implementation of a new or significantly changed **corporate strategy**	❑	❑
b. Implementation of **advanced management techniques** within your enterprise, e.g. knowledge management systems	❑	❑
c. Implementation of major changes to your **organizational structure**, e.g. introduction of cross-functional teams, outsourcing of major business functions.	❑	❑
d. Implementation of changes in **marketing concepts or strategies** *(e.g. packaging or presentational changes to a product to target new markets, or new activities to open up new markets)*	❑	❑