A Procedure for Measuring and Validating a Construct of Service Innovation Capability Maturity

Abstract

Service organisation success is not the result of discrete service innovations and should be attributed to the capability underpinning the repeated and continuous generation of these outputs, labelled service innovation capability (Pöppelbuß *et al.*, 2011; Lillis *et al.*, 2015; Nada and Ali, 2015; Hariandja, 2016). However, this capability is poorly understood and there is no mechanism available to organisations for evaluating their performance or identifying areas of strength or weakness (Hogan *et al.*, 2011). This is a consequence of inadequate systematic effort devoted to methodological issues in this domain, where existing measures fail to follow established procedures in their development or measure the effectiveness, or maturity, of this capability (Tuominen and Anttila, 2006; Kohler *et al.*, 2013). In response, this paper nominates a solution, describing comprehensive, best practice guidelines for the development and validation of a measure of the maturity of service innovation capability (MacKenzie *et al.*, 2011).

Introduction

Service innovation capability (SIC) has become increasingly important to small and medium-sized enterprises (SMEs) as it not only determines their competitive advantage, but often their very survival (McDermott and Prajogo, 2012). However, these organisations lack a clear understanding of the effectiveness of this capability and managers, who want to plan and control organisational activities, remain unaware of their performance or where resources ought to be directed to improve their SIC (Enkel *et al.*, 2011). Consequently, they are unable to realise the full economic benefits of service innovation. For Tuominen and Anttila (2006) and Hogan *et al.* (2011) this dilemma is attributed to defective procedures in the development of SIC measures that violate a best practice sequence of logical and incremental activities prescribed for the development and validation of legitimate measures of constructs (Churchill, 1979; Hinkin *et al.*, 1997; MacKenzie *et al.*, 2011; DeVellis, 2017).

As illustrated on Table 1, these guidelines are ignored or implemented arbitrarily and no measure of SIC fulfils all requirements in its development. One such step is clarification of the conceptual theme, the neglect of which has resulted in confusion surrounding the distinctness of SIC from other constructs and the utilisation of deficient indicators (Podsakoff *et al.*, 2016). Another shortcoming relates to the failure of measures to consider the dimensionality of SIC. Despite its acceptance in the literature as a multidimensional construct (Wang and Ahmed, 2004; Tuominen and Anttila, 2006; Ngo and O'Cass, 2009; Hogan *et al.*, 2011), SIC is repeatedly measured unidimensionally (Grawe *et al.*, 2009; Daugherty *et al.*, 2011; Thambusamy and Palvia, 2011; Tang *et al.*, 2015; Tang, 2015). This approach has too narrow a focus to adequately tap the domain of SIC and impedes diagnostic potential by concealing variables key to improving its performance. Furthermore, while it is usual for measures to identify the property to which the construct refers (Schwab, 1980; Davis, 1989; MacKenzie *et al.*, 2011), no SIC measure on Table 1 articulates that its examines the intensity, performance, effectiveness, or any other attribute of this capability. Instead, they provide statements with which respondents are asked to rate their level of agreement and neither provide a picture of capability performance or identify areas of strength and weakness.

Phase	Step		Designer of measure							
			(Wang and Ahmed, 2004)	(Tuominen and Anttila, 2006)	(Ngo and O'Cass, 2009)	(Thambusamy and Palvia, 2011)	(Hogan *et al.*, 2011)	(Daugherty *et al.*, 2011; Grawe *et al.*, 2009)	(Tang, 2015)	(Tang *et al.*, 2015)
Conceptualisation	Examine existing concept definitions	Examine how the construct has been defined and is used in existing research. Identify closely related constructs.	✓	×	✓	×	✓	✓	×	×
	Specify the conceptual domain of the construct	Specify the property to which the construct refers and the entity to which the property applies.	×	×	×	×	×	×	×	×
	Specify conceptual theme	Describe the necessary and sufficient attributes or characteristics something must possess to be an example of the construct. Consider the stability of the construct over time.	×	×	×	×	×	×	×	×
	Unambiguously define construct	Clearly and concisely define the construct.	✓	×	✓	✓	✓	✓	✓	✓
	Construct dimensionality	Determine whether the construct is unidimensional or multidimensional and how the dimensions relate to each other and the construct.	✓	✓	✓	×	✓	×	×	×
Development of measures	Generate items to represent the construct	Generate and precisely write a set of items that fully represent the construct's conceptual domain.	✓	✓	✓	✓	✓	✓	✓	✓
	Assess the content validity of items	Evaluate the extent to which the items represent the construct's content domain.	×	✓	✓	×	✓	×	×	×
Model specification	Formally specify the measurement model	Specify the empirical relationships between indicators and the focal construct.	✓	×	×	×	×	✓	×	×
Measure evaluation and refinement	Collect data to conduct pretest	Data are obtained from a sample representative of the population to evaluate the psychometric properties of the measure.	×	×	×	✓	×	×	×	×
	Measure purification and refinement	Decisions relating to the purification of the measure through the elimination of items are made by evaluating the model's goodness of fit and the validity of indicators.	✓	×	×	×	✓	×	×	×
Validation	Gather data from a new sample and re-examine measure properties	If items are added, dropped, or reworded during purification and refinement of the measure, its psychometric properties are re-examined with a new sample representative of the population.	×	×	×	×	×	×	×	×
	Assess measure validity	Assess the validity of the construct.	✓	✓	✓	✓	✓	✓	✓	✓
	Cross-validate the measure	To confirm the equivalence and invariance of the measure across groups, its psychometric properties are cross-validated with a new sample representative of another population to which the measure is expected to apply.	×	×	×	×	×	×	×	×
Norm development	Develop norms for the measure	Develop norms to aid in the interpretation of scores on the measure.	×	×	×	×	×	×	×	×
Maturity			×	×	×	×	×	×	×	×

Table 1: Procedural steps adhered to for development and validation of SIC measures

Despite the importance of the relationship between SIC and its dimensions or indicators, this association has been given insufficient consideration. The conventional approach to measurement, which perceives causality as flowing from the construct to measures that imperfectly reflect it, is adopted without question in all instances, and changes in SIC are detected through corresponding changes in its indicators (Churchill, 1979; DeVellis, 2017). Failure to examine this relationship is apparent from the neglect of any measure to adopt a formative approach, where SIC is conceptualised as being constituted or formed by its indicators (Bollen and Lennox, 1991; Edwards and Bagozzi, 2000). This is in direct conflict with the stated importance of understanding the dimensions of this capability as levers through which it may be enhanced (Hogan *et al.*, 2011).

The deficiencies in the development SIC measures are not exclusive to their early phases. For successive steps, all measures neglect cross-validation, an omission that raises serious questions regarding their applicability to other contexts (Steenkamp and Baumgartner, 1998). Furthermore, all measures overlook the final step, where a frame of reference and standards should be provided in order to support the interpretation of meaning from scores. Consequently, organisations that use these measures are unaware of the significance of their results and whether or what management actions are required (Spector, 1992).

This peculiarity in the domain runs contrary to the very purpose of measuring organisational capabilities which is to inform their strategic management and improve the performance of an organisation (Helfat *et al.*, 2007). To support performance management in other domains, it is common for measures to assess the maturity of a capability (Röglinger *et al.*, 2012; Pekkola *et al.*, 2015). This describes an organisation's current status compared to best practice, represented along a continuum of 'maturity levels' that detail the characteristics of the capability, or its components, at qualitatively distinct plateaus of achievement (Esterhuizen *et al.*, 2012b; Wendler, 2012). The approach enables organisations to identify their strengths and weaknesses and prioritise actions for improvement (Guédria *et al.*, 2015). Indeed, maturity assessments have gained prominence in recent years as a result of gathering evidence that they are a prerequisite to superior results and consistent, strong organisational performance (Ibbs *et al.*, 2004; Gibson *et al.*, 2006). However, to this point, no researchers have yet taken the initiative to apply this concept to service innovation capability, meaning that its effective management or optimisation is unattainable for organisations.

The collective consequence of these inadequate and non-systematically constructed measures is that organisations have no psychometrically sound apparatus with which to diagnose the performance of their SIC or identify actions for its enhancement. Indeed, none of these measures have any practical application. In response to the deficiencies detailed in this section, this paper proposes best practice guidelines (Churchill, 1979; MacKenzie *et al.*, 2011), composed of six phases, for the development of a measure of SIC maturity.

The paper proceeds as follows. The next section overviews the procedural phases for constructing and testing the measure. This is followed by an elaboration of activities required for the successful execution of each step. Finally, the paper concludes by summarising its contributions.

Methodology

This section overviews the rigorous multistage procedure to develop and validate a measure of SIC maturity. It was derived from guidelines suggested by several methodologists (Churchill, 1979; Hinkin *et al.*, 1997; Diamantopoulos and Winklhofer, 2001; MacKenzie *et al.*, 2011; DeVellis, 2017) and is consistent with approaches taken by other researchers assessing capability maturity (Aho, 2012; Wulf *et al.*, 2015). The procedure consists of six phases encompassing fourteen steps and is illustrated in Figure 1. It commences with conceptualisation of the focal construct and its maturity. This is followed by the generation of items that allow for maturity to be assessed and confirmation of their content validity. After this, the measurement model is specified and steps taken to empirically validate the measure. Guidelines for each of these steps will be discussed in the sections that follow. Additionally, practical examples of the execution of these instructions is described by the text segregated in boxes.

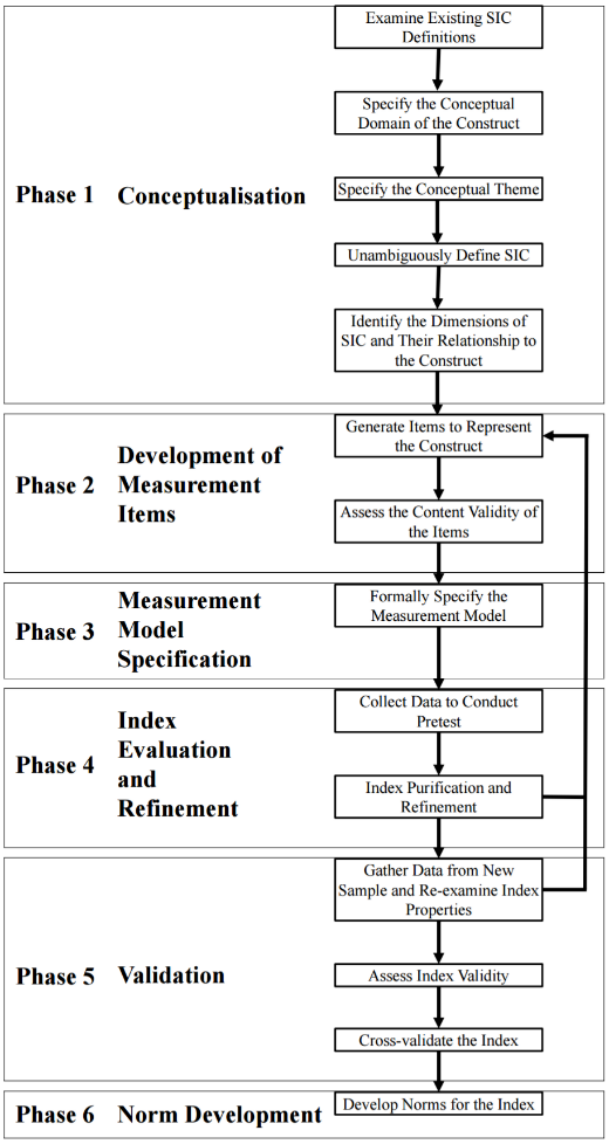

Figure 1: Overview of construct measurement procedure. Adapted from MacKenzie et al. (2011)

1. Conceptualisation

The first stage in developing a scale or index to measure a phenomenon is to define the construct's conceptual domain (Hinkin, 1995; Lewis *et al.*, 2005; MacKenzie *et al.*, 2011; DeVellis, 2017). This requires specifying the conceptual meaning of the construct, explicating its differences from other constructs, and identifying what the construct intends to capture (Wong *et al.*, 2008).

Examine Existing SIC Definitions

Initially, the researcher must examine how the focal construct has been defined or conceptualised in prior research (Clark and Watson, 1995). From this, an understanding can be developed regarding its use by other authors, clarification of conceptual boundaries, the identification of closely related constructs, and confirmation that the proposed scale or index is indeed necessary (Clark and Watson, 1995; MacKenzie *et al.*, 2011).

SIC is a multifaceted concept that has been used to describe the collective activities that enable an organisation to consistently and predictably produce service innovations (Lawson and Samson, 2001; Gryszkiewicz et al., 2013). There is consensus that possession of this capability enables an organisation to respond and adapt to changes in their operating environment through the development or improvement of services (Pöppelbuß et al., 2011; Lillis et al., 2015).

It is understood to be distinct from new service development (NSD) which describes the architectural elements and processes through which new services are delivered (Storey and Kelly, 2001). The important difference is that NSD is concerned with activities at a project or process level (Alam and Perry, 2002), while SIC is more general at the organisational level (Ordanini and Parasuraman, 2011). There is support too for a strong positive relationship between SIC and organisational performance (Tang et al., 2015; Omar et al., 2016). Importantly, the requirement for a mechanism to measure this phenomenon is an issue that is repeatedly discussed in the literature (Grawe et al., 2009; Hogan et al., 2011; McLaughlin, 2012; Carroll and Richardson, 2017).

Specify the Conceptual Domain of the Construct

Next, the property represented by the construct and the entity or object to which it applies must be specified (Diamantopoulos and Winklhofer, 2001). The represented property can refer to many things, including thoughts, feelings, perceptions, actions, outcomes, or intrinsic characteristics (MacKenzie *et al.*, 2011). The entity, or object, to which the property applies can encompass individuals, groups, or the entire organisation (MacKenzie *et al.*, 2011).

For SIC, its maturity is the property referred to. It refers to an organisation's effectiveness at developing or improving services compared to best practice (Becker et al., 2009). It follows that the examined entity is the organisation itself as this is a firm-level phenomenon and is appropriately analysed from this perspective (Hogan et al., 2011).

Specify the Conceptual Theme

Next, the conceptual theme, or fundamental attributes or characteristics of the construct, which are necessary and sufficient for an entity to possess in order to represent an archetype of that construct, must be specified (MacKenzie *et al.*, 2011). To accomplish this, clarity of thought is required to establish characteristics that are both common and unique. On the whole, balance is required to avoid all entities possessing certain characteristics being classified as an instance of the construct, or the other extreme, where overly unique characteristics prevent other researchers from identifying eligible instances as an example of the construct (MacKenzie *et al.*, 2011).

Consistent with best practice, an extensive literature review was undertaken to specify the attributes of SIC at various levels of maturity (Van Steenbergen et al., 2010). This incorporated the maturity levels specified in 73 business process management maturity models (Van Looy et al., 2013). Because they described either divergent or domain specific maturity stages, or used similar nomenclature to describe different levels, themes were instead identified and the emergent viewpoints combined to create an integrated, composite model (Chung-Yang et al., 2014). The levels selected were Initial, Managed, Defined, Measured, and Optimising and are detailed on Table 2. Together they illustrate the evolutionary path that an organisation's SIC takes from ad hoc and immature execution to that which is more disciplined and mature (Wendler, 2012).

5	Optimising	A final idealistic state that represents best practice. Processes are precisely formalised and continuously improved.
4	Measured	Metrics monitor and evaluate formalised procedures to ensure they are predictably managed and controlled.
3	Defined	The breakthrough stage where there are defined plans, standardised processes, and acceptable management.
2	Managed	Inconsistent and reactive management processes, but represents the emergence of formalisation.
1	Initial	Short-term focus, conservative toward innovation, with ad hoc, undisciplined processes.

Table 2: Maturity levels

While the properties differ between each maturity level, they are expected to be broadly similar and discernible across all organisations. The maturity levels, or attributes, are unique in that they unmistakably and distinctly represent possession of SIC to varying degrees; but also account for commonality between instances, describing a degree of ability that organisations possess which may correspond to that of other firms.

Also at this stage, guidelines encourage researchers to specify how stable the attribute is expected to be over time and across situations and cases (MacKenzie *et al.*, 2011).

SIC maturity is hypothesised to be relatively stable over time. As it is deeply embedded within an organisation it is therefore not subject to rapid fluctuations, exhibiting either an extreme improvement or decline. In practice, this means that an organisation would not obtain a maturity score of 5 and after a short period obtain a score of 1.

Unambiguously Define SIC

The literature is very clear that unambiguous and concise definitions of constructs are integral to successful theory building (Johnson *et al.*, 2012; Hoehle and Venkatesh, 2015). The researcher must complete this task using only language that is not overly technical or that can be subject to multiple interpretations (MacKenzie *et al.*, 2011). Furthermore, it is recommended to avoid tautology in the definition and make certain that it positively describes the construct, rather than exclusively through explanations of what it is not, or its antecedents or consequences (Howell *et al.*, 2007b). Failure to unambiguously define a construct results in deficient indicators, misspecification of the measurement model, and inexactness regarding what precisely is being examined (MacKenzie, 2003).

Drawing on domain literature (Den Hertog et al., 2010; Nada and Ali, 2015), a novel and original definition for SIC was derived. Specifically, that SIC describes a key dynamic capability, embedded in the routines or processes of an organisation, with the potential to repeatedly deploy and reconfigure resources in the continuous creation or improvement of services.

Identify the Dimensions of SIC and Their Relationship to the Construct

Upon careful definition of the construct, the researcher must consider whether it has any conceptually distinguishable facets, or dimensions, and how these relate both to each other and the focal construct (MacKenzie *et al.*, 2011). If its fundamental characteristics do not describe distinctive or unique aspects of the construct and can be eliminated without restricting its conceptual domain, from a conceptual perspective the construct is considered unidimensional (Wetzels *et al.*, 2009). Conversely, if essential characteristics describe unique aspects of the construct, which if removed, do restrict its conceptual domain, it is designated multidimensional (Petter *et al.*, 2007). Constructs of this type have more than one dimension, each of which represent a portion of the overall construct and accordingly capture its heterogeneity (Law *et al.*, 1998; El Akremi *et al.*, 2015).

For SIC, a number of discrete dimensions were apparent. It was important that they were all included as the omission of any would significantly restrict the domain of the construct (Bollen and Lennox, 1991). To ensure this was achieved, a rigorous process was undertaken. This is illustrated in Figure 2. It commenced with an extensive literature review of studies concerning SIC or identifying key service innovation success factors (Van Riel et al., 2004; Menor and Roth, 2007; Den Hertog et al., 2010). As a result, 50 candidate dimensions were identified. Next, this large list was reduced through the elimination of 14 items that failed to correspond with the studies' operational definition of a capability, specifically those describing a behavioural characteristic, trait, proclivity, or aspect of an organisation's culture, rather than actions manifested in activities, routines, or processes (Helfat et al., 2007). From the surplus, a further 17 items were removed due to insufficient support that they were a critical dimension of, or enabled SME SIC. The remaining candidate dimensions were then subjected to a grouping and categorisation exercise and ultimately clustered around 4 dimensions, user involvement, networking, strategising, and knowledge management. Thus, SIC was considered to be a multidimensional construct, in that it represents "several distinct, related dimensions that can be treated as a single, higher-order, theoretical concept" (El Akremi et al., 2015: 3).

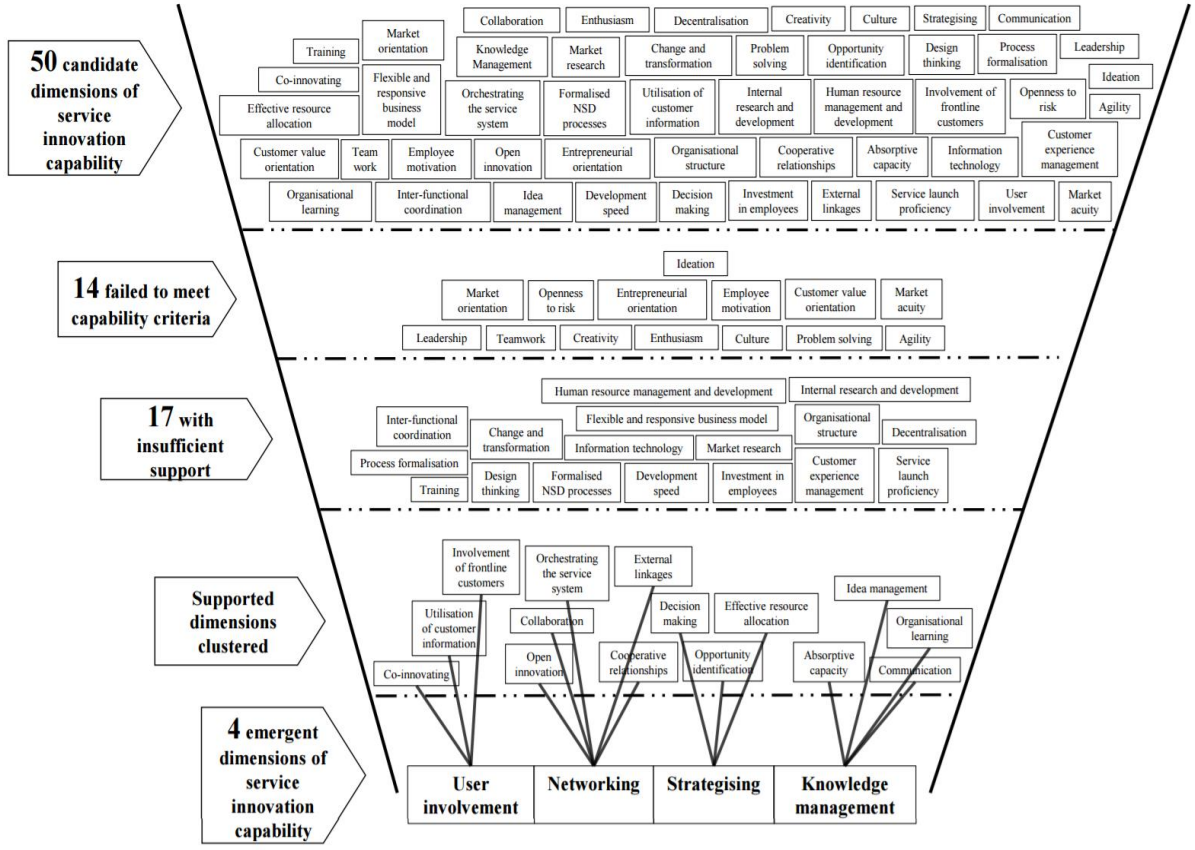

Figure 2: Process for identifying dimensions of service innovation capability

The following paragraphs provide some detail regarding the emergent dimensions.

User Involvement: This dimension is universally agreed upon by academics (Agarwal and Selen, 2009; Salunke et al., 2011; Jin et al., 2014). The explanation for this resides in the simultaneous production and consumption of services, with the implication that user involvement (UI) is not only a basis of production, but a decisive factor in an organisation's SIC (Milutinovic and Stosic, 2013). It highlights the importance of understanding the role of customers in value creation and utilising their participation at all stages of service innovation including, creation, development, production, and delivery (Lettl, 2007; Nicolajsen and Scupola, 2011). Lundkvist and Yakhlef (2004) argue that customers can be used as resources and are important sources of inputs, including development capabilities or knowledge that an organisation does not possess. In the context of this study, UI incorporates the organisation's ability to employ multiple methods for involving service users in the development of innovations, ensure their involvement at many stages, and integrate users in multiple roles.

Knowledge Management: Many scholars have highlighted the importance of knowledge management (KM) as an enabler, input, or support of SIC (Lawson and Samson, 2001; Den Hertog et al., 2010; Esterhuizen et al., 2012a). It is an umbrella term describing a variety of interlocking activities which manage and deploy knowledge for innovative purposes (du Plessis, 2007; Delgado-Verde et al., 2011). Through the effective management of knowledge, organisations improve their decision making, integrate data, enhance collaboration, and reduce the risk and uncertainty surrounding service innovation (Mehrabani and Shajari, 2012;

Jin et al., 2014). Hence, KM capability leverages processes and systems to support the effective use of knowledge for service innovation.

Strategising: There is widespread acknowledgement of the importance of strategising to SIC (Lawson and Samson, 2001; Giannopoulou et al., 2011; Gryszkiewicz et al., 2013). This dimension is considered to be a prerequisite for any innovative activity (Huang, 2011), enabling firms to align their service innovation strategy to the overall strategy of the business, appropriately use resources, promote creativity and experimentation, and balance market needs with service offerings (Jin et al., 2014). The capability is manifested by how firms define their goals and objectives, identify focus areas, and allocate resources (Gryszkiewicz et al., 2013). Roper and Xia (2014) detail how strategic decision making enables SMEs to overcome their resource constraints in the selection of projects, determine the most effective manner to undertake them, and evaluate acceptable levels of risk and complexity. While firms may be able to innovate in a non-routine or ad hoc manner without a strategy, goals, or a common vision, it is unlikely that they will be able to do so persistently (Clausen et al., 2012). Strategising therefore encompasses the capability of an organisation to allocate resources, identify specific areas of focus for innovation, and set goals and objectives that service innovations can be developed in pursuit of.

Networking: Numerous authors outline the importance of orchestrating and managing networks to an organisation's SIC (Den Hertog et al., 2010; Janssen et al., 2012; Kindström et al., 2012). Networking can be described as a process through which services are innovated which combines "the ideas, knowledge, capabilities, and technologies" of interconnected actors (Mustak, 2014: 152). There are a variety of motives for engaging in networking behaviours, including, access to diverse resources and capabilities, the distribution of costs and risk, enhanced knowledge transfer and organisational learning, and faster and more efficient commercialisation and diffusion of innovations (Mitrega et al., 2012; Mustak, 2014; Rusanen et al., 2014). However, the overarching incentive is that the outcomes that this dimension enables are greater than what could be realised by a firm independently (Hsueh et al., 2010; Ngugi et al., 2010). Hence, this dimension refers to an organisation's ability to configure and manage networks, effectively select beneficial partners, and proactively build networks for service innovation.

Relational form

If a construct is characterised as multidimensional, the nature of the relationship between each of the dimensions and the higher-order construct must be considered on the basis of conceptual criteria (Edwards, 2001; MacKenzie *et al.*, 2005). Specifying the direction and structure of this relationship is necessary to avoid erroneous results, adverse effects on theory development, and threats to the validity of statistical conclusions (Edwards and Bagozzi, 2000; Johnson *et al.*, 2012).

In determining this relationship, called 'relational form', the researcher is directed to consider two opposing relational directions consistent with the two primary classes of construct (Wong *et al.*, 2008). The first, and most frequently employed, is labelled reflective or superordinate, where the dimensions are manifestations of the focal construct (Johnson *et al.*, 2012). The second is labelled aggregate or formative, where the dimensions combine to form an overall representation of the construct (Law *et al.*, 1998). Central to these relational structures is whether the direction of causality flows from the measures to the construct or whether the reverse is true (Jarvis *et al.*, 2003; Howell *et al.*, 2007b). To reach a decision regarding which is most appropriate, researchers must consider whether the dimensions are manifestations of the construct or defining characteristics of it; whether the construct exists separately at a deeper

level or is a function of the dimensions; and whether a change in the construct is associated with a change in all dimensions or only in a single dimension, while the others remain unchanged (Law *et al.*, 1998; Jarvis *et al.*, 2003; Petter *et al.*, 2007).

The dimensions of SIC are understood to be its defining characteristics; it is a function of these dimensions; and a change in the maturity of SIC can occur as the result of a change in the maturity of a single dimension, without a change in the maturity of other dimensions necessarily occurring (Polites et al., 2012). Indeed, further examination of SIC reveals that it meets all of the conditions for when a formative representation of a construct should be used (Bollen and Ting, 2000; Howell et al., 2007b). These are depicted in Table 3.

✓	The indicators are viewed as defining characteristics of the construct
✓	Changes in the indicators are expected to cause changes in the construct
✓	Changes in the construct are not expected to cause changes in the indicators
✓	The indicators do not necessarily share a common theme
✓	Eliminating an indicator may alter the conceptual domain of the construct
✓	A change in the value of one of the indicators is not necessarily expected to be associated with a change in all of the other indicators
✓	The indicators are not expected to have the same antecedents and consequences

Table 3: Criteria for establishing a construct as formative. Adapted from Jarvis et al. (2003)

Thus, the dimensions which comprise SIC are measuring different aspects of it and each captures unique aspects not examined by the others (MacKenzie et al., 2005; Petter et al., 2007). Logically, as the dimensions are neither caused by, nor determined by the construct there is no requirement for them to be correlated and they may be entirely uncorrelated (MacKenzie et al., 2005).

With formative constructs, their dimensions are aggregated, or combined, according to specific algebraic formulae into a general concept (Edwards, 2001; El Akremi *et al.*, 2015).

For SIC, its maturity is an aggregation of the maturity of its dimensions (Cohen et al., 1990; Podsakoff et al., 2003b). They too can be executed at any of the five levels of maturity, which likewise describe the evolving characteristics of that dimension. Figure 3 depicts a conceptual model illustrating how the maturity of the dimensions are hypothesised to constitute the maturity of SIC.

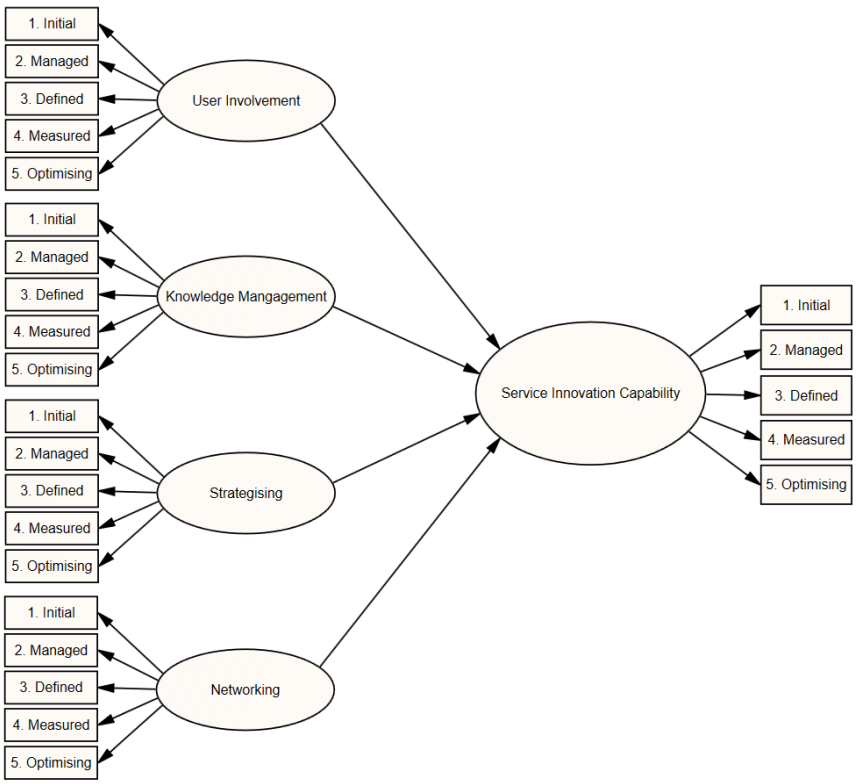

Figure 3: Conceptual model of SIC maturity

However, while the construct is evidently a function of its dimensions, whether it is additive, multiplicative, or based on "more complex algebraic formulas" must be determined by the researcher when deciding the manner in which the combination of dimensions give meaning to the construct (Polites *et al.*, 2012: 25). This structural property describes the relationship between the variables and can be direct, where one effects the other; indirect, where the effect of one variable on another is mediated by one or a number of other variables; spurious, in which the effect is a result of correlated or common causes; or unanalysed, in that effects result from the associations among predetermined variables (Edwards and Bagozzi, 2000).

For SIC, measurement occurs through a direct, additive model, where there is a linear relationship between the maturity of SIC and the maturity of its dimensions, and each contributes separately to the overall meaning of the construct (Polites et al., 2012). SIC maturity is determined by selecting the value of the maturity level of the dimension with the lowest score. This is because this represents the only maturity level for which all dimensions have achieved the maturation criteria. SIC is understood to be a dependent variable, where a change in the maturity of only one, or a combination, of the dimensions (independent variables) imply changes in overall SIC maturity, without a change necessarily occurring in the maturity level of any of the other dimensions (Bollen and Lennox, 1991; Blommerde and Lynch, 2014).

2. Development of measurement items

The purpose of this phase is to produce a content valid set of items that fully capture all essential aspects of the construct's conceptual domain (MacKenzie *et al.*, 2011).

Generate Items to Represent the Construct

First, a census of indicators is generated that cover the "entire scope of the latent variable as described under the content specification" (Diamantopoulos and Winklhofer, 2001: 271). The

measure developed for formative constructs should be referred to as an index and focuses on explaining abstract or unobserved variance, understands indicators to be predictors of a construct, and considers multicollinearity between them to be undesirable (Diamantopoulos and Siguaw, 2006).

Various sources may be employed to establish these indicators, including literature reviews, expert suggestions, interviews or focus groups, deductions from the theoretical definition, or a combination thereof (Churchill, 1979; MacKenzie *et al.*, 2011). Integral to this phase is the inclusion of indicators that capture the construct and the purpose of the instrument, while minimising items which focus on concepts outside the focal construct's domain (MacKenzie *et al.*, 2011). Accordingly, its implementation is guided by the understanding and definition developed during the previous phase (DeVellis, 2017).

Additionally, the attention of the researcher is directed towards the writing and editing of items. Here effort must be made to ensure that the reading difficulty level is appropriate, wording of each statement is as precise and clear as possible, semantic and syntactic factors are accounted for, excessive length or unnecessary wordiness is avoided, jargon or colloquialisms are excluded, multiple negatives dismissed, and infrequently used or unfamiliar words are removed (Diamantopoulos and Winklhofer, 2001; Podsakoff *et al.*, 2003a). Generally, 'good items' are understood to be those with high clarity and low complexity (DeVellis, 2017).

For the Service Innovation Capability Maturity Index (SICMI), the indicators were devised a priori informed by relevant literature (Diamantopoulos and Siguaw, 2006). The starting point for the formulation of these items were the hypothesised properties of each of the dimensions as represented at each level of maturity (Oh et al., 2007). Therefore, an extensive review of guidelines for developing maturity models (Becker et al., 2009; Maier et al., 2012), coupled with frameworks from related areas (Arveson et al., 2010; Jin et al., 2014) was conducted to synthesise comprehensive descriptions of the characteristics of each dimension at all 5 levels of maturity (Wulf et al., 2015).

Some of these characteristics are generic, common advancement criteria that assume the improvement of organisational capabilities is made in predictable, distinct patterns. For instance, it is hypothesised that the highest level of maturity is continuously improved and level 4 is measured or monitored (Blommerde and Lynch, 2016). The other characteristics describe the evolving qualities of specific dimensions and their increased sophistication at higher levels of maturity. A 5 point scale was used to develop these maturity descriptions, with a significant effort made to adhere to the guidelines for item writing (Hoehle and Venkatesh, 2015).

Assess the Content Validity of the Items

Next, the researcher must evaluate the content validity of the generated items (Hinkin, 1995; Diamantopoulos and Winklhofer, 2001). Content validity is an indicator of the psychometric quality of measures and is defined as the "the extent to which a measure's items reflect a particular theoretical content domain" (Hinkin and Tracey, 1999: 175). The goal of this phase is to examine whether developed items measure what they intend and fully capture the construct's domain (Straub, 1989; Petter *et al.*, 2007).

It is important that this matter be addressed swiftly after the generation of measures because in cases with inadequate content there is no purpose in proceeding (Schriesheim *et al.*, 1993; Schriesheim *et al.*, 1999). Moreover, establishing content validity is strongly recommended due to the fact it is a precondition to establishing construct validity (Anderson and Gerbing, 1991; Hinkin and Tracey, 1999; Lewis *et al.*, 2005).

Content validity is a theoretical question, where subjective assessments are used to make judgements regarding the reasonableness of a measure's item content (Anderson and Gerbing, 1991; Schriesheim *et al.*, 1999; Straub *et al.*, 2004). These are often made by the researcher themselves by carefully and critically examining measurement items, their appropriateness to the theoretically specified content domain, and confirming the absence of item contamination (Schriesheim *et al.*, 1993; Lewis *et al.*, 2005).

An alternative to conducting this evaluation in isolation is to involve a panel of judges (Malhotra and Grover, 1998). However, this has numerous drawbacks and debate continues with regard to whose judgement should be used (Lawshe, 1975; Anderson and Gerbing, 1991). Furthermore, it is acknowledged that the subjective judgements of panellists can be unreliable (Lawshe, 1975) and may not be representative of intended respondents (Yao *et al.*, 2008).

For SICMI, the assessment of content validity was conducted in two parts.

(1) A critical comparison was undertaken with a deductively constructed Service Innovation Capability Maturity Matrix which provided descriptions of each dimension at each level of maturity (Blommerde and Lynch, 2016). The assessment of content validity was concerned with the extent to which the survey items sample the maturity of each of the dimensions in a representative and comprehensive manner. Content validity can be said to have been achieved as the items were similar to those described by the theoretical matrix.

(2) Experts were invited to evaluate the items. This review took the form of a content validity check, conducted by 4 experienced doctoral level researchers and one late stage PhD candidate (Hardesty and Bearden, 2004). Some concerns were expressed regarding the length of items and the use of academic language to describe the evolving dimensions. Upon completion of suggested revisions, content validity was deemed to be acceptable.

Ultimately, content validity was confirmed through consistency between the measurement items and maturity matrix, coupled with the verdict of an expert panel. The items are detailed on Table 4 on the following page.

	5. Optimising	4. Measured	3. Defined	2. Managed	1. Initial
User Involvement	Users play an intrinsic, collaborative, and permanent role in all phases of our new service development processes. They are treated as knowledgeable innovation partners and our relationship does not dissolve once a project is completed, but instead extends to multiple projects. Because of their value, we make an effort to continuously increase and enhance their input and cooperation at all stages of new service development.	Users have a direct, personal, and active role at each stage of our service development processes. While this role is extensive, it is not fully collaborative. We monitor and track their involvement throughout, from early development, through to the verification and testing of new services or service improvements.	In our organisation, users are loosely involved in the early phases of developing new services. Our service development processes happen in the same way each time and users, as 'experts', are able to share their specific needs, wishes, and requirements. Surveys or similar techniques are our preferred mechanism to gather users' opinions or insights.	We study and observe users, adopting various situation specific approaches, with the aim of defining the requirements for new or improved services. Usually, there is no direct contact with users. We tend to use internal channels like sales reports, feedback, and customer complaints to improve our understanding of service users' specifications.	In our organisation, user participation in the development of services is infrequent and ad hoc. In fact, unless a user approaches us, we assume we can develop the services that they want.
Knowledge Management	There is a culture in our organisation in which widespread, automatic sharing of knowledge and open communication occurs. We consider ourselves to be a learning organisation and use our experiences to continually improve how we manage knowledge for service development.	In our organisation, there are standard processes in place for capturing and sharing knowledge between employees. Knowledge sharing and learning is not organisation wide, but is presently limited to the departmental or group level. Metrics are in place to ascertain the performance of these processes and to provide feedback.	Our organisation has the basic framework and tools in place to support the systematic gathering, documentation, and communication of knowledge. Employee roles in these activities have been specified, but knowledge sharing chiefly occurs between individuals within groups.	We have some basic processes in place for capturing or utilising knowledge, but they are not always adhered to by staff. Staff are generally guided by their individual experiences, observations, and intuition, which are difficult to share with others.	We do not formally manage communication or knowledge in our organisation and any activities that occur in these areas do so in an unconscious and unsystematic way.
Strategising	In our organisation, standardised processes that integrate the contribution of employees at all levels are in place for deciding which services to develop or improve. We make changes or adjustments to these processes when we believe we can enhance their effectiveness. The resulting strategies aim to create new markets by doing what competitors cannot and are widely communicated for the purpose of supporting operational decisions.	During strategy development, we strive to identify future success factors, frequently engage with employees, and monitor the activities undertaken to confirm that our internal standards and methods are adhered to. The aim of developing or improving services is to outperform similar competitors.	We have formal and comprehensive strategic planning processes in place that occasionally involve staff. Generally, we use forecasting tools which allow us to keep pace with competitors or address niche markets.	Strategic planning for services only occurs in our organisation as a reaction to a specific urgent problem. It is conducted inconsistently, with erratic employee input, and a focus primarily on budgeting and costs.	Our strategies for service development or improvement are developed in an ad hoc way and neither involve staff nor explicitly specify our objectives.
Networking	We have established processes in place for building and managing relationships with our stakeholders. We learn from our successes and we continuously improve these processes. All of our stakeholders are involved with service development activities and collaborations allow us access to their skills and knowledge. We actively identify new parties with whom we can create beneficial relationships and maintain and maximise those with highly skilled parties such as research groups and consultants.	When possible, all stakeholders interested in, or impacted by, our service development activities are integrated into the process. However, this is not achievable on every occasion. Despite not actively searching for compatible organisations, we periodically initiate alliances or collaborations related to service development and use performance metrics to monitor and control how cooperation occurs.	In our organisation, all of our own employees are involved in service development and there are defined practices in place that govern our interactions and partnerships with other organisations. Usually, only significant external stakeholders are permitted to have an input into service development processes. Some knowledge is shared across the boundaries of our organisation and informal discussions, relationships, and associations with stakeholders are encouraged.	We sporadically involve only members of our organisation who are impacted by service changes, but we are beginning to understand the value of involving external parties too.	Creating or maintaining relationships with external parties for the purpose of enhancing our services is not represented in our businesses' processes. If collaboration does occur, it is entirely dependent on the skills or initiative of individuals. As an organisation, we ignore the potential impact changes to our services may have on supply chain actors and have a conservative attitude towards opening our boundaries for the purposes of knowledge sharing or cooperation.

Table 4: Content valid items for measuring the maturity of the dimensions of service innovation capability

3. Measurement model specification

The purpose of this phase is to depict the expected relationships between measured items and ensure they are correctly represented (Diamantopoulos, 2011).

Formally Specify the Measurement Model

An acceptable measurement model for SICMI is depicted in Figure 4. The rationale for its structure and properties are explained in this section.

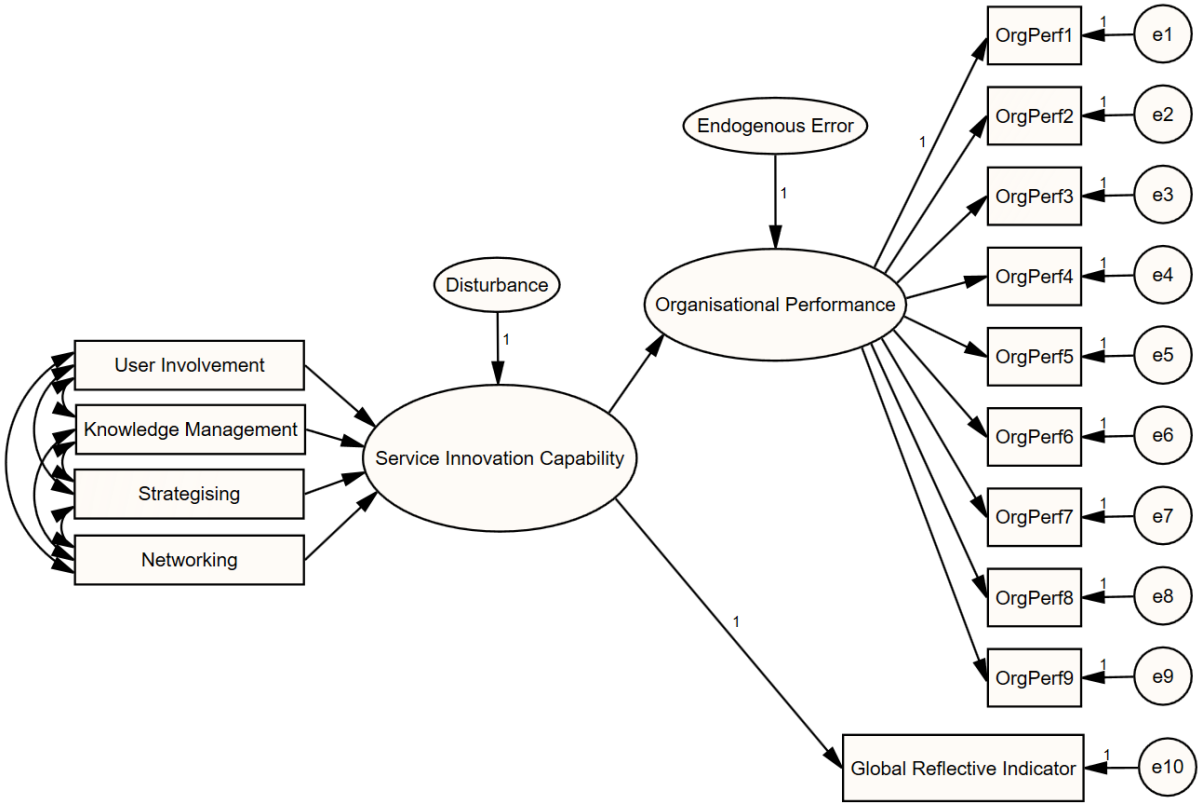

Figure 4: Diagram of an acceptable SICMI measurement model

Upon generation of a content valid set of items, formal specification of the measurement model takes place (MacKenzie *et al.*, 2011). However, this is complicated by the requirement to set the scale of measurement and fulfil other conditions so that all model parameters can be estimated using structural equation modelling software (Heise, 1972; MacCallum and Browne, 1993; Edwards, 2011).

For first-order constructs with multiple formative indicators, the scale of measurement can be set through any of the following acceptable solutions: (1) by fixing a path between the latent construct and one of its indicators at some non-zero value, usually 1; (2) by fixing the variance of the construct at a non-zero value, usually 1; or (3) by fixing an emitted path from the latent construct to a non-zero value, usually 1 (MacCallum and Browne, 1993; MacKenzie *et al.*, 2005; Bollen and Davis, 2009a; Diamantopoulos, 2011).

As illustrated in Figure 4, the scaling issue for SICMI can be resolved in a manner that does not interfere with determining the value of path coefficients from the indicators to the latent construct, by constraining to 1 the path from SIC to a global reflective indicator. This is an

item included to aid with validation which reflectively summarises the index, measuring SIC maturity using only a single indicator (Ali et al., 2012; Giovanis, 2013).

A second issue that complicates the specification of constructs with formative indicators, is the identification of the construct-level error term, or disturbance term (ζ) (MacCallum and Browne, 1993; Diamantopoulos *et al.*, 2008; Bollen and Davis, 2009b; MacKenzie *et al.*, 2011). In circumstances where measurement error is not expected to be present, ζ can be fixed to zero or excluded from the model (Diamantopoulos, 2006). However, it is required in the majority of cases as formative latent variables are determined by their indicators *plus* this disturbance term (Hildebrandt and Temme, 2006; MacKenzie *et al.*, 2011).

Indeed, identifying ζ is a requirement for SICMI as its dimensions may not fully represent the construct domain or account for all variance in the construct. This unaccounted for variance, attributed to alternative causes or additional conceptually appropriate determinants other than the four dimensions, must be quantified to confirm the validity of the dimensions (Bollen and Lennox, 1991; Jarvis et al., 2003; Diamantopoulos and Siguaw, 2006; Bollen and Davis, 2009b; Kim et al., 2010).

The challenge of identifying ζ can be overcome providing certain conditions are met (Bollen and Davis, 2009b; MacKenzie *et al.*, 2011). Included in these conditions is the '2+ emitted paths rule' that stipulates the latent variable must emit at least two directed paths to theoretically appropriate reflective variables that also have unrestricted error variances (Land, 1970; Anderson and Gerbing, 1988; MacCallum and Browne, 1993; MacKenzie *et al.*, 2005). It is advised that these measures are "caused directly or indirectly by the latent variable" (Edwards, 2011: 375) and accordingly their selection can be as important as the selection of the formative indicators (Diamantopoulos *et al.*, 2008; Wilcox *et al.*, 2008). These supplementary variables can be in the form of latent constructs, single indicators, or a blend of both (MacKenzie *et al.*, 2005).

In the case of SICMI, the global reflective indicator performs another function at this point, where it can be employed as an outcome variable to solve identification problems (Jarvis et al., 2003; Edwards, 2011). Adhering to the guidance of methodologists (Howell et al., 2007b; Diamantopoulos, 2011), an endogenous latent construct should also be introduced that represents one of the effects of service innovation capability, organisational performance (Tang et al., 2015; Omar et al., 2016). This is portrayed in Figure 4. While it is not conceptually appropriate or desirable in all cases for the focal construct to cause other latent constructs (Jarvis et al., 2003), this is not true of SIC, a capability that enables an organisation to generate innovative service outcomes and improve their performance (Blommerde and Lynch, 2013). It is the view of the authors that the entire structure ought to be interpreted as a measurement model for a single latent construct as each of its measures, whether reflective or formative, collectively operationalise the same focal construct (MacKenzie et al., 2005; MacKenzie et al., 2011).

In circumstances where the '2+ emitted paths rule' is used to identify the disturbance using structural relationships with other latent constructs (Wilcox *et al.*, 2008), it is critical that the researcher is aware of the potential impact of interpretational confounding (Diamantopoulos, 2011). This is defined as a "situation in which the empirically observed meaning between a latent variable and its measures differs from the nominal meaning expected under the original specification" (Kim *et al.*, 2010: 347). In other words, when meaning is assigned to a model from structural criteria, rather than epistemic criteria (Burt, 1976; Howell *et al.*, 2007b).

However, for SICMI, the model is not understood to be at risk of interpretational confounding as it is predominantly an implication of model misspecification and underidentification (Bollen, 2007; Howell et al., 2007a), neither of which impact this measurement model.

The final decision when specifying a construct with formative indicators is whether to constrain or freely estimate the covariances among the indicators (MacCallum and Browne, 1993; MacKenzie *et al.*, 2005).

For the SICMI measurement model, indicator covariances can be freely estimated once the theoretical and empirical impact of doing is considered (Jarvis et al., 2003; Petter et al., 2007). An illustration of the potential structure of an acceptable measurement model is shown in Figure 4.

4. Index evaluation and refinement

The purpose of this phase is to empirically test the measure, confirm that it is comprehensible to respondents, and eliminate or revise any inadequate measurement items.

Collect Data to Conduct Pretest

Initially, pretesting of the questionnaire under realistic data collection conditions, using similar procedures, with a small group of respondents representative of the target population must occur (Hunt *et al.*, 1982). Pretests have a qualitative character and the review panel are asked to complete the questionnaire, evaluating clarity, layout, length, question formats, order of questions, quality of instructions, unfamiliar words or terminology, sentence structure, and instances where the required information or response form is ambiguously specified (Anderson and Gerbing, 1991; Easterby-Smith *et al.*, 2002). The feedback provided facilitates revision of the instrument through the location and correction of weaknesses or ambiguities (Cannell *et al.*, 1989; Straub, 1989). Consequently, there may be reworded items, additional instructions, or changes in the design of the questionnaire.

Following the pretest, a pilot study can commence. This can be understood as a "testing ground or dry run for final administration of the instrument" (Straub, 1989: 161). The pilot study should be conducted with a sample representative of the target population and of sufficient size to facilitate statistical analyses (Hinkin, 1998; Oppenheim, 2000).

Index Purification and Refinement

The pilot data is used to purify and refine the index through the elimination of items (MacKenzie *et al.*, 2011). To inform decisions in this regard, a set of statistical tests are first undertaken to evaluate the measurement model's goodness of fit. This requires calculating values for chi-square (χ^2), comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardised root mean residual (SRMR) (Hu and Bentler, 1999). With formative models, attention should also be given to ζ, a value for unmeasured variance, as the lower this value, the higher the amount of variance accounted for by the construct and the greater its validity (Williams *et al.*, 2003). Finally, the validity of individual indicators should be considered through an examination of the strength and significance of their paths to the latent construct and confirmation that multicollinearity is not excessive (Diamantopoulos and Winklhofer, 2001; MacKenzie *et al.*, 2011). Informed by these determinations, the decision is made regarding whether items should be retained, modified, or eliminated.

With SICMI, the data generated are integers rather than being continuous. This means that while a non-significant p value of .10 or above is desired for χ^2 (MacKenzie *et al.*, 2011), the sensitivity of this test to nonnormally distributed data requires an additional determination of

the relative or normed χ^2 (χ^2/df) (Marsh and Hocevar, 1985). Values for this goodness-of-fit statistic below 5, in combination with a CFI above .95, RMSEA less than .06, and SRMR below .08 confirm an acceptable fit of the model to the data (Hu and Bentler, 1999). Following this, it must be confirmed that ζ constitutes less than half of the total variance of the construct, all structural coefficients are significant, and variance inflation factor (VIF) values are below 10 (Diamantopoulos and Winklhofer, 2001; Diamantopoulos, 2006).

5. Validation

The purpose of the validation phase is to confirm that the measure does indeed capture the intended construct and can be applied in other contexts.

Gather Data from New Sample and Re-examine Index Properties

Any changes to the pilot tested measurement items necessitate a re-evaluation of the index's psychometric properties, repeating all analyses in the previous step, using data obtained from a new sample (MacKenzie *et al.*, 2011).

Assess Index Validity

Upon confirmation that the psychometric properties of the purified index are acceptable, its nomological and discriminant validity are assessed (MacKenzie *et al.*, 2011). The former class of validity evaluates whether the measured construct behaves in the manner expected by underlying theory for a valid indicator of that construct (Giovanis, 2013). This requires an examination of its relationships with antecedents or consequences (Park *et al.*, 2017). The latter class of validity verifies that the construct is distinguishable from other measured items (Diamantopoulos *et al.*, 2008).

To assess the nomological validity of SICMI, the relationship between the SIC construct and the Organisational Performance outcome variable should have a strong and significant path coefficient. Discriminant validity is established through a determination that the SIC construct is less than perfectly correlated with Organisational Performance.

At this point, data is collected from a larger sample than that used for the pilot study, representative of another population to whom the measure is expected to apply. The responses obtained are employed for the final two steps of index validation.

Cross-validate the Index

The psychometric properties of the index, determined in the previous phase, are cross-validated with those of the sample of the new population (MacKenzie *et al.*, 2011). Specifically, comparisons are made regarding goodness-of-fit indices, values for path coefficients, and the disturbance term (Diamantopoulos and Papadopoulos, 2010). This establishes the equivalence, or measurement invariance of the index across groups and confirms its generalisability to other contexts (Steenkamp and Baumgartner, 1998; Bèzes, 2014).

For SICMI, data obtained from the pilot sample should be compared to that from the new sample vis a vis fit indices for the measurement model, values for the unconstrained standardised path coefficient from the SIC construct to Organisational Performance, values for the standardised estimates between the formative indicators and SIC construct, and disturbance terms.

6. Norm development

The purpose of norm development is to establish the distribution of scores for a measure across a population. This allows for meaning to be assigned to individual scores.

Develop Norms for the Index

Finally, to provide a frame of reference and assist with the interpretation of maturity scores, norms should be developed using the second sample (Spector, 1992). This requires values for the mean, standard deviation, and those related to distribution of the normative sample, specifically skewness and kurtosis, to be reported (MacKenzie *et al.*, 2011). It is likely that these norms will change over time and therefore should be updated periodically.

For SICMI, values for the mean service innovation capability maturity and the skewness and kurtosis of the distribution curve are calculated. An appropriate interval is decided for when these values should be revised.

Conclusion

This paper has established the deficiencies in current measures of SIC which have resulted in a vacuum of practical tools to support its effective management. It addresses these shortcomings and provides the basis for the development of a practical performance measurement tool in which users may have confidence. This is discharged through the advancement of a best practice set of procedural steps for developing and validating a measure of SIC maturity and an accompanying illustration of their operationalisation. Adhering to these guidelines, SIC was revealed to be a four-dimensional construct composed of user involvement, knowledge management, strategising, and networking capabilities. Its maturity, represented by five qualitatively distinct levels, is determined through a formative measurement model that aggregates the respective maturity levels of the four first-order dimensions.

The paper makes several important contributions to the literature. First, it forms the basis for a response to requests for a rigorously developed measure of SIC (Hogan *et al.*, 2011; Kohler *et al.*, 2013; Stryja *et al.*, 2013). Second, it offers guidance regarding the definition and conceptualisation of the construct. This has been neglected elsewhere, resulting in vague definitions and inconsistent dimensionality, both of which have been to the detriment of SIC measurement. Finally, it proposes a novel, formative approach to the measurement of SIC that transcends existing reflective measures. Exclusive utilisation of the reflective directional relationship between SIC and its indicators has, to this point, concealed levers for the enhancement of this capability.

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