

Online appendices (A – D)

The Effect of Business Improvement Methods on Innovation in SMEs in Peripheral Regions

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Abstract

We test whether commonly used business improvement methods (BIM) foster or inhibit innovation in SME's in peripheral regions. Our findings show that adopting BIM diverts firms away from successful innovation (i.e., in terms of new products/services and new processes in the past three years), and instead is associated with undertaking innovation-related activities while remaining non-innovators. Indeed reinforcing BIM (through greater 'depth' of use) may lead to further exclusion from successful innovation.

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Appendix A. Other determinants of innovation activities

Other determinants of whether the firm commits relevant resources (e.g., R&D) with the aim of producing innovation outputs include the following:¹ the size (and/or age) of the firm; technological opportunity; (knowledge) spillovers from other firms in the same and/or other industries, which can be linked to the wider importance of absorptive capacity (since it involves internalising external knowledge); markets served, especially through exporting; ownership characteristics (such as whether the firm is family-owned or foreign owned); and such factors as culture in the firm, the role of strategy, and lifecycle effects.

Larger firms may have an innovation advantage due to economies-of-scale and scope, access to finance (cf. Fisher and Temin, 1973; Cohen and Klepper, 1996; Legge 2000), and being better placed to internalise R&D spillovers due to product diversification (see Cohen *et. al.*, 1987; Acs and Audretsch, 1991; and Almeida *et. al.*, 2003, from a learning perspective; also Lichtenberg and Siegel, 1991; Cohen, 1995; Legge, 2000; Henderson and Cockburn, 1996, for empirical evidence). Larger firms may also be more able to exploit complementarities between R&D and other business functions (Cohen, 1995).² For example, early theoretical work was particularly concerned with how productivity was related to size, the learning-by-doing effect associated with the age of the firm, and thus the likelihood of survival (cf. Jovanovic, 1982; Pakes and Ericson, 1998).³ Learning-by-doing models have been extended to include the investments of individual firms (particularly on intangible assets – cf. Griliches, 1981) to allow for ‘active learning’. According to resource-based theories⁴, firms that invest in intangible assets, such as R&D, and consequently increase their specific internal capabilities and ability to absorb external knowledge, are more likely to increase their competitiveness.⁵ Aw *et. al.* (2011) also allow firms to generate (external) knowledge through participating in new (e.g., export) markets, so that the evolution of firm productivity over time is determined by past productivity as well as investments in such knowledge acquiring activities as undertaking R&D (and exporting). Path-dependency is therefore an important theme of this type of approach; competitive advantage is dependent on accumulated firm-specific resources and production capabilities that have been (often slowly) developed over time and which cannot easily be acquired, replicated, diffused, or copied – they therefore cannot easily be transferred or built-up outside the firm (Nelson and Winter, 1982; Pavitt, 1984; David, 1985; Arthur, 1989; Teece and Pisano, 1998; Dosi *et. al.*, 2000). Roper and Hewitt-Dundas (2008) present evidence that innovation persistence – presumably linked to accumulated capabilities – was a feature of firms in Ireland (north and south). Thus overall there is a need to take account of internal and external knowledge creation, including its obsolescence (as represented by the age of the plant).

Technological opportunity is usually proxied by industry structure (e.g., Jaffe, 1986;

¹ E.g. see Shefer and Frenkel (2005).

² The literature has also provided examples where small firms may be at an advantage, such as through exploiting behavioral (rather than material) advantages (Rothwell and Dodgson, 1994) such that the more rapid decision-making and better focus of smaller firms may be more important (Acs and Audretsch, 1990).

³ Thus age and innovativeness are positively related, as the stock of knowledge and competences improves (e.g., Nelson, 1991); but they might also be negatively related if aging leads to internal rigidities within the firm (Sorensen and Stuart, 2000).

⁴ The resource-based view (RBV) of the firm was initially put forth by Penrose (1959), and subsequently developed by Wernerfelt (1984) and Barney (1991, 2001). The thrust of this viewpoint lies in the established assumption that ‘better’ firms possess intangible productive assets that they are able to exploit to derive competitive advantages. See also footnote 4.

⁵ Roper *et al.* (2013) found that firms in Ireland (north and south) had better innovation outcomes if they engaged in absorbing external knowledge.

Klevorick *et. al.*, 1995)⁶. As alluded to above, the impact of exporting on R&D/innovation is traditionally justified by a ‘learning-by-exporting’ effect (e.g., Aw *et. al.*, 2011, p. 1317). Firms that operate in more competitive export markets, and thus have access to (and knowledge of) these markets comprising better technologies and/or higher quality products, can obtain an additional (current and future) productivity benefit if they can internalise this additional knowledge and expertise (i.e., exporters may benefit from the technology of their customers). Direct information on technical and product development is often provided by customers and suppliers (Salomon and Shaver, 2005; Clerides *et. al.* 1998) that can stimulate the firm’s own innovation outputs. The probability of undertaking R&D is also likely to be boosted by exporting because it is necessary to increase the capacity of the firm to absorb the useful knowledge obtained from exporting.

The inclusion of foreign ownership is justified by the observation that, to make it worthwhile for a foreign firm to incur the costs of setting up or acquiring a plant in the domestic market, foreign firms must possess characteristics that give them a cost advantage over domestic firms (Hymer, 1976). These characteristics may include specialised knowledge about production and better management or marketing capabilities, both of which would lead to higher productivity and thus a higher propensity to undertake innovation-related investments. It should be noted that, in the long-run, some of these advantages may dissipate as domestically owned firms learn to imitate the foreign firms as a result of knowledge spillovers (Harris and Robinson, 2003); the speed at which this process occurs will be dependent upon levels of absorptive capacity in the domestic firms. Furthermore, firms may undertake FDI to source technology from the host economy rather than to exploit superior technology from the home country (Driffield and Love, 2007). Plants owned by foreign owned firms that are motivated by technology sourcing rather than technology exploiting are likely to have lower productivity than plants owned by foreign owned that are technology exploiting (Fosfuri and Motta, 1999; Cantwell *et al.*, 2004; Driffield and Love, 2007). Foreign-owned plants may also be expected to have lower levels of TFP if foreign-owned firms tend to keep their high value production at home and leave lower value added assembly operation to their foreign subsidiaries (Doms and Jensen, 1998). The latter will tend to employ lower-skilled workers and older technologies. This phenomenon may be especially problematic in peripheral regions as this is where multinationals often place low value added ‘branch plant’ activities (Harris, 1991). It is therefore not clear from the literature whether foreign owned plants should be expected to have higher or lower TFP than domestically owned plants, and thus a higher propensity to undertake innovation-related investments.⁷

As to the implications for innovation of whether the firm is family-owned, there are theoretical arguments as to why family-owned firms should act differently (i.e. have different governance arrangements and different management practices); these generally appeal to agency relationships and the associated costs that arise when owners (who are also engaged in the management of the company) face the moral hazard problem of how to engender a higher level of worker output (Chami, 2001). According to agency theory, owner-management should minimise agency costs, because ownership aligns managers’ attitudes towards growth opportunities and risk, so there is much less need to reach, monitor and enforce agreements between owners and managers (Jensen, 1998). However, the extant literature on family-owned firms tends to reach the opposite conclusion, by providing

⁶ Cohen *et. al.* (1987) found that sector dummy variables explained half the variance in R&D intensity in their data; Geroski (1990) found that at least 60% of the variation in R&D could be explained by industry effects.

⁷ Love *et. al.* (2009) found “... support for the view that innovators and non-innovators have different profitability determinants, and that the profitability of externally-owned plants depends on very different factors to those of indigenously-owned enterprises” (p.424).

evidence that such firms often use governance procedures and adopt practices that would seem to act as barriers to growth. This has led to the extension of agency theory to incorporate altruism when looking at family-owned firms. Inter alia, altruism (towards members of the family) is likely to lead to a more general paternalistic approach to the workforce employed in the company; i.e., there is the likelihood that in family-owned businesses paternalistic behaviour reinforces and is reinforced by a high degree of altruism on the part of family members, and this will mean that the firm does not necessarily seek to just increase efficiency but is also concerned with equity issues (i.e. employees are 'looked-after' and treated fairly in return for their loyalty and effort). As shown in Chami (2001) when trust between owner, non-family managers, and the workforce is low and/or altruism is asymmetric, the agency problem in the family-owned business is exacerbated and often interferes with the survival of the family business. Thus, family-owned establishments are likely to take a different approach to employee involvement (EI) practices (e.g. with respect to consultation and communication) and indeed other HRM strategies related to worker effort, as well as their involvement in R&D, innovative activities and workplace change more generally. There is little empirical evidence in this area, although Zinger and Mount (1993) found that such firms do not see new products and services as a key concern. Moreover, Tanewski *et. al.* (2003) also found using Australian data that family-owned firms were less innovative, emphasised industry leadership less, but had a greater prospecting orientation than non family-owned firms. For Great Britain, Harris and Reid (2008) found that family-owned plants belonging to SME's were less likely to have formal strategic plans which set out objectives and how they will be achieved; they were less likely to service international destinations as their main market for sales; they were less likely to acquire the quality standards BS5750 or ISO9000; and most importantly for the present study, family-owned firms were less likely to be involved with product or process innovations.

With regard to the role of 'culture', essentially an argument can be made from the literature that a more open and inclusive SME culture is associated with more radical forms of innovation. Wilson and Stokes (2006) describe innovation as a "fundamentally social process" which is based on people and culture within the organisation. Thus, people and culture based constructs are identified as being key organisational aspects of innovation implementation that can promote or hinder innovation efforts (e.g. Hyland and Beckett, 2005; Voss, 1998; Schmidt, 1990). Indeed, Ghobadian and Gallear (1997) state: "SMEs are more likely to be people-orientated than system orientated". Verbees and Meulenber (2004) found that the organisations' people and culture, along with its leadership, must be one of "openness" where innovation is recognised as a legitimate organisational value (McAdam, 2004). Thus a culture of innate flexibility and responsiveness to environmental changes within SMEs is likely to foster innovation beyond that of continuous improvement, processes and products (Naveh and Erez, 2004). A team-based culture in SMEs should promote empowerment amongst the SME workforce (Davenport and Bibby, 1999) and effective two-way communications (Ghobadian and Gallear, 1997) to develop innovative ideas from employees. Thus in general, culture is based on the ethos of team work at all levels in the SMEs (Pearce and Ensley, 2004; McAdam et al, 2010), a proactive change culture (Hyland and Beckett, 2005); effective two way communication between managers and staff at all levels (Verbees and Meulenber, 2004); a clear organisational structure to support the culture; and clearly defined roles and responsibilities (Wan et. al., 2005). We have endeavoured to capture as many of these factors as possible below in our empirical analysis.

A number of studies have suggested that the lifecycle stage of an SME is likely to have a significant effect on innovation implementation (Oke et al, 2007; Cope and Watts, 2000). Different stages (cf. the models of Churchill and Lewis, 1983, and Moy and Luk, 2003)

reflect growth and the availability of resources, and thus the ability to innovate (Vossen, 1999). In the earliest stage I (existence) the main problems of the business is obtaining customers and delivering the product or service. As the firm moves through stage II (survival), stage III (success), stage IV (take-off) to stage V (resource maturity) innovation implementation is likely to become more imbedded (Mohannak, 2007). Lifecycle (and also cultural) effects are also linked to the strategic approach taken by the firm (Miles and Snow, 1978), which determines its approach to innovation (Johnston and Pongatichat, 2008).

Appendix B. Robustness checks allowing for selection effects

The model estimated above includes all the observations available in the dataset. However, if firms that use BIM have characteristics that make them on average more/less likely to achieve different innovation-related outcomes, then our measurement of the BIM-innovation relationship may be biased due to selection effects (see, for example, Moffitt, 2004; Heckman, 2000; Heckman and Navarro-Lozano, 2004; and especially Imbens and Wooldridge, 2009, for a discussion and practical approaches that can be taken) – such firms would be predicated towards achieving the innovation-related outcome observed, even if they do not use BIM. The typical solution to this problem of selection is to use ‘matching’, whereby ‘untreated’ firms which do not use BIM are matched on their characteristics to the ‘treated’ group (those that use BIM), to as far as possible (given the limitations of the dataset available) create a control group that has (very) similar characteristics to the treated group of firms. Thus, any difference between the treated and control sub-groups of firms, in terms of the impact of BIM on innovation-related activities, should not be contaminated by selection effects.

We use a probit model of the determinants of which firms use BIM, to compute propensity scores which are then used by the PSMATCH2 algorithm in STATA to create ‘treated’ and ‘control’ sub-groups. We use one-to-one matching, without replacement, and limit the two sub-groups to have ‘common support’ (i.e., we drop members of the ‘treated’ group that have propensity scores higher/lower than the maximum/minimum values for the ‘control’ group). The result is that we lose 110 firms from the sub-group of ‘untreated’ firms that cannot be matched into the control sub-group.⁸ The results obtained when limited to observations contained in the ‘treatment’ and ‘control’ sub-groups are provided in Table B.2 confirming our findings above with regard to the impact of BIM on innovation outcomes, including any regional differences. For the latter, there remains some evidence that SMEs in the Republic of Ireland with greater ‘depth’ are more likely to be successful rather than unsuccessful innovators. There is also some indication that SME’s in Northern Ireland with greater depth of BIM are more likely to be in the ‘not engaged in innovation’ sub-group, rather than be unsuccessful innovators. It would seem, based on the ‘matched’ data, that greater involvement in BIM detracts from product and process innovation to a much greater extent in Northern Ireland, which given that it is often rated lowest in terms of innovation (see Harris and Trainor, 2011) is a concern.

Finally, as a further check we have also estimated two simple probit models where the dependent variable includes successful innovators versus unsuccessful innovators (those not engaged in innovation activities are dropped) in the first model; and unsuccessful innovators versus those not engaged in innovation activities in the second model. Both models were estimated using all firms comprising the sub-groups included, as well as models where ‘matching’ had also been used. The results are provided in Table B.3, again confirming our overall findings.

⁸ We use the procedure PSTEST to check if the means of the variables determining whether firms use BIM differ between ‘treated’ firms and those in the ‘control group’. We find that in all cases differences are reduced significantly to the extent that t-tests of differences across means values indicate that for all variables there is no statistically significant difference when comparing ‘treated’ and ‘control group’ firms (whereas there were differences before applying ‘matching’). The results from the PSTEST procedure are available in Table B.1).

Appendix C. Factor analysis

The results from the various factor analyses to obtain the principal component factors listed in Table 1 (of the main text) are provided here.

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Table B.1: PSTEST results from ‘matching’ procedure

Variable	Unmatched	Treated	Mean	% bias	% reduction	t	t-test
	Matched		Control		bias		p> t
Scotland	U	0.316	0.368	-11.0		-1.4	0.178
	M	0.352	0.352	0.0	100	0.0	1.000
N. Ireland	U	0.319	0.343	-5.1		-0.6	0.535
	M	0.338	0.338	0.0	100	0.0	1.000
Employs 16-27	U	0.185	0.199	-3.3		-0.4	0.683
	M	0.215	0.215	0.0	100	0.0	1.000
Employs 28-55	U	0.249	0.155	23.5		2.9	0.004
	M	0.228	0.228	0.0	100	0.0	1.000
Employs 56+	U	0.231	0.144	22.3		2.7	0.007
	M	0.160	0.160	0.0	100	0.0	1.000
Mining and quarrying except energy materials	U	0.006	0.014	-8.3		-1.0	0.301
	M	0.000	0.000	0.0	100	.	.
Manufacture of textiles and textile products	U	0.033	0.036	-1.5		-0.2	0.858
	M	0.009	0.009	0.0	100	0.0	1.000
Manufacture of wood and wood products	U	0.073	0.087	-5.0		-0.6	0.535
	M	0.064	0.064	0.0	100	0.0	1.000
Manufacture of pulp paper and paper products; publishing and printing	U	0.024	0.040	-8.7		-1.1	0.279
	M	0.005	0.005	0.0	100	0.0	1.000
Manufacturing n.e.c	U	0.116	0.141	-7.6		-0.9	0.353
	M	0.055	0.055	0.0	100	0.0	1.000
Education	U	0.009	0.004	6.9		0.8	0.405
	M	0.000	0.000	0.0	100	.	.
Health & social care	U	0.030	0.004	20.8		2.5	0.014
	M	0.000	0.000	0.0	100	.	.
Culture – strong team and communication	U	0.031	-0.037	6.8		0.8	0.402
	M	0.018	0.025	-0.6	90.6	-0.1	0.935
Knowledge acquired from outside bodies	U	0.096	0.114	-21.1		-2.6	0.010
	M	0.023	0.085	-10.9	48.6	-1.2	0.237
Lifecycle - survival dominates	U	-0.059	0.070	-13.0		-1.6	0.112
	M	0.095	-0.037	-5.8	55.7	-0.7	0.504
% local sales	U	53.130	57.755	-12.7		-1.6	0.120
	M	54.593	56.264	-4.6	63.9	-0.5	0.625

TABLE B.2 Marginal Effects From Various Multinomial Logit Models Of Innovativeness (based on ‘matched’ sample of 496 observations)

Variables	Successful innovator		Unsuccessful innovator		Not engaged in innovation activities		\bar{X}
	$\partial p / \partial x$	z-value	$\partial p / \partial x$	z-value	$\partial p / \partial x$	z-value	
<i>Baseline model</i>							
BIM – in place 2+ years	-0.048	-0.86	0.157	2.44	-0.109	-2.92	0.442
<i>Preferred model (Table 2)</i>							
BIM – in place 2+ years	-0.010	-0.25	0.103	2.02	-0.093	-1.67	0.442
BIM – in place 2+ years × Depth of BIM	-0.066	-2.15	0.109	2.60	-0.043	-0.82	0.249
<i>Moderated by absorptive capacity</i>							
BIM – in place 2+ years	-0.055	-1.00	0.184	4.03	-0.129	-2.65	0.442
BIM – in place 2+ years × Strong internalisation of external knowledge	0.071	1.22	0.048	1.08	-0.119	-2.29	0.022
<i>Moderated by culture</i>							
BIM – in place 2+ years	-0.055	-1.00	0.168	3.77	-0.113	-2.35	0.442
BIM – in place 2+ years × Culture - strong team and communication	0.049	0.80	-0.010	-0.22	-0.039	-0.67	0.008
<i>Limiting BIM to TQM</i>							
TQM – in place 2+ years	-0.134	-2.16	0.165	2.77	-0.030	-0.52	0.204
<i>Limiting BIM to Continuous Improvement</i>							
CI – in place 2+ years	-0.088	-1.50	0.229	4.30	-0.141	-2.86	0.280
<i>Moderated by location</i>							
BIM – in place 2+ years	-0.007	-0.07	0.140	1.98	-0.157	-2.04	0.442
BIM – in place 2+ years × located in Northern Ireland	-0.121	-0.98	0.110	1.89	0.061	0.54	0.149
BIM – in place 2+ years × located in Republic of Ireland	-0.022	-0.16	-0.031	-0.31	0.097	0.81	0.137
<i>Moderated by location</i>							
BIM – in place 2+ years	-0.033	-0.49	0.134	2.54	-0.101	-1.73	0.442
BIM – in place 2+ years × Depth of BIM	-0.106	-1.32	0.200	3.46	-0.094	-1.24	0.249
BIM – in place 2+ years × Depth of BIM × located in Northern Ireland	-0.006	-0.05	-0.171	-1.98	0.176	1.60	0.094
BIM – in place 2+ years × Depth of BIM × located in RoI	0.218	1.78	-0.209	-2.30	-0.008	-0.07	0.105

Table B.3 Marginal Effects for BIM Variables Based on Preferred Model Of Innovativeness (based on full and 'matched' samples of observations)

Variables	Successful versus unsuccessful innovator		Unsuccessful innovator versus not engaged in innovation	
	$\hat{\partial p} / \partial x$	z-value	$\hat{\partial p} / \partial x$	z-value
<i>Full sample</i>				
BIM – in place 2+ years	-0.098	-1.77	0.171	2.65
BIM – in place 2+ years × Depth of BIM	-0.059	-1.36	0.082	1.47
N	408		336	
<i>Matched sample</i>				
BIM – in place 2+ years	-0.140	-2.43	0.167	2.46
BIM – in place 2+ years × Depth of BIM	0.070	1.94	0.098	1.63
N	323		312	

Table C1: Structure matrix of factor loadings: correlations between variables and rotated common factors: Lifecycle issues^a

Input Variables ^b	<u>Factor 1:</u> Expansion issues dominate	<u>Factor 2:</u> Survival dominates	Uniqueness	Kaiser- Meyer-Olkin Measures
The main problems of the business are obtaining customers and delivering the product or service.	0.209	0.778	0.351	0.471
The Company has now developed with sufficient customers and satisfies them sufficiently with its products or services.	0.213	-0.700	0.464	0.533
The decision facing owners at this stage is whether to expand or to keep the company stable and profitable, providing a base for alternative owner activities.	0.656	0.122	0.555	0.574
The key problems facing the company are how to grow rapidly and how to finance the growth.	0.645	-0.037	0.583	0.569
The challenges are to consolidate and control the financial gains brought on by rapid growth and to retain the advantages of small size, including flexibility.	0.781	-0.115	0.377	0.549
			Overall =	0.553

^a Factors extracted using principal-component method (all factors with eigenvalues > 1), then rotated using orthogonal varimax technique.

^b Respondents were asked to strongly agree (coded 2), agree (coded 1), neutral (coded 0), disagree (coded -1) or strongly disagree (coded -2) with each statement.

Table C.2: Structure matrix of factor loadings: correlations between variables and rotated common factors: Strategic focus^a

Input Variables ^b	<u>Factor 1:</u> narrow products & seldom adjusts	<u>Factor 2:</u> continual search to be better	Uniqueness	Kaiser- Meyer-Olkin Measures
The company has a narrow range of products and markets.	0.774	0.001	0.401	0.556
The company continually searches for new market opportunities.	-0.228	0.724	0.423	0.549
The company watch their competitors closely for new ideas, and then rapidly adopt those which appear to be the most promising.	0.089	0.822	0.317	0.533
The organisation seldom makes adjustments of any sort until forced to do so by environmental pressures.	0.775	-0.121	0.384	0.540
			Overall =	0.545

^a Factors extracted using principal-component method (all factors with eigenvalues > 1), then rotated using orthogonal varimax technique.

^b Respondents were asked to strongly agree (coded 2), agree (coded 1), neutral (coded 0), disagree (coded -1) or strongly disagree (coded -2) with each statement.

Table C.3: Structure matrix of factor loadings: correlations between variables and common factors: Leadership^a

Input Variables ^b	<u>Factor 1:</u> proactive for change	Uniqueness	Kaiser- Meyer-Olkin Measures
The senior management team makes a point of “being seen” around the organisation	0.491	0.759	0.866
Management fosters creative thinking and innovation in the company	0.718	0.484	0.850
Our top managers like to try new ways of doing things	0.751	0.437	0.850
Management spend adequate time planning change	0.706	0.502	0.843
If the company is performing well, change is still a priority	0.675	0.545	0.897
The organization is working to a clear business plan	0.624	0.610	0.888
Management encourages everyone in the organization to come up with new ideas.	0.718	0.485	0.895
The management team take time to think constructively/creatively about the future	0.775	0.400	0.865
		Overall =	0.867

^a Factors extracted using principal-component method (all factors with eigenvalues > 1)

^b Respondents were asked to strongly agree (coded 2), agree (coded 1), neutral (coded 0), disagree (coded -1) or strongly disagree (coded -2) with each statement.

Table C.4: Structure matrix of factor loadings: correlations between variables and rotated common factors: Culture^a

Input Variables ^b	<u>Factor 1:</u> strong team and communication	<u>Factor 2:</u> good HRM	Uniqueness	Kaiser-Meyer-Olkin Measures
There is a strong team spirit at all levels of the organisation	0.704	0.278	0.428	0.911
The culture in this organization promotes change	0.687	0.198	0.489	0.839
Two way communication happens at all levels of the organisation	0.730	0.306	0.373	0.930
There is a clear organisational structure which everyone understands	0.626	0.459	0.398	0.888
There are clearly defined roles and responsibilities	0.557	0.507	0.433	0.885
The structure of the organization facilitates change	0.699	0.294	0.425	0.898
The organization is not bureaucratic	0.645	0.003	0.584	0.933
There is a feeling of openness in this organization	0.667	0.339	0.441	0.902
Overall, employees have access to all the resources needed to get the job done	0.503	0.409	0.580	0.946
Employees are involved in setting and agreeing performance targets	0.091	0.794	0.361	0.917
Everyone in the company has a good grasp off how the organization is performing	0.264	0.764	0.347	0.902
Employees get useful feedback about their work	0.326	0.741	0.345	0.917
			Overall =	0.903

^a Factors extracted using principal-component method (all factors with eigenvalues > 1), then rotated using orthogonal varimax technique.

^b Respondents were asked to strongly agree (coded 2), agree (coded 1), neutral (coded 0), disagree (coded -1) or strongly disagree (coded -2) with each statement.

Table C.5: Structure matrix of factor loadings: correlations between variables and common factors: Business Improvement methods^a

Input Variables ^b	<u>Factor 1:</u>		Kaiser-Meyer-Olkin Measures
	BIM depth	Uniqueness	
The organisation has a formal/informal total quality – continuous improvement programme	0.756	0.429	0.990
Responsibilities for the TQ/CI programme are clearly defined	0.964	0.071	0.941
The TQ/CI programme has clear goals, objectives and measures of success	0.968	0.063	0.936
Successful TQ/CI problem solving teams are spread throughout the organisation	0.928	0.138	0.968
The programme is adequately resourced	0.941	0.116	0.968
There is a clearly defined reward and recognition scheme for TQ/CI activity	0.891	0.207	0.979
Greater than 50% of the workforce are involved in TQ/CI	0.894	0.200	0.982
The TQ/CI programme is used to improve processes	0.964	0.071	0.918
A number of quality improvements have been achieved from the programme	0.964	0.072	0.912
		Overall =	0.951

^a Factors extracted using principal-component method (all factors with eigenvalues > 1)

^b Respondents were asked to strongly agree (coded 2), agree (coded 1), neutral (coded 0), disagree (coded -1) or strongly disagree (coded -2) with each statement.

Table C.6: Structure matrix of factor loadings: correlations between variables and common factors: Knowledge incorporation^a

Input Variables ^b	<u>Factor 1:</u>		Kaiser-Meyer-Olkin Measures
	Strong internal knowledge	Uniqueness	
Everyone is in possession of the information/ knowledge necessary to do their job	0.700	0.511	0.929
Knowledge that employees hold in their heads (i.e. tacit knowledge) is managed and captured effectively	0.764	0.417	0.928
Efforts are made to share information/knowledge across the organization	0.797	0.364	0.930
Lessons learned from daily experiences and projects are captured and disseminated	0.861	0.258	0.890
New information/knowledge is effectively incorporated within the processes and routines within the organization	0.873	0.237	0.868
Active management of information/knowledge produces a range of business benefits	0.866	0.250	0.879
		Overall =	0.899

^a Factors extracted using principal-component method (all factors with eigenvalues > 1)

^b Respondents were asked to strongly agree (coded 2), agree (coded 1), neutral (coded 0), disagree (coded -1) or strongly disagree (coded -2) with each statement.

Table C.7: Structure matrix of factor loadings: correlations between variables and rotated common factors: Knowledge acquisition^a

Input Variables ^b	<u>Factor 1:</u>	<u>Factor 2:</u>	Uniqueness	Kaiser-Meyer-Olkin Measures
	Strong internalisation of external knowledge	Knowledge acquired from outside bodies		
We conduct frequent market research so that we are aware of customer needs	0.574	0.195	0.633	0.735
Licensing is a method we often use to obtain information/knowledge or technology	0.684	-0.052	0.529	0.736
We have developed new products/services and/or processes in collaboration with other firms	0.601	0.145	0.618	0.748
We are well aware of the information/knowledge and technologies being developed by our competitors	0.642	0.069	0.584	0.730
We have become an information/knowledge or technology supplier to other firms in the sector	0.516	0.486	0.498	0.746
We usually go to outside private sector bodies (e.g. consultants) to find out about fresh opportunities for introducing new products/services	0.106	0.848	0.269	0.664
We usually go to outside public sector bodies (e.g. universities) to find out about fresh opportunities for introducing new products/services	0.062	0.867	0.244	0.633
			Overall =	0.702

^a Factors extracted using principal-component method (all factors with eigenvalues > 1), then rotated using orthogonal varimax technique.

^b Respondents were asked to strongly agree (coded 2), agree (coded 1), neutral (coded 0), disagree (coded -1) or strongly disagree (coded -2) with each statement.

Table C.8: Structure matrix of factor loadings: correlations between variables and common factors: Linkages^a

Input Variables ^b	Factor 1:		Kaiser-Meyer-Olkin Measures
	Strong networking capabilities	Uniqueness	
Sufficient resources are allocated to support network activities with other organisations and collaborators	0.808	0.348	0.941
The organisation uses a range of activities and mechanisms to initiate new relationships with other organisations	0.875	0.235	0.917
Information is freely exchanged across other organisational partners in networks	0.858	0.264	0.936
Network activities are systematically linked to organisation plans	0.869	0.245	0.940
Where appropriate the company adapts its activities to fit with the needs of specific networks	0.878	0.229	0.950
Relationships between employees and those of other organisations in networks are carefully managed.	0.880	0.226	0.952
The company has performance measures to measure the effectiveness of networks with other organisations	0.833	0.305	0.885
Company employees receive sufficient training in network relationship management	0.843	0.289	0.894
		Overall =	0.927

^a Factors extracted using principal-component method (all factors with eigenvalues > 1)

^b Respondents were asked to strongly agree (coded 2), agree (coded 1), neutral (coded 0), disagree (coded -1) or strongly disagree (coded -2) with each statement.

Appendix D. Innovation Benchmark Survey

A. Background Information

A1. What is the main product or service produced by your company? *Refer to Industrial Classification sheet and after confirming with respondent write most appropriate code:*

A2. Where is the Headquarters of your company? *Code one of the following.*

Northern Ireland	1
Scotland	2
Republic of Ireland	3
England or Wales	4
Other EU	5
North America	6
Japan	7
Other country	8

ALL THE FOLLOWING QUESTIONS I am going to ask you RELATE ONLY TO OPERATIONS IN (NI/RoI/Scotland)

Firstly, I shall ask you some background questions relating to your operations in Northern Ireland

A3. In which year did this business commence operations?

A4. How many are currently FTE employed by the company in (NI/RoI/Scotland)?

A5. Is the company a family-owned business? *Defined as 50+% ownership with the family*

Yes No

If YES, how many generations has the family held control of this firm:

First generation First/second Second Second/third Third or more

A6. What % of your sales from operations in (NI/RoI/Scotland) are sold in the following markets: *(Please check that answers sum to 100%)*

Northern Ireland%
Scotland%
Republic of Ireland%
England or Wales%
Other EU%
North America%
Japan%
Other country%

If the respondent has a problem breaking down sales, then concentrate on a NI, Scotland, RoI and 'rest' split

A7. (a) In the next 3-5 years what single most important factor would you say will provide the competitive edge of your business here in (NI/RoI/Scotland)? Will it be:

Read options and tick 1 box.

- Your product design
- Your process technology
- Your cost effectiveness
- Your marketing
- Your financial management
- Other (please specify)

B. New Products and Services

- B1.** Have you introduced any new products/services produced in *(NI/RoI/Scotland)* in the last 3 years?
Yes No **(If NO go to C1)**
- B2.** How many new products/services have there been?
If unsure best guess answer will do
- B3.** How many of them were designed or developed mainly in *(NI/RoI/Scotland)* ?.....
- B4.** Approximately, what percentage of your current *(NI/RoI/Scotland)* sales/turnover is accounted for by these new products/services introduced in the last 3 years?.....
- B5.** Considering the most important new product(s)/services(s) introduced in the last 3 years, I am going to read out a list of possible factors which may have influenced your design and development process. Please tell me which factors had the most influence. *(Circle all that are mentioned)*
- | | |
|---|---|
| Production staff at the establishment crucial | 1 |
| R&D department crucial | 2 |
| Technical inputs from customers crucial | 3 |
| Cooperation with customers crucial | 4 |
| Company staff located outside <i>(NI/RoI/Scotland)</i> crucial | 5 |
| Local consultant advice crucial | 6 |
| Consultant advice from outside <i>(NI/RoI/Scotland)</i> crucial | 7 |
| Financial resources crucial | 8 |
| Market testing/evaluation crucial | 9 |
- B6.** Without the need for any fundamental, major changes in its design or specification how many years have your current most important product(s)/service(s) been available to customers?
.....years
- B7.** How modern is your current most important product(s)/service(s) when compared to your competitors?
(Circle one answer)
- | | | | | | |
|--------------------------|---|---------------------|---|------------------|---|
| Very up-to-date | 1 | Up to 1 year behind | 2 | 1-3 years behind | 3 |
| More than 3 years behind | 4 | Don't know | 5 | | |
- B8.** I am going to read out some statements; could you tell me if you strongly agree, agree, neither agree or disagree, disagree, or strongly disagree:

	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
We are committed to making our existing products and services obsolete by introducing new ones	1	2	3	4	5
We regularly compare our products and services with those of our competitors	1	2	3	4	5
Our products/services have a high level of technology built into them	1	2	3	4	5
Our products and services use better technology than our competitors	1	2	3	4	5

C. Involvement in Innovation Activities

Moving on now to looking at your involvement in innovation related activities in *(NI/RoI/Scotland)* where innovation related activities is defined as **committing resources to** developing new products, processes or services and/or significantly improving existing products, processes or services, or developing new niches for the firm.

C1. Is your business engaged in innovation related activities in *(NI/RoI/Scotland)*?

Yes No **IF NO GO TO E1**

C2. For how many years has your business been involved in innovation related activities in *(NI/RoI/Scotland)*?years

C3. Have innovation related activities undertaken in *(NI/RoI/Scotland)* resulted in any **major** product or process innovations introduced into your *(NI/RoI/Scotland)* plants in the last 3 years? *Check back to B1 and ensure consistent. If answer is 'yes to new products in B1' but 'no' on product innovation in this question check to confirm that no significant local resources were involved in producing 'new products in B1'.*

Product innovation Yes No
 Process innovation Yes No

(Approx.) How many product innovations in the last 3 years?

(Approx.) How many process innovations in the last 3 years?

C5. How many of these have been patented? Product Process

C6. Could you tell me if any of the following are very important source(s) of knowledge and information (K&I) for your innovation related activities?
Tick as many as apply and tick main reason.

	Tick ALL that apply	Tick MAIN reason only
K&I from within the establishment (e.g. design, production, operational)		
K&I from within the enterprise (e.g. parent company)		
K&I from other local company/companies		
K&I from other company/companies located in (UK/RoI)		
K&I from other foreign company/companies		
K&I from Suppliers of equipment, materials etc.		
K&I from Customers		
K&I from Consultants		
K&I from Universities/Government research organisations		
K&I from Private research institutes		
K&I from Other public sector bodies e.g. Invest NI/Scottish Enterprise/Enterprise Ireland		
K&I from Trade associations/ Trade fairs		
K&I from Regulatory bodies e.g. Health & Safety, Environmental Standards		
<i>Other K&I</i>		

D. Reasons and Attitudes regarding innovation related activities

Moving on now to looking at your reasons for undertaking innovation related activities in (NI/RoI/Scotland):

- D1. A.** Does your business carry out innovation related activities in order to? *(Read out list)*
- B.** What is the main reason? *(Read out answers from column A that were ticked and choose 1)*

	A	B
	Tick ALL that apply	Tick MAIN reason only
a. to Develop new products		
b. to Improve existing products		
c. to Adapt existing products to meet market demands		
d. to Replace existing products		
e. to Reduce production costs		
f. to Increase speed of production		
<i>g. Other (please specify)</i>		

Turning now to your attitudes towards undertaking innovation related activities in (NI/RoI/Scotland):

- D2.** Which of the following statements **BEST** describes the importance of innovation related activities to your business? *Circle one letter*
- a. innovativeness has always been vital to our business
 - b. innovativeness is becoming increasingly important to our business
 - c. innovativeness is important but not essential to our business
 - d. innovativeness is not important to our business

- D3.** Which if the following statements best describes your business plans for innovation?
- a. We expect to increase our involvement in innovation related activities
 - b. We expect to maintain our current level of involvement in innovation related activities
 - c. We expect to decrease our level of involvement in innovation related activities
 - d. We expect to cease our involvement in innovation related activities

GO TO section G

E. Previous/Future Involvement in Innovation Related Activities

E1. Has your business been engaged in innovation related activities in *(NI/RoI/Scotland)* at any time in the last 5 years?

Yes No

E3. Do you expect your business to engage in innovation related activities at any time in the next 3 years?
 Yes – definite plans exist GOTO E4

Yes – but no definite plans
 Possibly
 No

} GOTO F1

E4. What are your reasons for planning to undertake innovation related activities within the next 3 years?
 Are they*(Read out list and tick as many as apply)*

a. to Develop new products	
b. to Improve existing products	
c. to Adapt existing products to meet market demands	
d. to Replace existing products	
e. to Reduce production costs	
f. to Increase speed of production	
g. because Senior management regard innovation related activities as a strategic priority for the future	
h. Other <i>(please state)</i>	

F. Reasons for Not Undertaking Innovation Related Activities

Moving on now to looking at your reasons for not undertaking innovation related activities in *(NI/RoI/Scotland)*.

F1. For each statement that I read out please tell me if you strongly agree, agree, neither agree or disagree, disagree, or strongly disagree.

	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
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The nature of our product or production process does not require or justify expenditure on innovation related activities	1	2	3	4	5
It is a corporate decision not to invest in innovation related activities in <i>(NI/RoI/Scotland)</i>	1	2	3	4	5
External economic/market conditions associated with risk and uncertainty prevent us from undertaking innovation related activities	1	2	3	4	5
Lack of access to finance (including government aid) restricts our ability to undertake innovation related activities	1	2	3	4	5
There is limited competition in the market for our products (i.e. our product is highly price sensitive), so we do not engage in innovation related activities	1	2	3	4	5
We are unable to engage in innovation related activities due to a lack of appropriate skills within the business	1	2	3	4	5
There is too long a time lag between undertaking innovation related activities and generating financial returns	1	2	3	4	5
It makes more sense to wait and copy the innovations of competitors than undertake these activities ourselves	1	2	3	4	5
Senior management do not regard innovation related activities as a strategic priority	1	2	3	4	5
We are unable to develop links with external bodies/organisations that would stimulate innovation related activities	1	2	3	4	5

F2. Which of the following factors is most likely to encourage your business to undertake innovation related activities in *(NI/RoI/Scotland)* in the future? *(Read out list and tick most important)*

	Most important
a. An improvement in the financial performance of the business	
b. The recruitment of staff with appropriate skills	
c. A change in management attitudes to innovation related activities	
d. A greater demand for innovative products	
e. Stronger competition in the market	
f. Less price sensitivity for products	
g. Technological developments in the industry	
h. A change in corporate policy regarding <i>(NI/RoI/Scotland)</i> operations	
i. Improved government incentives for innovation related activities (e.g. grants)	
j. The nature of our business means that innovation related activities would never be considered	
k. <i>Other (please state)</i>	

Business and management factors relating to innovation effectiveness

G. Lifecycle

For each statement that I read out please tell me if you strongly agree, agree, neither agree or disagree, disagree, or strongly disagree.

	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
The main problems of the business are obtaining customers and delivering the product or service.	1	2	3	4	5
The Company has now developed with sufficient customers and satisfies them sufficiently with its products or services.	1	2	3	4	5
The decision facing owners at this stage is whether to expand or to keep the company stable and profitable, providing a base for alternative owner activities.	1	2	3	4	5
The key problems facing the company are how to grow rapidly and how to finance the growth.	1	2	3	4	5
The challenges are to consolidate and control the financial gains brought on by rapid growth and to retain the advantages of small size, including flexibility.	1	2	3	4	5

H. Strategic focus

For each statement that I read out please tell me if you strongly agree, agree, neither agree or disagree, disagree, or strongly disagree.

	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
The company has a narrow range of products and markets.	1	2	3	4	5
The company continually searches for new market opportunities.	1	2	3	4	5
The company watch their competitors closely for new ideas, and then rapidly adopt those which appear to be the most promising.	1	2	3	4	5
The organisation seldom makes adjustments of any sort until forced to do so by environmental pressures.	1	2	3	4	5

I. Leadership

Moving on now to looking at the leadership style for supporting innovation related activities in *(NI/RoI/Scotland)*. For each statement that I read out please tell me if you (a) strongly agree, (b) agree, (c) neither agree nor disagree, (d) disagree or (e) strongly disagree. *Please circle one answer for each statement.*

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The senior management team makes a point of "being seen" around the organisation	1	2	3	4	5
Management fosters creative thinking and innovation in the company	1	2	3	4	5
Our top managers like to try new ways of doing things	1	2	3	4	5
Management spend adequate time planning change	1	2	3	4	5
If the company is performing well, change is still a priority	1	2	3	4	5
The organization is working to a clear business plan	1	2	3	4	5
Management encourages everyone in the organization to come up with new ideas.	1	2	3	4	5
The management team take time to think constructively/creatively about the future	1	2	3	4	5

J. Culture

Moving on now to looking at the culture within the organisation for supporting innovation related activities in *(NI/RoI/Scotland)*.

For each statement that I read out please tell me if you (a) strongly agree, (b) agree, (c) neither agree nor disagree, (d) disagree or (e) strongly disagree.

Please circle one answer for each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
There is a strong team spirit at all levels of the organisation	1	2	3	4	5
The culture in this organization promotes change	1	2	3	4	5
Two way communication happens at all levels of the organisation	1	2	3	4	5
There is a clear organisational structure which everyone understands	1	2	3	4	5
There are clearly defined roles and responsibilities	1	2	3	4	5
The structure of the organization facilitates change	1	2	3	4	5
The organization is not bureaucratic	1	2	3	4	5
There is a feeling of openness in this organization	1	2	3	4	5
Overall, employees have access to all the resources needed to get the job done	1	2	3	4	5
Employees are involved in setting and agreeing performance targets	1	2	3	4	5
Everyone in the company has a good grasp off how the organization is performing	1	2	3	4	5
Employees get useful feedback about their work	1	2	3	4	5

K. Business Improvement Methods

Moving on now to looking at the business improvement methods within the organisation for supporting innovation related activities in *(NI/RoI/Scotland)*.

K1 Please indicate which of the following business improvement methods are used within your organisation to drive innovation activities:

	present	If present, greater than 2 years?
Total Quality Management (TQM)		
Continuous Improvement		
European Business Excellence Model		
Balanced Scorecards		
Total Preventative Maintenance (TPM)		
Investors in People (IiP)		
ISO 9001		
ISI14001		
Others – please list:		

K2 In relation to the method(s) used for each statement that I read out please tell me if you (a) strongly agree, (b) agree, (c) neither agree nor disagree, (d) disagree or (e) strongly disagree.

Please circle one answer for each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The organisation has a formal/informal total quality – continuous improvement programme	1	2	3	4	5
Responsibilities for the TQ/CI programme are clearly defined	1	2	3	4	5
The TQ/CI programme has clear goals, objectives and measures of success	1	2	3	4	5
Successful TQ/CI problem solving teams are spread throughout the organisation	1	2	3	4	5
The programme is adequately resourced	1	2	3	4	5
There is a clearly defined reward and recognition scheme for TQ/CI activity	1	2	3	4	5
Greater than 50% of the workforce are involved in TQ/CI	1	2	3	4	5
The TQ/CI programme is used to improve processes	1	2	3	4	5
A number of quality improvements have been achieved from the programme	1	2	3	4	5

L. Internal and External Knowledge processes

L1. Knowledge Incorporation

I will now read out a set of statements that will help us understand how your organisation incorporates or uses knowledge and information internally.

For each statement that I read out please tell me if you (a) strongly agree, (b) agree, (c) neither agree nor disagree, (d) disagree or (e) strongly disagree. *Please circle one answer for each statement.*

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Everyone is in possession of the information/ knowledge necessary to do their job	1	2	3	4	5
Knowledge that employees hold in their heads (i.e. tacit knowledge) is managed and captured effectively	1	2	3	4	5
Efforts are made to share information/knowledge across the organization	1	2	3	4	5
Lessons learned from daily experiences and projects are captured and disseminated	1	2	3	4	5
New information/knowledge is effectively incorporated within the processes and routines within the organization	1	2	3	4	5
Active management of information/knowledge produces a range of business benefits	1	2	3	4	5

L2. Knowledge Acquisition

I will now read out a set of statements that will help us understand how your plant identifies and employs information/knowledge developed elsewhere. Please circle one answer for each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
We conduct frequent market research so that we are aware of customer needs	1	2	3	4	5
Licensing is a method we often use to obtain information/knowledge or technology	1	2	3	4	5
We have developed new products/services and/or processes in collaboration with other firms	1	2	3	4	5
We are well aware of the information/knowledge and technologies being developed by our competitors	1	2	3	4	5
We have become an information/knowledge or technology supplier to other firms in the sector	1	2	3	4	5
We usually go to outside private sector bodies (e.g. consultants) to find out about fresh opportunities for introducing new products/services	1	2	3	4	5
We usually go to outside public sector bodies (e.g. universities) to find out about fresh opportunities for introducing new products/services	1	2	3	4	5

M. Linkages

I will now read out a set of statements that will help us understand how your networks with other organisations in *NI/RoI/Scotland*:

For each statement that I read out please tell me if you (a) strongly agree, (b) agree, (c) neither agree nor disagree, (d) disagree or (e) strongly disagree.

Please circle one answer for each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Sufficient resources are allocated to support network activities with other organisations and collaborators	1	2	3	4	5
The organisation uses a range of activities and mechanisms to initiate	1	2	3	4	5

new relationships with other organisations					
Information is freely exchanged across other organisational partners in networks	1	2	3	4	5
Network activities are systematically linked to organisation plans	1	2	3	4	5
Where appropriate the company adapts its activities to fit with the needs of specific networks	1	2	3	4	5
Relationships between employees and those of other organisations in networks are carefully managed.	1	2	3	4	5
The company has performance measures to measure the effectiveness of networks with other organisations	1	2	3	4	5
Company employees receive sufficient training in network relationship management	1	2	3	4	5

N. Background on your operations

N1. Based on the following bands, what was your sales turnover in *(NI/RoI/Scotland)* during the most recent period for which you have data? *Code one of the following:*

<250k 250-500k 500-999k 1000-1999k 2000-2999k 3000-3999k >4000k

N2. Over the last three years would you say that the level of competition you face from your rivals has:

Increased significantly Increased Same Decreased Decreased significantly

N3. Compared to your rivals, how would you rate your overall performance in the last year?

Significantly better Better Same Worse Significantly worse

O. Next stage of project

O1. As well as carrying out this survey in *(NI/RoI/Scotland)*, a number of companies are being invited to take part in a series of workshops and in-house support to help in the development of their innovative capacity and capability, aimed ultimately at improving their competitiveness through the commercialisation of new ideas, products, services and processes on a cross border and cross regional basis. Would you be willing to allow your contact details (linked to the answers to this survey) to go forward to the project team to indicate your interest in being involved in this further stage in the project?

Yes No

O2. Would you like to receive a copy of the overall anonymised results from this survey? If so, this implies you give consent for your contact details to go forward to the project team (although these will not be linked to your responses to this survey).

Yes No

THANK YOU FOR TAKING PART IN THIS SURVEY