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An empirical investigation of the impact of management accounting on structural capital and business performance

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Abstract

Purpose – The purpose of this paper is to develop and test a series of conceptual models that investigates the impact of management accounting (MA) (systems and information) on firms' structural capital and business performance. It also replicates previous research in this area which focused on the interplay between the three primary elements of intellectual capital (IC) (i.e. human capital, structural capital and relational capital) and business performance.

Design/methodology/approach – A survey instrument was used to collect the data required to conduct the study. All respondents who participated occupied the role of chief financial officer or equivalent and were employed by firms competing within the indigenous Irish information and communications technology sector. Consistent with prior quantitative IC-based research, a form of structural equation modelling called partial least squares was used to test the data collected.

Findings – The findings reject the suggestion that MA is most appropriately situated as an element of firms' structural capital. The findings support a plausible and statistically significant relationship between advanced MA systems and business performance. The findings also generally support previous research on the relationship between the three elements of IC and business performance.

Originality/value – Although much has been written about the potential role for MA in the IC area, little empirical evidence has yet emerged. This exploratory research begins to address this deficiency by developing and testing a series of MA-related constructs within the IC research domain.

Keywords Management accounting, Structural capital, Intellectual capital, Business performance

Paper type Research paper

1. Introduction

In this paper, intellectual capital (IC) is deemed to consist of a firm's unique collection of human capital (i.e. employees), structural capital (i.e. systems and procedures) and relational capital (i.e. external relationships). Despite the continuing debate surrounding the importance of IC to organisational competitiveness, the potential contribution of management accounting (MA) in this regard has yet to be fully established despite the fact that much of the original IC literature emerged from an accounting perspective (Bontis, 2002). Theoretically, MA ought to have a prominent role to play in IC measurement and management, as without it, firms' primary competitive resource (i.e. their knowledge), may never realise its full potential (Mouritsen, 2009).

The accounting function has been challenged to respond in unison to the elevation of intangible assets (which underpin IC) as the primary driver of organisational performance (Guthrie and Boedker, 2006). This transformation has required the development and deployment of management (accounting) systems capable of supporting organisational knowledge-based competencies which has heretofore not been the case (Isaac *et al.*, 2009). However, from the accounting perspective, it has been suggested that this requirement

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has not been actively pursued, resulting in accusations of neglect being levelled at the profession (Sharabati *et al.*, 2010). Furthermore, it has been claimed that incumbent MA systems are now at risk of becoming increasingly irrelevant due to their inability to cater for the unique characteristics of knowledge-based organisations (Ghosh and Mondal, 2009; Lonnqvist *et al.*, 2005). This is in spite of the realisation that to succeed in the knowledge economy, senior management need to be able to access relevant and timely information upon which to inform their subsequent decision making (Bose and Thomas, 2007; Tseng and Goo, 2005); a role traditionally the preserve of MA.

Thus far, limited research has been conducted on the organisational factors required to facilitate firms in effectively managing their IC. Consequently, guidance relating to what combination of internal structures, systems and practices (including MA) that would assist firms in achieving this particular objective is notably lacking from the academic discourse (Isaac *et al.*, 2009; Tayles *et al.*, 2007). Therefore, this exploratory research aims to contribute to this debate by investigating whether, and how, the use of MA (systems and/or information) can positively influence the subsequent performance of Irish indigenous knowledge-intensive firms. It will also seek to determine whether MA is most appropriately situated as an element of firms' structural capital as has been suggested (see, e.g. Novas *et al.*, 2012; Roberts, 2003).

The remainder of the paper is organised as follows: Section 2 provides a literature review of the primary areas of interest covered in this paper and concludes by outlining the rationale for the proposed research, Section 3 describes the research methodology adopted, Section 4 traces the development of a series of new and exploratory MA constructs before outlining the results obtained from the study, Section 5 discusses the research findings and finally, Section 6 offers some concluding remarks.

2. Literature review

It is generally assumed that the vast majority of organisational knowledge originates from a firm's employees and constitutes their primary value-creating resource (Blanco *et al.*, 2002; Kelley and Caplan, 1993; Rogers, 2001). However, as legal ownership of such organisational knowledge cannot be easily determined; the challenge for firms' is to embed it within their very fabric, so as to allow it to become of sustained value and therefore potentially capable of influencing future organisational performance (Bontis and Fitz-enz, 2002; Bontis *et al.*, 2000; Bontis, 1998; Cabrita and Bontis, 2008; Do Rosario Cabrita and Landeiro Vaz, 2006; Garcia-Ayuso, 2003; Grant, 1997; Ordonez de Pablos, 2002; Wang and Chang, 2005).

Although intangible assets rarely affect business performance directly; they can do so indirectly through relationships of cause and effect (Kaplan and Norton, 1993). Empirically testing the relationship between IC and business performance is not straightforward as no global consensus exists as to the most appropriate means of measuring a firm's IC (Clarke *et al.*, 2011). Nevertheless, in those studies that have occurred, a very strong association between business performance and IC has generally been found. Examples of such findings include; Perrin (2000) who found that certain human capital, structural capital and relational capital dimensions were each positively associated with business performance, whereas Sharabati *et al.* (2010) and Cabrita and Bontis (2008) found that only relational capital and structural capital had a positive impact on firm performance. Alternatively, Novas *et al.* (2012), Jardon and Martos (2009) and Ordonez de Pablos (2002) reported that structural capital alone had a positive and significant relationship with firm performance, while Mention and Bontis (2013) came to the same conclusion for human capital.

One possible reason for the divergence of findings reported in the literature may be due to the different countries and industries within which previous studies have been conducted as researching IC is very much dependent upon the context in which it is applied (Mouritsen, 2006). Nevertheless, based upon the results from prior studies, firms wishing to attain and sustain a competitive advantage should either invest directly in their structural capital, or alternatively, they should invest indirectly in the creation of structural capital via investments in human capital and/or relational capital.

In terms of positioning, it has been suggested that MA (defined by Burns *et al.*, 2013, p. 4 as the provision of "information to assist organisational managers in their decision making") is most appropriately situated within the realm of a firm's structural capital. This is because it can, to a large extent, be owned by firms' (Booth, 1998; Lynn, 1999; Roberts, 2003) as well as broadly adhering to the definition of structural capital as, "a valuable strategic asset, which is comprised of non-human assets such as information systems, routines, processes and databases. It is the skeleton and the glue of an organisation because it provides the tools and architecture for retaining, packaging and moving knowledge along the value chain" (Cabrita and Bontis, 2008, p. 217). Novas *et al.* (2012) suggested that MA systems are fundamentally part of structural capital, and their subsequent research, which was conducted within a wide spectrum of companies in Portugal, revealed a positive and statistically significant relationship between both.

Management accountants therefore would appear to have a potentially pivotal role to play in IC management; one in which the focus is on making better use of the information and knowledge that is already available and accessible within the firm, with a view to enhancing subsequent organisational performance (Edwards *et al.*, 2005; Sofian *et al.*, 2004; Tayles *et al.*, 2002). Unless they do so, there is a distinct risk that firms' IC will not be leveraged to its full potential (Bontis, 1998; Lev and Daum, 2003; Sofian *et al.*, 2004). However, in response, it has been claimed by Gowthorpe (2009) and Novas *et al.* (2012) that the use of MA within such knowledge-based organisations has been both enhanced and extended to cater specifically for the increased importance of IC for subsequent business performance. The exploratory research underpinning this paper aims to determine whether or not this claim is supported from the perspective of firms operating within a knowledge-intensive sector of the Irish economy.

Concerning the use of MA within organisations; at its most rudimentary level, firms' information systems (incorporating MA) should furnish business intelligence (i.e. information) capable of facilitating subsequent managerial decision making (Atkinson *et al.*, 2001; Bromwich, 1990; Cabrita and Bontis, 2008; Chenhall and Morris, 1986; Mia and Chenhall, 1994). In this regard, MA systems have been defined as "formal mechanisms for gathering, organising and communicating information about an organisation's activities" (Horngren *et al.*, 2000, p. 6). Firms who strive to become customer-focused and market-driven need to develop efficient organisational routines and processes (including accounting and control systems) to cater for the informational needs created by the series of relationships that they have formed with external entities (Bontis *et al.*, 2000; Ordonez de Pablos, 2002).

Additionally, research conducted by both Mia and Clarke (1999) and Waldron and Everett (2004) found that as competition increases, firms make greater use of the information generated by their MA systems in formulating, implementing and monitoring strategies to cater for increased levels of competition, which in-turn, is associated with improved business performance. This is supported by Gordon and Narayanan (1984), Chenhall and Morris (1986) and Mia (1993) who found that the usefulness of information generated by a firm's MA systems increases with increased environmental uncertainty.

Therefore, this research aims to test the proposition that MA is most appropriately situated as an element of a firm's structural capital (Booth, 1998; Lynn, 1999; Novas *et al.*, 2012; Roberts, 2003) as well as examining its direct impact on business performance (Mia and Clarke, 1999; Waldron and Everett, 2004). The MA constructs used here are new and therefore constitutes exploratory research, albeit conducted within the confines of a previously validated model of IC (Bontis and Fitz-enz, 2002; Bontis, 1998). In doing so, the paper will also test the relationships between the three elements of IC (i.e. human capital, structural capital and relational capital) and business performance.

3. Research methodology

The emergence and indeed the on-going prominence of the Irish indigenous information and communications technology (ICT) sector has contributed significantly towards Ireland's elevation to a knowledge-based economy and therefore provides an ideal platform within which to conduct research of this nature. Firms in this sector are typically involved in activities such as software design and development, web design, network security implementation, hardware assembly and other-related functions. By their very nature, these firms are required to invest heavily in research and development, so as to ensure a future stream of marketable products and/or services. Such investments may be indicative of the creation of significant levels of IC and therefore provides a potentially significant role for the application of MA within such a setting.

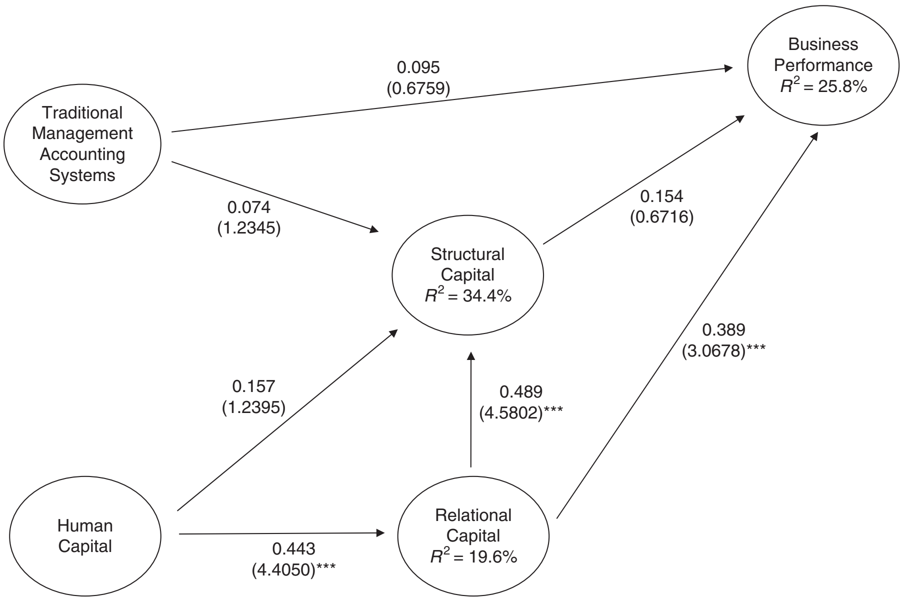
Consequently, 385 privately owned indigenous firms operating within the knowledge-intensive Irish ICT sector (and with at least ten full-time permanent employees each) were chosen to participate in the study. The methodological approach adopted for this study q(i.e. a survey) was subsequently endorsed by Tayles *et al.* (2007, p. 541) who claimed that, "relatively few surveys have been reported on management accounting for intellectual capital". Each firm's chief financial officer's or financial equivalent, was posted a copy of the survey instrument, and after numerous follow-ups, this eventually generated a usable response rate of slightly less than 23 per cent (representing 88 completed surveys with an average number of full-time permanent employees per participating firm of approximately 50), which is reasonable when compared with recent surveys of similar proportions (Beattie and Pratt, 2003).

The raw data from the completed surveys was inputted into the data analytics software package, Statistical Package for the Social Sciences, to begin the analysis phase of the research study. In keeping with best research practice, the data were initially tested for the existence of both non-response bias and temporal bias – neither of which was found. Structural equation modelling (SEM) was the statistical approach used to test the data collected. The primary advantage of using SEM is that it facilitates researchers in conducting path-analytic modelling using latent variables (Chin and Newsted, 1999), thereby permitting a simultaneous examination of both theory and measures. SEM has been used extensively in IC-based research (see, e.g. Bontis, 1998) but has also been deemed suitable for MA-based research owing to its ability to facilitate the development of holistic models (Smith and Langfield-Smith, 2004). Therefore, its use is appropriate here.

Within SEM, a variety of different statistical techniques can be used. For this study, the partial least squares (PLS) approach to data analysis was adopted; consistent with previous studies in the IC domain (Bontis and Fitz-enz, 2002; Bontis, 2002, 1998; Do Rosario Cabrita and Landeiro Vaz, 2006; Jardon and Martos, 2012; Mention and Bontis, 2013; Ordonez de Pablos, 2002; Wang and Chang, 2005). The primary objective of PLS is to explain how much variance is contained within a particular model configuration, and this is achieved by reference to the corresponding R^2 values and statistical significance of relationships between constructs. However, prior to this, the validity and reliability of the measurement model (i.e. items and constructs) must be confirmed.

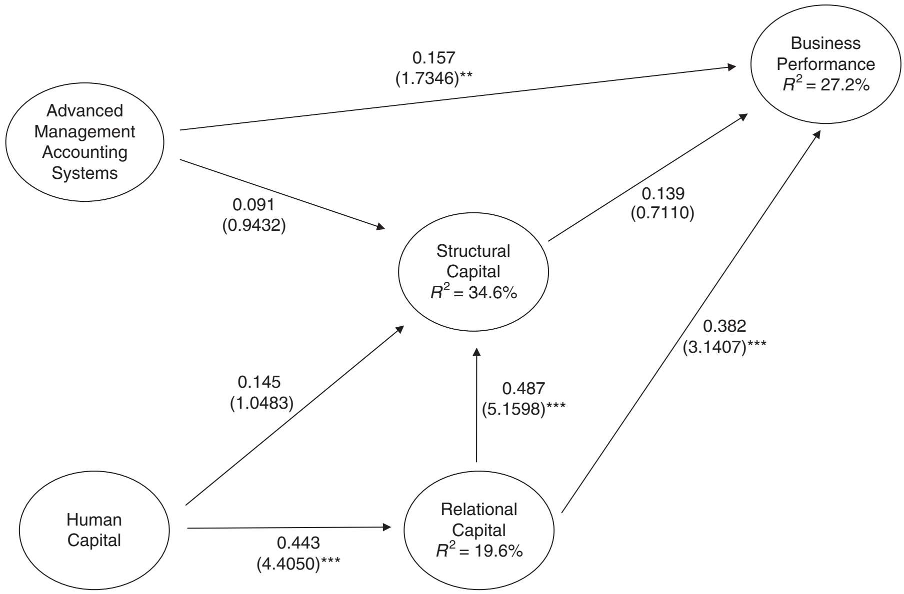
In terms of the appropriateness of using the PLS approach here; as it is generally recommended for the analysis of small data sets of up to 100 cases (Hoyle, 1999), its use is appropriate in this instance (i.e. this research is based upon the results of 88 completed surveys). Also, concerning minimum sample size requirements, the normal protocol (Barclay *et al.*, 1995; Chin, 1997) for a PLS study containing "reflective" indicators (i.e. the items/statements which comprise each construct "reflect" the construct) is ten times the largest number of antecedent constructs (e.g. structural capital) leading to an endogenous construct (i.e. business performance). Based upon the four proposed conceptual models in this paper (see Figures 1-4) the minimum acceptable sample size for this research study is 40 (4 antecedent constructs × 10). With 88 responses, PLS is deemed suitable here.

Concerning the measurement model, the reliability of the items/statements comprising each construct is first assessed. The norm for well-established items is to accept those with loadings of 0.70 or more (Carmines and Zeller, 1979). As loadings are correlations (item loading squared), this implies that more than 50 per cent of the variance contained within an item is shared with the construct (Barclay *et al.*, 1995). Any item that fails to meet this 0.70 loading threshold is generally removed from further testing, unless a valid reason exists as to why the item should be retained. The remaining items within each construct are then re-tested to ensure that their corrected item-to-total correlation score is at least 0.35 as suggested by Saxe and Weitz (1982). A matrix of loadings of cross-loadings is then produced to test the discriminant validity of each of the remaining items contained in each construct. To evaluate this,



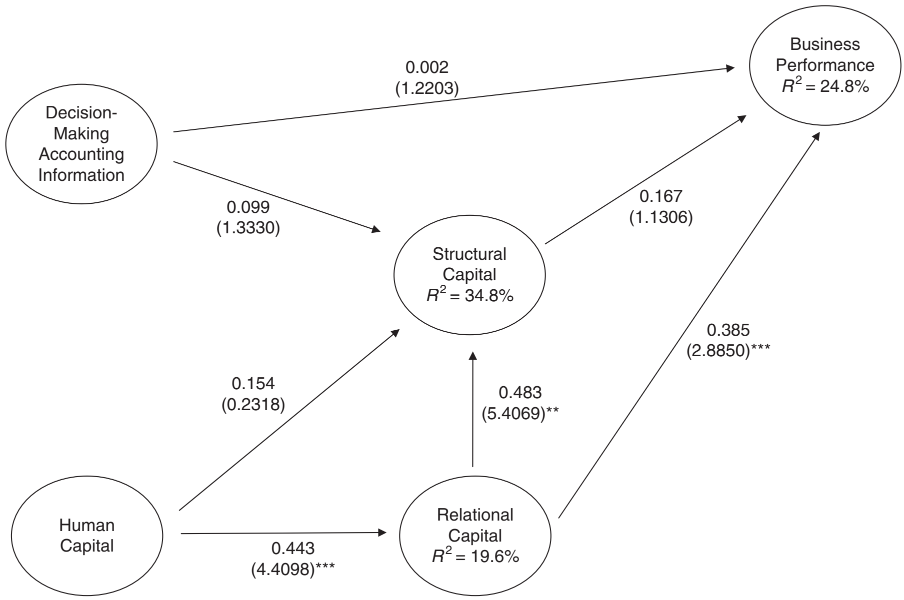
Notes: Top number is path, *t*-values in brackets. ***Significant at *p*-value <0.01

Figure 1.
Traditional management accounting systems



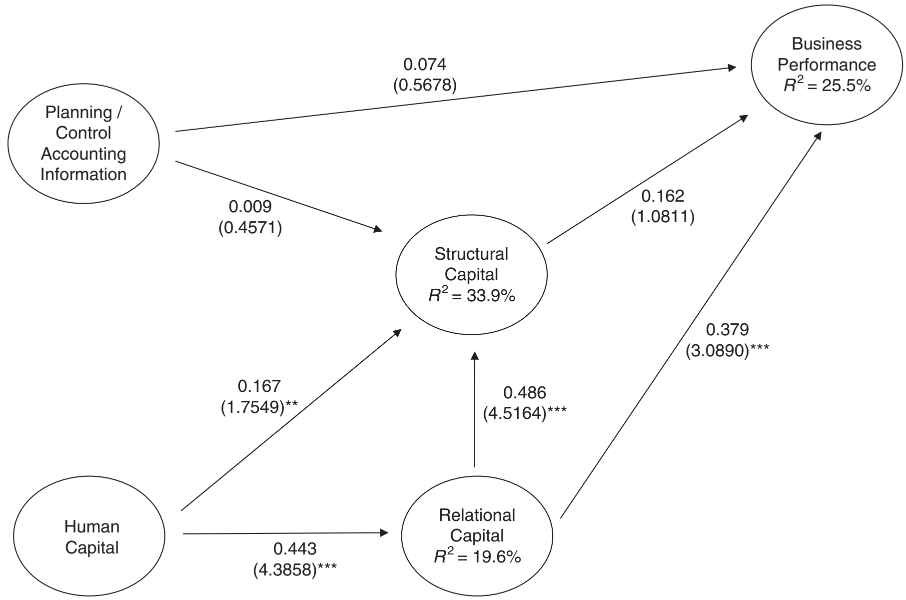
Notes: Top number is path, *t*-values in brackets. **,***Significant at *p*-value <0.10 and <0.01, respectively

Figure 2. Advanced management accounting systems



Notes: Top number is path, *t*-values in brackets. ***Significant at *p*-value <0.01

Figure 3. Decision-making accounting information



Notes: Top number is path, *t*-values in brackets. **,***Significant at *p*-value <0.10 and <0.01, respectively

Figure 4.
Planning/control accounting information

one compares the loading of an item with its associated construct to its cross-loadings with each of the other constructs included in the analysis. Intuitively, it is to be expected that the majority of items in a particular study should have higher loadings with their respective construct in comparison to their cross-loadings on each of the remaining constructs used in the study.

The focus of attention then moves from items to constructs. Internal consistency is first evaluated using both the Fornell and Larcker (1981) measure and Cronbach's α, both of which require minimum scores of 0.70. Regarding convergent validity (an additional test of reliability), the minimum acceptable threshold level for this statistical test as outlined by Fornell and Larcker (1981) is 0.50. As this test calculates the amount of shared variance contained within the measurement model, if the result is less than 50 per cent it suggests that the variance due to measurement error is larger than the variance captured by the construct, and hence the validity of the items and the construct itself is questionable.

Finally, discriminant validity at the construct level examines the extent to which a construct shares more variance with its items than it does with the other constructs used in a particular model. In conducting this test using a correlation matrix, Fornell and Larcker (1981) recommend the use of the average variance extracted (AVE) equation. For appropriate levels of discriminant validity, values along the diagonal of the correlation matrix (square root of the AVE for each construct) should be greater than the corresponding values in each row or column (Hulland, 1999).

Having determined the statistical validity and reliability of both the items and constructs (referred to as the "measurement model"), the proposed structural model(s) can now be assessed. This was achieved using the PLS-Graph version 3.0 software package which was developed by Dr Wynne Chin, and has previously been used by other IC researchers (Bontis and Fitz-enz, 2002; Bontis, 1998; Cleary, 2009; Cleary *et al.*, 2007; Do Rosario Cabrita and Landeiro Vaz, 2006; Ordonez de Pablos, 2002; Wang and Chang, 2005). A jackknife analysis is one component of the functionality of this software package which allows the researcher to assess the statistical significance of the item loadings and of the β-path coefficients connecting the various constructs contained with a particular hypothesised model using a programme developed by Fornell and Barclay (1983). Also, the use of PLS-Graph allows the researcher to determine R^2 values for each of the endogenous constructs contained within a particular model configuration. Collectively, these values represent the predictive power of a proposed structural model, as for each construct, they indicate the amount of variance that is explained by the model (Barclay *et al.*, 1995). Having described the research methodology used in this exploratory study, the next section will outline the results obtained.

4. Results

This study included four IC-based constructs (i.e. human capital, structural capital, relational capital and business performance) each of whom consisted of various items/statements. For each item/statement, respondents to the survey instrument were requested to assess each one using a seven-point Likert scale (1 = strongly disagree; 7 = strongly agree). As all of these constructs had been subject to statistical validation in prior studies (see, e.g. Bontis and Fitz-enz, 2002; Bontis, 2002), the use of the 0.70 loading threshold to test for the reliability of each individual item/statement was deemed appropriate in this instance.

As Table I illustrates, a number of the IC-based items/statements failed to reach this 0.70 loading threshold level and as per the statistical protocol, they were subsequently removed from further analysis. Specifically, the following items/statements were removed, HumCap3, StrCap4, RelCap5 and BusPer6. All of the remaining items in each construct were then re-evaluated by examining the corrected item-to-total correlation score, each of which successfully reached the minimum threshold of 0.35 (Saxe and Weitz, 1982).

In relation to the exploratory MA dimension of this research study, Table II outlines the items used. Collectively, the 30 items (15 items representing MA systems and 15 items representing MA information) represent an attempt at gaining comprehensive coverage in the MA domain and is based on a thorough review of the relevant MA literature (Atkinson *et al.*, 2001; Chenhall and Morris, 1986; Drury, 2004; Horngren *et al.*, 2000; Mia and Chenhall, 1994; Scapens *et al.*, 2003; Scapens, 1996) along with discussions with accounting academics, practitioners and colleagues.

As shown in Table II, the 15 MA systems items are a combination of the traditional and advanced systems typically used by progressive firms, and range from basic cost-based MA systems such as standard costing/variance analysis to more modern and robust MA systems such as backflush costing and the balanced scorecard (Bhimani, 2003; Ittner and Larcker, 2001; Waldron and Everett, 2004). Based upon this distinction, it was therefore deemed appropriate to test these particular items as comprising two distinct MA systems constructs – traditional systems (see Figure 1) and advanced systems (see Figure 2) – both of which are exploratory, untested and developed specifically for the purposes of this study. To do so, respondents were requested to indicate via a seven-point Likert scale (1 = no usage; 7 = very high usage) the usage of these MA systems within their respective ICT firms.

Table I. Item statistics – intellectual capital constructs

	Mean	SD	Loading level (0.70)	Item to construct (0.35)
Human capital				
HumCap1	4.82	1.218	0.723	0.643
HumCap2	5.28	1.005	0.803	0.714
HumCap3	4.83	1.341	0.554	Removed
HumCap4	5.49	1.028	0.775	0.673
HumCap5	5.73	0.944	0.805	0.703
HumCap6	5.94	0.862	0.874	0.788
HumCap7	5.84	0.945	0.815	0.725
Structural capital				
StrCap1	5.72	1.093	0.797	0.641
StrCap2	5.02	1.470	0.868	0.770
StrCap3	5.18	1.378	0.864	0.792
StrCap4	6.03	0.940	0.653	Removed
StrCap5	4.90	1.339	0.787	0.659
Relational capital				
RelCap1	4.95	1.212	0.767	0.639
RelCap2	4.26	1.335	0.700	0.536
RelCap3	4.45	1.469	0.863	0.739
RelCap4	4.16	1.469	0.824	0.659
RelCap5	4.23	1.468	0.630	Removed
Business performance				
BusPer1	4.86	1.297	0.837	0.787
BusPer2	4.26	1.410	0.875	0.837
BusPer3	4.14	1.448	0.853	0.792
BusPer4	5.60	1.140	0.783	0.611
BusPer5	4.98	1.470	0.817	0.711
BusPer6	5.91	1.002	0.677	Removed

Table II. Management accounting items

	MA systems		MA information
MaSys1	Standard costing/variance analysis	MaInfo1	Financial performance indicators
MaSys2	Absorption (full) costing	MaInfo2	Non-financial performance indicators
MaSys3	Variable costing	MaInfo3	Product and/or service pricing
MaSys4	Activity-based costing/management	MaInfo4	Budgeting/budgetary control
MaSys5	Balanced scorecard	MaInfo5	Rolling forecasts/best estimates
MaSys6	Target costing	MaInfo6	Cost modelling/simulation
MaSys7	Job costing	MaInfo7	Key activities/cost drivers
MaSys8	Process costing	MaInfo8	New product development
MaSys9	Life-cycle costing	MaInfo9	Customer profitability analysis
MaSys10	Through-put accounting	MaInfo10	Cost management/reduction
MaSys11	Backflush costing	MaInfo11	Break-even analysis
MaSys12	Functionality costing	MaInfo12	Sensitivity analysis
MaSys13	MRP/ERP/EVA/SVA	MaInfo13	Value-added accounting analysis
MaSys14	Strategic managerial accounting	MaInfo14	Capital investment appraisal/allocation
MaSys15	Transfer pricing models	MaInfo15	Benchmarking

Similarly, the usage of a broad spectrum of MA information types were offered to respondents (see Table II), ranging from traditional financial information requirements such as financial performance indicators and budgeting/budgetary control to more contemporary forms such as rolling forecasts/best estimates and non-financial performance indicators. Collectively, these 15 items are indicative of the two primary roles (decision making and planning/control) usually attributed to the information generated by firms' MA systems (Andon *et al.*, 2003; Antola *et al.*, 2005; Bromwich, 1990; Burns and Vaivio, 2001; Emmanuel *et al.*, 1990; Ittner and Larcker, 2001) and were therefore adopted as the two distinct MA information constructs within which to test these particular items (for decision making – see Figure 3 and for planning/control – see Figure 4). As before, these particular constructs are novel and exploratory in nature and therefore have not been subjected to any statistical testing/validation previously. Here, respondents were asked to indicate the degree of importance they attached to these 15 different types of MA information in their respective firms using a seven-point Likert scale (1 = no importance; 7 = very high importance).

Despite extensive and robust statistical testing, the 0.70 loading threshold level generally used for well-established items was ultimately deemed unsuitable for these exploratory MA items. In the interests of developing relevant and credible MA constructs, it was then decided to adopt the loading threshold level used in recent IC research of an exploratory nature, i.e. 0.50. This was also the pragmatic decision taken in Cleary (2009) and in Cleary *et al.* (2007) and is supported by Chin (1998) who suggested that at the initial stages of scale development, items with a minimum loading of 0.50 are generally acceptable. Hulland (1999, p. 198) also supports this view when he stated that; "items with loadings of less than 0.40 (a threshold commonly used for factor analysis results) or 0.50 should be dropped".

This decision should not adversely impact upon the robustness and validity of any subsequent MA-related constructs developed, as according to Hair *et al.* (1987) items that load at this level (i.e. > 0.50) are considered to be very significant. Furthermore, a number of previous IC-based research studies also adopted item loading values below the generally accepted 0.70 threshold level. For example, Do Rosario Cabrita and Landeiro Vaz (2006) when investigating the IC practices of the Portugese banking industry retained all items that loaded at a level of at least 0.50, which was also the loading level deemed appropriate in Bontis' (1998) seminal paper. Furthermore, Wang and Chang (2005) in researching IC in the Taiwanese IT industry retained loading values as low as 0.248.

Consequently, in relation to the MA systems constructs; having conducted the necessary statistical tests for individual item reliability (see Table III), item MaSys15 (i.e. transfer pricing models) was removed from the traditional systems construct for failing to meet the 0.50 loading level, while item MaSys14 (i.e. strategic managerial accounting) was removed from the advanced systems construct as despite loading onto this construct at a level greater than 0.50 (i.e. 0.576), it simultaneously loaded onto an alternative construct at a higher loading level. The statistical appropriateness of both of these newly created and thus exploratory constructs was then confirmed by testing the corrected item-to-construct correlation for each individual item, which as shown in Table III, all of the remaining items exceeded the 0.35 threshold as suggested by Saxe and Weitz (1982).

Pertaining to the MA information constructs (see Table IV), all eight items comprising the decision making construct loaded successfully at the 0.50 level. However, in relation to the planning/control construct, two out of the seven items failed

	Mean	SD	Loading level (0.50)	Item to construct (0.35)
Traditional systems				
MaSys1	3.97	2.141	0.733	0.568
MaSys2	2.33	1.824	0.742	0.564
MaSys3	2.94	1.878	0.820	0.664
MaSys7	4.58	2.159	0.608	0.463
MaSys8	2.37	1.865	0.748	0.597
MaSys15	2.64	1.901	0.463	Removed
Advanced systems				
MaSys4	2.98	2.006	0.551	0.430
MaSys5	1.92	1.563	0.686	0.598
MaSys6	2.30	1.820	0.708	0.609
MaSys9	1.83	1.324	0.654	0.583
MaSys10	1.73	1.420	0.885	0.799
MaSys11	1.36	1.041	0.869	0.786
MaSys12	1.74	1.326	0.894	0.812
MaSys13	1.73	1.191	0.579	0.448
MaSys14	2.92	1.972	0.576	Removed

Table III. Item statistics – management accounting systems constructs

	Mean	SD	Loading level (0.50)	Item to construct (0.35)
Decision making				
MaInfo7	4.28	1.695	0.611	0.496
MaInfo8	4.76	1.800	0.562	0.437
MaInfo9	4.03	1.712	0.599	0.469
MaInfo10	4.74	1.671	0.652	0.522
MaInfo11	4.41	1.873	0.696	0.570
MaInfo12	3.75	1.883	0.794	0.686
MaInfo13	2.75	1.697	0.783	0.674
MaInfo14	3.35	1.813	0.644	0.506
Planning/control				
MaInfo1	5.78	1.601	0.603	0.346
MaInfo2	4.32	1.879	0.484	Removed
MaInfo3	4.78	1.810	0.344	Removed
MaInfo4	5.85	1.264	0.753	0.585
MaInfo5	5.33	1.460	0.787	0.608
MaInfo6	4.09	1.766	0.658	0.430
MaInfo15	2.91	1.720	0.508	0.322

Table IV. Item statistics – management accounting information constructs

to load successfully at the 0.50 level and were subsequently removed from further statistical analysis. Furthermore, the "MaInfo15" item (i.e. benchmarking) failed (0.322) to meet the 0.35 corrected item-to-construct threshold level (Saxe and Weitz, 1982) and was therefore removed from the construct. Finally, although the "MaInfo1" item (i.e. financial performance indicators) returned a corrected item-to-construct score of 0.346, this was deemed close enough to the 0.35 threshold level to warrant inclusion in this exploratory construct. Therefore, after concluding these statistical tests to determine individual item reliability, the planning/control construct consists of the following four items; MaInfo1, MaInfo4, MaInfo5 and MaInfo6.

Consistent with the sequential logic required for determining the reliability and validity of the measurement model; a matrix of loadings of cross-loadings was then calculated to test the discriminant validity of each of the remaining items contained within each construct. As Table V illustrates, all of the remaining items (with one exception) had higher loadings with their corresponding constructs when compared to their cross-loadings. Therefore, it can be concluded that each has adequate

	TraSys	AdvSys	DecMak	PlaCon	HumCap	StrCap	RelCap	BusPer
MaSys1	*0.737*	0.386	0.273	0.110	0.121	0.083	0.079	0.041
MaSys2	*0.739*	0.515	0.297	0.102	0.109	0.037	−0.050	−0.073
MaSys3	*0.823*	0.523	0.391	0.138	0.052	0.079	0.084	0.000
MaSys7	*0.631*	0.302	−0.043	0.028	0.020	0.055	−0.114	−0.070
MaSys8	*0.767*	0.680	0.346	0.127	0.186	0.099	−0.020	0.141
MaSys4	0.615	*0.525*	0.302	0.060	0.117	0.111	0.075	0.059
MaSys5	0.482	*0.683*	0.416	0.206	0.322	0.130	0.108	0.196
MaSys6	0.434	*0.725*	0.329	0.197	0.106	0.020	0.004	0.000
MaSys9	0.492	*0.680*	0.267	0.038	0.154	0.070	−0.099	0.088
MaSys10	0.566	*0.890*	0.409	0.196	0.153	0.130	0.050	0.194
MaSys11	0.498	*0.881*	0.451	0.245	0.261	0.157	0.121	0.219
MaSys12	0.547	*0.899*	0.540	0.258	0.215	0.186	0.138	0.256
MaSys13	0.304	*0.569*	0.243	0.140	0.210	0.168	0.161	0.053
MaInfo7	0.183	0.227	*0.611*	0.413	0.194	0.005	−0.091	−0.002
MaInfo8	0.142	0.289	*0.562*	0.214	0.194	0.050	0.063	−0.015
MaInfo9	0.364	0.395	*0.599*	0.378	0.214	0.105	0.053	0.074
MaInfo10	0.193	0.198	*0.652*	0.464	0.122	0.041	0.080	0.037
MaInfo11	0.236	0.273	*0.696*	0.324	−0.066	−0.046	−0.065	−0.027
MaInfo12	0.175	0.348	*0.794*	0.517	0.118	−0.089	−0.062	0.045
MaInfo13	0.351	0.562	*0.783*	0.370	0.034	−0.002	0.023	0.026
MaInfo14	0.272	0.406	*0.644*	0.246	−0.084	0.091	0.026	0.036
MaInfo1	0.024	0.113	0.165	*0.610*	0.176	0.137	0.037	0.070
MaInfo4	0.178	0.148	0.392	*0.813*	0.321	0.101	0.171	0.131
MaInfo5	0.062	0.159	0.445	*0.850*	0.215	−0.035	0.088	0.096
MaInfo6	0.142	0.290	0.615	*0.652*	0.144	−0.046	−0.087	−0.004
HumCap1	0.038	0.115	0.167	0.318	*0.742*	0.329	0.476	0.402
HumCap2	0.205	0.242	0.144	0.265	*0.790*	0.262	0.312	0.291
HumCap4	0.199	0.237	0.203	0.308	*0.774*	0.181	0.238	0.330
HumCap5	0.074	0.198	0.138	0.191	*0.815*	0.364	0.366	0.438
HumCap6	0.049	0.208	0.021	0.147	*0.875*	0.339	0.324	0.437
HumCap7	0.088	0.243	0.012	0.222	*0.833*	0.293	0.323	0.443
StrCap1	0.090	0.113	−0.012	0.104	0.348	*0.792*	0.378	0.376
StrCap2	0.090	0.164	0.035	−0.050	0.282	*0.880*	0.458	0.254
StrCap3	0.035	0.066	−0.101	−0.041	0.251	*0.895*	0.504	0.299
StrCap5	0.114	0.216	0.160	0.171	0.368	*0.800*	0.523	0.347
RelCap1	−0.073	0.048	−0.062	−0.006	0.409	0.511	*0.804*	0.440
RelCap2	0.182	0.164	−0.047	0.051	0.289	0.391	*0.723*	0.357
RelCap3	−0.100	0.029	0.081	0.132	0.349	0.489	*0.873*	0.373
RelCap4	0.021	0.075	0.020	0.083	0.303	0.387	*0.818*	0.336
BusPer1	−0.040	0.159	−0.029	−0.005	0.372	0.336	0.344	*0.870*
BusPer2	0.033	0.165	0.049	0.102	0.430	0.342	0.390	*0.908*
BusPer3	0.054	0.167	0.060	0.096	0.403	0.271	0.432	*0.877*
BusPer4	0.111	0.143	0.101	0.255	0.501	0.330	0.435	*0.730*
BusPer5	−0.087	0.176	−0.035	0.015	0.353	0.307	0.376	*0.817*

Table V. Matrix of loadings and cross-loadings discriminant validity. The exception was item MaSys4 (i.e. activity-based costing/management) which loaded onto its "own" construct at a level of 0.525, whilst simultaneously loading onto the traditional systems construct at a level of 0.615. This "finding" suggests that for some firms within the Irish indigenous ICT sector, activity-based costing/management may have been implemented in a basic fashion, while for others, it represents a sophisticated approach to costing.

In relation to the statistical tests required to determine the internal consistency of all eight constructs used in this study; seven met the 0.70 threshold for both tests (see Table VI). The only exception was the planning/control construct which although it fell marginally short (0.695) of the minimum Cronbach's α score (i.e. 0.70) generally required to demonstrate adequate internal consistency; it was nevertheless deemed acceptable due to the fact that it easily surpassed (at 0.9074) the minimum 0.70 requirement for Fornell and Larcker test of internal consistency. With regard to the test for convergent validity (i.e. reliability) at the construct level; one of the MA information constructs, i.e. decision making generated a result of 0.4520. However, the exploratory nature of this construct, coupled with the fact that it met and exceeded all other statistical validation requirements (and is reasonably close to the requisite 0.50 convergent validity level), renders this result acceptable in an exploratory study.

Finally, all of the eight constructs were tested for discriminant validity via a correlation of constructs (see Table VII). As each construct successfully passed this statistical requirement (i.e. each construct correlates at a higher level with itself than it does with any of the other seven constructs used in the study), the existence of adequate discriminant validity for all constructs used in this study is confirmed.

Having successfully determined the statistical validity and reliability of both the items and constructs used in this study (known as the "measurement model"),

Table VI. Internal consistency and convergent validity

	Internal consistency		Convergent validity
	α (0.70)	Fornell and Larcker (0.70)	Fornell and Larcker (0.50)
TraSys	0.789	0.8588	0.5506
AdvSys	0.859	0.9056	0.5538
DecMak	0.823	0.8668	0.4520
PlaCon	0.695	0.9074	0.5452
HumCap	0.885	0.9174	0.6848
StrCap	0.862	0.9074	0.7107
RelCap	0.818	0.8809	0.6501
BusPer	0.896	0.9242	0.7102

Table VII. Discriminant validity – correlation of constructs

	TraSys	AdvSys	DecMak	PlaCon	HumCap	StrCap	RelCap	BusPer
TraSys	*0.742*							
AdvSys	0.675	*0.744*						
DecMak	0.332	0.501	*0.672*					
PlaCon	0.131	0.241	0.558	*0.738*				
HumCap	0.131	0.250	0.155	0.297	*0.806*			
StrCap	0.096	0.162	0.032	0.047	0.365	*0.843*		
RelPer	0.001	0.094	0.004	0.059	0.426	0.551	*0.806*	
BusPer	0.007	0.171	0.031	0.092	0.482	0.371	0.465	*0.843*

the results of the PLS statistical testing performed upon all four of the conceptual (i.e. structural) models using the software package PLS-Graph can now be analysed.

The majority of the results generated (see Figures 1-4) strongly support previous studies which considered the relationship between the three primary components of IC (i.e. human capital, structural capital and relational capital) and business performance. Specifically, the following three β-path coefficients were found to be both positive and statistically significant at a p-value < 0.01 in all four models tested – human capital and relational capital, relational capital and structural capital, and relational capital and business performance. Additionally, the β-path coefficient between the structural capital construct and the business performance construct, although positive in all four models, was not found to be statistically significant in any instance. Finally, partial support is offered for the β-path coefficient between the human capital construct and the structural capital construct, as it is positive in all four models but only statistically significant at a p-value < 0.10 in Figure 4 – planning/control accounting information.

In terms of the MA-related results; in Figure 1 – the impact of traditional MA systems on both the structural capital and business performance of the respondent firms was considered. Although both β-path coefficients are positive, neither are statistically significant with results as follows; structural capital ($\beta = 0.074$; $t = 1.2345$) and business performance ($\beta = 0.095$; $t = 0.6759$).

Similarly, Figure 2 examined the same relationships but in the context of the impact of advanced MA systems. In relation to structural capital, the β-path coefficient is positive but not statistically significant ($\beta = 0.091$; $t = 0.9432$) whereas for business performance, the result is somewhat surprising as it is both positive and statistically significant at a p-value < 0.10 ($\beta = 0.157$; $t = 1.7346$).

Figure 3 proposed that decision making accounting information was positively associated with both structural capital and business performance. although positive, neither proposition was statistically significant with results as follows; structural capital ($\beta = 0.099$; $t = 1.3330$) and business performance ($\beta = 0.002$; $t = 1.2203$).

Finally, Figure 4 proposed that planning/control accounting information was positively associated with both structural capital and business performance. Here, the results revealed weak positive β-path coefficients, neither of whom is statistically significant, with results as follows; structural capital ($\beta = 0.009$; $t = 0.4571$) and business performance ($\beta = 0.074$; $t = 0.5678$).

To assess the predictive power of each of the four structural models, the R^2 values of each endogenous construct must be considered. Here, the results generated are very consistent, within a narrow range and support previous IC-based research. Specifically, they are as follows; structural capital (33.9-34.8 per cent), relational capital (19.6 per cent in all instances) and business performance (24.8-27.2 per cent). The next section of the paper now discusses these results.

5. Discussion

The recent findings of Novas *et al.* (2012), who reported that within their sample of Portugese firms' MA systems were found to have a positive and statistically significant impact on their structural capital, is not supported here. Results from Figure 1 (traditional MA systems) and Figure 2 (advanced MA systems), although positive, are not statistically significant. Concerning MA information (see Figures 3 and 4), the results from this study also confirm that the relationship between MA information for both decision making and planning/control purposes and structural capital although positive are not statistically significant. Collectively, these results reject the contention (Booth, 1998; Lynn, 1999; Roberts, 2003) that MA is most appropriately situated as an element of a firm's structural capital within the Irish ICT sector.

In relation to the impact of MA (both systems and information) on subsequent business performance; although the results from all four models are positive, the sole statistically significant result at a *p*-value < 0.10 was that obtained from Figure 2 (advanced MA systems). Therefore, for firms operating within the Irish indigenous ICT sector, it can be concluded that these results offer only very partial and modest support for the potential direct impact of MA upon business performance (Mia and Clarke, 1999; Waldron and Everett, 2004).

Concerning the relationship between the three elements of IC and business performance; the results obtained here generally supports prior research in this area (see, e.g. Bontis and Fitz-enz, 2002; Bontis *et al.*, 2000; Jardon and Martos, 2009; Ordonez de Pablos, 2002; Wang and Chang, 2005). However, unlike for example; Bontis (1998), Do Rosario Cabrita and Landeiro Vaz (2006), Novas *et al.* (2012) and Jardon and Martos (2009) no statistically significant relationship was found to exist between structural capital and business performance in this particular research study; although this does not necessarily imply that such a relationship does not exist. The findings from this study also confirm the importance to firms of their employees (human capital) in impacting positively upon both their structural capital and their relational capital, which may, in-turn impact upon business performance (Bontis, 1998; Bontis *et al.*, 2000; Bontis and Fitz-enz, 2002; Wang and Chang, 2005; Do Rosario Cabrita and Landeiro Vaz, 2006).

6. Conclusion

The results obtained from this study do not support the proposition that MA is most appropriately situated as an element of structural capital in Irish indigenous ICT firms. However, the results do support a modest and statistically significant relationship between these firms use of advanced MA systems and their subsequent business performance. The findings also generally support previous research concerning the relationships between the three elements of IC (i.e. human capital, structural capital and relational capital) and business performance.

With regard to the mean usage of MA systems within this sector (see Table III), it appears as though indigenous Irish ICT firms still generally favour the use of "traditional" rather than "advanced" MA systems. This is a potentially serious issue for both firms and management accountants, as it suggests that more contemporary systems such as activity-based costing, balanced scorecard and others are not typically used in this sector and it therefore appears that such firms are making operational and strategic decisions using traditional MA systems. One possible reason for this reluctance to implement and utilise the outputs generated from more advanced MA systems was provided by Van Der Steen (2009) who claimed that employees overly familiar with incumbent MA systems makes it difficult for management to implement new and potentially more beneficial systems. However, in their defence, as the indigenous Irish ICT sector continues to expand and mature, then it is very likely that they will begin to implement more sophisticated MA systems to cater for their increasingly sophisticated managerial information requirements (Bhimani, 2003; Ittner and Larcker, 2001; Waldron and Everett, 2004).

Alternatively, it could be argued that the current scenario offers support for Otley's (2008, p. 235) argument when he claimed that, "[…] the role of traditional management accounting is diminishing. Many of the new techniques prove to be not all that new; the developments that appear to offer most potential move into areas where the traditional skills of a management accountant are able to add little value". This stance was endorsed by Anderson (2007) who in discussing "strategic" MA claimed that although there was evidence to suggest that much was happening in this regard within organisations', much of it was occurring outside of the accounting function.

Based upon the above, it is reasonable to suggest that MA may be at risk (or may have already begun the process) of losing its privileged position as the information provider of choice for subsequent managerial decision making. Furthermore, it has also been claimed that the role of both MA and management accountants continues to diminish due to a combination of factors such as heightened pressures for enhanced internal controls and fraud detection, the introduction of new International Financial Reporting Standards, firms operating in a Sarbanes-Oxley environment and others (Langfield-Smith, 2008). All of this uncertainty surrounding MA affords researchers' significant opportunities to investigate how the global knowledge economy within which organisations now operate has been embraced (or not) by those employed in this area with the ability and authority to do so.

In relation to IC, the results re-affirm the importance for firms of augmenting their relationships with external stakeholders (relational capital), as a means of positively influencing both their structural capital and business performance. This requires that firms transform the knowledge generated in their dealings with external entities to become an element of their own internal knowledge base capable of dissemination throughout the organisation. This may, in turn, lead to enhanced business performance if managed appropriately. This finding supports earlier work by Galbreath and Galvin (2004) who suggested that no single resource can be considered critical in determining firm performance. Instead, elements of human capital, structural capital and relational capital are each needed for the creation of IC within firms. The findings also suggest that indigenous Irish ICT firms should encourage their employees to voluntarily share their knowledge with both their colleagues for use in developing subsequent products and/or services, and with external stakeholders to solidify relationships with this key grouping.

Concerning research limitations; as this study was conducted solely within the Irish indigenous ICT sector, the results are not generalisable to other economic sectors either in Ireland or abroad. Also, as a survey instrument was used to collect the data used in the study, the use of such an ostensive approach to IC research (e.g. a generalist survey) cannot and will not uncover the individual practices developed internally by organisations to assist them in developing and harnessing their organisation's IC (Murthy and Mouritsen, 2011), whereas a performative research approach (e.g. a case study) is likely to do so (Dumay, 2012; Mouritsen, 2006). Furthermore, as the MA dimension of this study is exploratory in nature, all of the items comprising MA systems and MA information used in this study were developed specifically for it and thus, have not been tested/used previously. These items would need to be used in other research studies, and probably improved upon, before the statistical validity and robustness of these MA constructs can be firmly established. Insights from case study work, and interviews with practicing management accountants should also enhance this process of construct improvement.

A number of areas of future research, both ostensive and performative (Mouritsen, 2009), may be suggested here. For example, a series of in-depth case studies could be undertaken to uncover how exactly the use of MA has evolved to cater for the increased prominence of intangible resources at an organisational level. Alternatively, the items and constructs used in this research could be replicated in studies conducted within other knowledge-intensive industries/sectors to gauge if the results obtained here are applicable elsewhere; and to further improve the relevant MA constructs. Ultimately, in conducting research investigating the role of (management) accounting in knowledge-intensive firms'; researchers should note the recent call made by Leif Edvinsson (2013, p. 169), when he stated that, "we need to go beyond IC reporting, to think in terms of cross-disciplinary systematised perspectives that will increase the IC consciousness".

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