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E-procurement quality from an internal customer perspective: Construct development, refinement, and replication using a mixed methods approach

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Abstract

Purpose: Despite significant investment in e-procurement by many organisations, perceived failings in the quality of such technologies and of the support provided to use them – termed here *e-procurement quality* – continue to generate resistance from internal customers who must assimilate e-procurement into their daily routines. Hence, the purpose of this paper is to advance our understanding of e-procurement quality from an internal customer perspective and to develop, refine, and validate construct measures.

Design/methodology/approach Research was undertaken in the UK and Netherlands incorporating a literature review, a qualitative study with 58 interviews, a quantitative study with 274 survey respondents, and a replication study with 154 survey respondents.

Findings: Analysis reveals that e-procurement quality comprises five universally applicable dimensions: *Processing*, *Content*, *Usability*, *Professionalism*, and *Training*. A sixth dimension, *Specification*, appears to be applicable, but context-specific.

Originality/value: The study represents one of the most extensive investigations of e-procurement quality to date and is the first to examine its underlying dimensional structure. The multi-item scales developed and validated using a mixed methods process are suitable for theory building and testing, as well as providing useful diagnostic value to practitioners.

Keywords: E-procurement quality; E-business technologies; Internal customer; Internal service; Service Quality; Mixed methods; Measurement and methodology; Replication

1. Introduction

The proliferation of e-procurement technologies over the last twenty years is fuelled by the belief that they can deliver significant operational benefits, including reduced transaction costs, greater delivery accuracy, lower purchasing prices, and greater control over organisational procurement (Gardenal, 2013; Kauppi et al., 2013; Rotchanakitumnuai, 2013; Swamy et al., 2014; Queenan et al., 2011). However, the potential value of e-procurement continues to be hampered by low levels of system and support provision to the internal customers (end users) who are expected to use them in their daily routines (Brandon-Jones and Carey, 2011; Doherty et al., 2013; Karjalainen and van Raaij, 2011), termed here 'e-procurement quality'. Despite
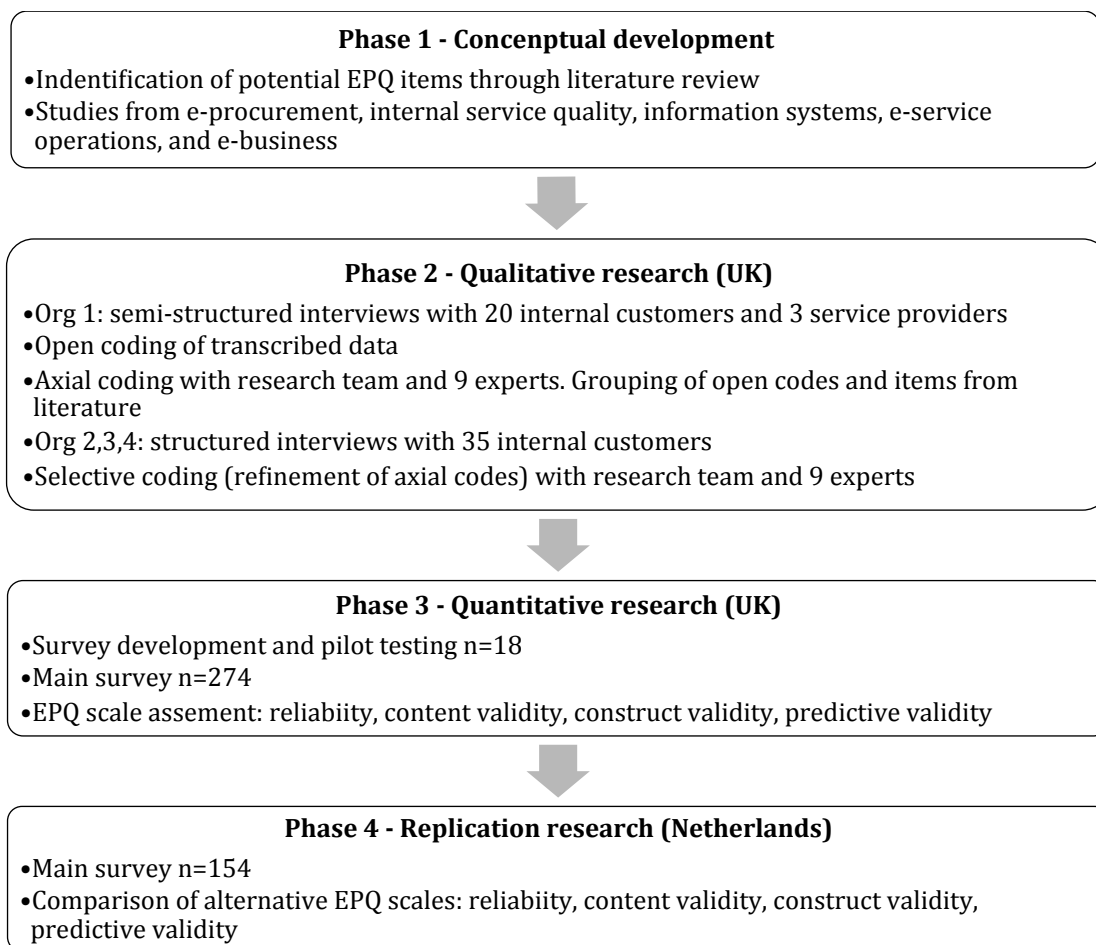
recognising the affect of user perceptions on the success of different e-business projects including e-procurement (Doherty et al., 2013; Cullen and Taylor, 2009), there remains a paucity of research exploring e-procurement quality from an internal customer perspective and no attempt to develop comprehensive construct measures. The development of robust measurement scales is increasingly acknowledged as critical to the knowledge base of Operations and Supply Management (OSM) in order to precisely specify complex constructs, measure them using fewer items, and to investigate relationships with other constructs in a more reliable manner (Roth et al., 2007; Shah and Ward, 2007). Considering e-business specifically, Zhu and Kraemer (2005) state that despite progressing to some extent over recent years, "The linkage between theory and measures is still weak" (p62).

This study builds on extant conceptual and single-method research, by examining the various facets of e-procurement quality from an internal customer perspective using a combination of qualitative (interview) and quantitative (survey) empirical data. In doing so, the work makes three key contributions to the OSM community. Firstly, the research represents one of the most extensive explorations of e-procurement quality to date and the first to study the underlying dimensional structure of this second-order construct. By adopting an internal customer perspective, it also answers calls by a number of OSM academics to explore the often-overlooked role of employee attitudes on operational performance (Boudreau, 2004; Yee et al., 2008). Secondly, the study addresses the lack of specific measures of e-procurement quality by developing new psychometrically robust scales that support both advancement of this research area and act as useful diagnostic tools for managers looking to improve e-procurement provision. Thirdly, this study provides a rare illustration of a genuinely mixed methods approach to scale development in OSM and thus responds to calls for increased use of mixed methods in our discipline (Boyer and Swink, 2008; Brandon-Jones et al., 2016; Singhal and Singhal, 2012a, 2012b). Specifically, to combat criticisms regarding an over-emphasis on psychometric testing at the expense of conceptual rigour within many extant scale development studies, the approach taken here places far greater emphasis on its qualitative 'front-end'. Further, the inclusion of replication data from a new context, rarely seen in OSM studies, increases confidence in the efficacy of developed scales and subsequent studies that use these for theory development.

The paper is structured according to the four phases of the mixed-methods study (Figure 1), which align closely with scale development steps (item generation, scale development, and scale evaluation) set out by Hinkin (1995) and Hensley (1999), and the replication principles of Kaynak and Hartley (2006). The next section presents phase one, a literature review aimed at

identifying potential elements of e-procurement quality. This is followed by the study's qualitative phase, covering 58 interviews in four UK-based organisations. Section four details the first quantitative phase of the study, incorporating survey data from 274 survey respondents in the UK, and section five details the replication phase of the research, with 154 survey respondents in the Netherlands. Finally, the last section of the paper provides a discussion of results, key contributions, limitations and avenues for future research.

Figure 1: Schematic representation of study exploring e-procurement quality

Phase 1 - Concenptual development
- Indentification of potential EPQ items through literature review
- Studies from e-procurement, internal service quality, information systems, e-service operations, and e-business

Phase 2 - Qualitative research (UK)
- Org 1: semi-structured interviews with 20 internal customers and 3 service providers
- Open coding of transcribed data
- Axial coding with research team and 9 experts. Grouping of open codes and items from literature
- Org 2,3,4: structured interviews with 35 internal customers
- Selective coding (refinement of axial codes) with research team and 9 experts

Phase 3 - Quantitative research (UK)
- Survey development and pilot testing n=18
- Main survey n=274
- EPQ scale assement: reliabiity, content validity, construct validity, predictive validity

Phase 4 - Replication research (Netherlands)
- Main survey n=154
- Comparison of alternative EPQ scales: reliabiity, content validity, construct validity, predictive validity

2. Phase one – conceptual development

To ensure that the conceptual domain of e-procurement quality was theoretically grounded, phase one of the study involved a review of extant literature as shown in figure 2 overleaf. This started by exploring the concept of e-procurement quality from an internal customer perspective and its importance in realising the potential benefits e-procurement. It then moved onto reviewing related conceptual domains of internal service quality, information systems, e-service, and e-business. Keywords in the literature review included *'e-procurement'*,

'electronic procurement', *'e-purchasing'*, *'e-procurement [non-] compliance'*, *'e-procurement adoption'*, *'system compliance'*, *'maverick purchasing'*, *'maverick buying'*, *'internal service'*, *'internal service quality'*, *'internal customer'*, *'next-operation-as-customer'*, *'e-service'*, *'e-commerce'*, *'service quality'*, *'e-business'*, *'ERP'*, *'enterprise resource planning'*, *'information systems quality'*, *'information system service'*, *'end user [computing] satisfaction'*, *'technology acceptance'*, and *'technology adoption'*.

Figure 2: Conceptual domain of e-procurement quality
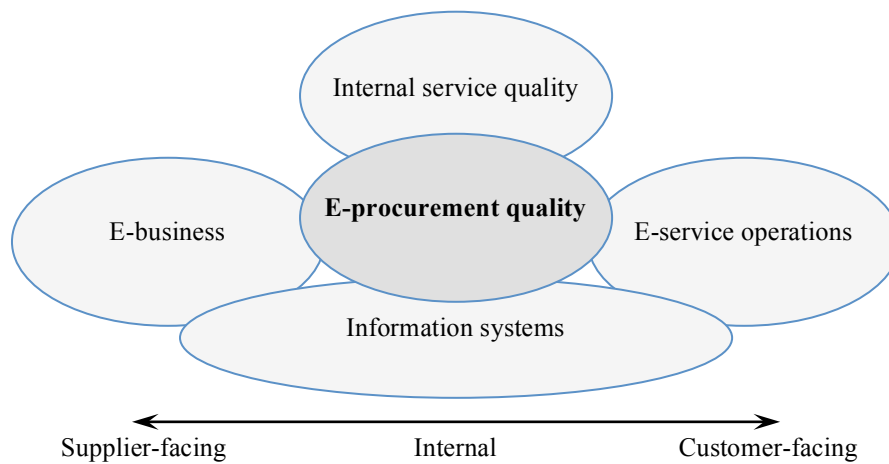
2.1. The concept and role of e-procurement quality

The last twenty years has seen a rapid proliferation of e-business technologies to support all aspects of supply chain management (Kauppi et al., 2013; Liu et al., 2016; Mishra et al., 2013; Sodero et al., 2013; Tenhiälä and Helkiö, 2015). Such fundamental changes to how supply chains are managed have been particularly evident in the implementation of e-procurement to support organisational purchasing (Doherty et al., 2013; Swamy et al., 2014). Yet despite widespread adoption, organisations continue to struggle to realise return on investments in e-procurement (Gonzalez-Benito, 2007; Kauppi et al., 2103) and e-business technologies more broadly (Doherty et al., 2013; Rosenzweig, 2009). As such, e-procurement sees strong evidence of the IT paradox, which highlights the inconsistent link between IT investments and organisational performance (Hajli et al., 2015; Power and Gruner, 2016). Fundamentally, the explanation for this paradox lays in the fact that organisational adoption of a technology is, in itself, insufficient in delivering performance improvements (Jeffers, 2010; Ordanini and Rubera, 2008). Rather, the realisation of potential benefits is largely determined by the extent to which individuals subsequently use systems within organisations (Karjalainen and van Raaij, 2011). Thus, a key challenge for companies looking to implement e-procurement is providing

support to internal customers, often located in many different sites, and in doing so ensuring the high levels of compliance necessary to maximise potential benefits of new technologies (Doherty et al., 2013; Karjalainen et al., 2009; Kim et al., 2015). In this context, compliance is the use of an e-procurement system or contracts by internal customers when placing orders (Kauppi et al., 2013).

Although the use of e-procurement systems can be, and often is, mandated by organisations, internal customer compliance is notoriously hard to force (Brandon-Jones and Carey, 2011; Sharabati et al., 2015). For example, Rosenzweig and Roth (2007) note that, "the application of new technology in B2B 'marketspaces' can be met with a chilly reception if users are not willing to change the way they work" (p1315) and such resistance limits the potential of such technologies. Thus, it is increasingly evident that e-procurement quality, as perceived by internal customers, plays a critical role in influencing compliance and ultimately the return on organisational investment in e-procurement (Brandon-Jones and Carey, 2011; Karjalainen et al., 2009).

2.2. Internal service quality

The idea of internal service quality (See top of figure 2) originates from TQM's 'next-operation-as-customer' (Ishikawa, 1985), whereby each link represents an interaction between internal service providers and internal customers. In the context of e-procurement, the internal customer refers to individuals who place orders, authorize, receipt, run reports, and receive support from the internal function tasked with delivering e-procurement, typically the purchasing function. Of particular interest to this study is the small body of work that attempts to measure perceptions of internal service quality. Here, a popular approach has been the adaptation of traditional business-to-customer (B2C) service quality measures (Joshi and Chadha, 2016; Kang et al., 2002; Sharma et al., 2016). However, differences between internal and external customers in terms of what they consume, choice of service provider, and level of experience raise concerns over the applicability of measures originally developed in external customer contexts. Items and dimensions, including confidentiality, training, proactive decision-making, attention to detail, leadership, communication, support flexibility, and information relevance have all been added to B2C service measures when applied to internal service contexts.

Such concerns have led a number of academics to develop specific measures of internal service quality from scratch. At a broad level, such work points to the likely importance of e-procurement support attributes such as training, communication, availability, reliability,

responsiveness, flexibility, and empathy (Asif et al., 2016; Bruhn, 2003; Prakash and Mohanty, 2013). More specifically, internal service quality scales developed in procurement contexts are of particular interest. These suggest a variety of e-procurement quality dimensions, including communication, commodity knowledge, internal customer concern, on-time delivery, speed of processing, problem resolution, responsiveness, service, and technical knowledge (Marshall et al., 1998; Rossler and Hirsz, 1996). However, the main limitation of internal service quality research is that perceptions of quality are almost exclusively explored in off-line service contexts and as such omit critical system aspects of e-procurement quality.

2.3. Information systems

Information systems literature (See bottom of figure 2) is useful in understanding e-procurement quality given the extensive systems element of e-procurement provision. The predominant focus of early information systems work is on the quality of product attributes and their important impact on adoption behaviours. In response to the increased use of computers by individuals during the 1980's, a number of information system quality measures were proposed. For example, Doll and Torkzadeh's (1988) end-user computing satisfaction instrument consists of five dimensions, content, format, accuracy, ease of use, and timeliness, whereas Baroudi and Orlikowski (1988) posit quality of information product, staff and services, and user knowledge and involvement dimensions in their user information satisfaction (UIS) scale. Davis' (1989), technology acceptance model (TAM) explores the effect of two cognitive factors, perceived usefulness and ease of use, on technology acceptance and adoption. More recent work has expanded the TAM framework to incorporate a number of antecedents to these cognitive factors, including system characteristics and facilitating resources (Autry et al., 2010; Jan and Haque, 2014; Smith et al., 2013).

Despite their widespread application, in particular UIS and TAM, traditional information system measures are largely product-oriented and place less emphasis on the significant service components, such as installation assistance, training, and trouble-shooting that are expected by information systems users (Lowry et al., 2016). To counter these limitations, some academics have looked to adopt traditional business-to-customer service scales to measure user perceptions of information systems (Jiang et al., 2012). However, such adaptations stand accused of over-emphasising functional service and failing to consider technical aspects of delivery that are captured within traditional information systems measures (Maddern et al., 2007).

2.4. E-service operations (B2C)

Despite its focus on external customers, e-service operations research (See right-hand side of figure 2) is relevant to the study given the similarities between online order processes and requisition processes within organisations, as well as commonalties in some technology support aspects for both e-service and e-procurement provision. Within extant literature, a number of academics have looked to measure e-service delivery through the application of traditional (off-line) service quality measures (Bressolles et al., 2014; Gawyer et al., 2014; Voss, 2003). However, it is unclear the extent to which results of traditional service research are equally applicable to technology-mediated settings (Kalia, 2017; Venkatesh et al., 2012) For instance, the 'goal orientation' of some on-line customers may reduce the relevance of tangible dimensions of traditional service quality (Collier and Bienstock, 2015), while ease of navigation, flexibility, efficiency, site aesthetics, and security emerge as new aspects of e-service quality, not found in face-to-face service contexts (Marakarkandy and Yajnik, 2013; Venkatesh et al., 2012; Wen et al., 2014).

There are also a number of attempts to develop e-service quality scales from scratch. For example, in their study of online home delivery grocers, Boyer and Hult (2006), find strong evidence that reliability, responsiveness, security, competence, courteousness, and communication, are critical in influencing behavioural intentions of customers. Four dimensions of e-service – website design / navigation; fulfilment; security / privacy; and customer service are found in a number of e-service studies (Ba and Johansson, 2008; Chiu et al., 2014; Venkatesh et al., 2012). Additional aspects of e-service quality based on both conceptual and empirical studies include access, ease of use, search efficiency, visual appeal, responsiveness, empathy, reliability, convenience, communication, competence, courtesy, personalisation, complete information, transaction duration, and service reliability. Despite being particularly useful in generating potential items relating to the on-line aspects of e-procurement quality, e-service studies naturally pay less attention to the more traditional face-to-face aspects of service. In addition, issues such as system integration, authorisation processes, and invoicing procedures are not typically considered within e-service research.

2.5. E-business (B2B)

Within e-business literature (See the left-hand side of figure 2), information quality is widely cited as a critical factor in the success of different e-business technologies (Bhakoo and Choi, 2013; Sodero et al., 2013). This may be assessed by the extent to which information

within and exchanged between systems meets organisational needs in terms of content, accuracy, availability, timeliness, and adequacy (Dobrzykowski and Tarafdar, 2015; Vaidyanathan and Devaraj, 2008;). A second key factor influencing attitudes towards e-business and its subsequent adoption is the extent to which technologies are considered easy to integrate with existing IT infrastructure (Devaraj et al., 2007; Park et al., 2012; Wong et al., 2015). Other system-related issues include customisability of technology and the expected improvements to the order fulfilment process (Klein, 2007; Vaidyanathan and Devaraj, 2008).

It is also clear that non-system issues play an important role in defining organisational perceptions towards e-business technologies (Bhakoo and Choi, 2013). For instance, Autry et al (2010) suggest that fear of change often creates cultural resistance to new e-business solutions, but can be overcome through benefit selling by technology suppliers. Other academics argue that perceived risks of transitioning to new structural forms and ineffective training both constrain technology implementation (Power and Singh, 2007; Trad and Kalpi, 2013; Trang et al., 2016). E-business literature is clearly useful in explicating likely facets of e-procurement quality. However, extant research in this area of OSM is predominantly focused at an organisational level and therefore underplays the critical role of internal customer perceptions and behaviours on the success (or failure) of e-procurement projects.

2.6. Summary of phase one literature review

In summary, phase one of this study focused on exploring the conceptual domain of e-procurement quality by reviewing e-procurement, internal service quality, information systems, e-service operations, and e-business research. Although the review identified a number of conceptual and empirical quality scales in related literature, none in isolation is capable of comprehensively measuring e-procurement quality. Table 1 provides a summary of variables identified in phase one that were considered pertinent to this study and taken forward into phase two – the first of three empirical phases of research.

Table 1: Summary of potential EPQ items identified in literature

Potential item	Internal service quality	Information systems	E-service operations	E-business
Information Quality / Provision of Information	◆	◆	◆	◆
Dealing with Problems / Problem Resolution / Trouble Shooting	◆	◆	◆	◆
Accurate Information / Accurate Records	⊙	◆	◆	⊙
Server Reliability / System Reliability	O	◆	◆	O
Timely Information / On-time Information	O	◆	O	⊙
Ease of Use	O	⊙	◆	O
Training	O	⊙	O	O
Functionality / Hardware Quality / Infrastructure / Capability / System Quality / System Design	O	⊙	⊙	⊙
Responsiveness / Promptness	◆	◆	◆	
Support Availability / Resources	◆	◆	◆	
Concern / Empathy	◆	◆	⊙	
Support Flexibility	◆	◆	⊙	
Service Reliability / Support Reliability / Dependability	◆	◆	⊙	
Friendliness	◆	◆	O	
On-time Delivery / Reliability	⊙		◆	⊙
Competence / Skills / Knowledge / Commodity Knowledge / Technical Knowledge	◆	O	⊙	
Up-to-date Equipment	⊙	◆	O	
System Speed / Capacity and Speed / Server Speed / Access Speed / Transaction Duration	O	⊙	◆	
Content / Database Contents / Selection / Variety		O	◆	⊙
Order Accuracy / Service Accuracy	⊙		◆	O
Trust	⊙	◆	O	
System Security / Transaction Security	O		◆	O
Speed of Processing / Efficiency / Processing Speed	O		◆	O
Encouraging Feedback	⊙	⊙	⊙	
Customisation / Configurability / Personalisation	O	⊙	⊙	
Lead-time / Cycle time / Fulfilment	⊙		⊙	O
Access / Availability / Convenience / Accessibility	⊙	⊙		O
System Integration	O	⊙		⊙
Talk User's Language / Interpersonal Skills / Ease of Understanding	O	⊙	O	
Helpfulness / Assistance	◆	◆		
Politeness / Courtesy	◆	◆		
Confidentiality / Integrity / Personal Information Security	◆		◆	
Visually Appealing Materials	⊙	◆		
Well-dressed Employees	⊙	◆		

Potential item	Internal service quality	Information systems	E-service operations	E-business
Individual Attention	⊙	◆		
Navigation		⊙	◆	
Complete Information		⊙	◆	
Visual Appeal of System / Aesthetics		O	◆	
Reputation of Purchasing / Reputation of Business	O		⊙	
Format / Structural Design and Layout		O	O	
Proactive Decision Making / Proactive Service	O		O	
Culture	O			O
Managing Suppliers	O			O
Stock Availability			O	O
Order Tracking			O	O
Search / Finding Information			◆	
Reporting / Management Information		⊙		
Reliable / Unbiased / Trustworthy Information		⊙		
Leadership	O			
Accountability	O			
Rewards	O			
Dealing with Complexity	O			
Interactions with Purchasing	O			
Shared Goals / Cooperation	O			
Individual Attitudes	O			
Understanding Needs	O			
Attention to Detail	O			
Communication of Problems			O	
Time Saving			O	
Relevant Information				O
Excitement / Enjoyment				O
Number of Catalogues				O
Number of Process Stages				O
Self-Learning				O
Compensation				O
Ease of Cancellation				O
Returns Policies				O

Extent of item coverage in reviewed literature: ◆Extensive (>30%); ⊙Moderate (16-30%); OLimited (1-15%); Blank (absent for literature reviewed)

3. Phase two - qualitative research (United Kingdom)

Whilst the review of literature undertaken in phase one helped to ensure that the conceptual domain of e-procurement quality was well grounded, the researcher looked to undertake an extensive qualitative study to explore the phenomenon more fully. Schoenherr and Mabert (2008) highlight the importance of using insights from case studies to support more robust development of construct measures in OSM, whilst Ambulkar et al (2015) argue that scale quality is improved by involving knowledgeable practitioners in the development process. In contrast to other OSM scale development studies that arguably relegate qualitative data to a relatively minor supporting role, the decision was taken to place much greater emphasis on the qualitative front-end. In doing so, the intention was to create a small set of highly defensible items representing the construct prior to the quantitative back-end (Hair et al., 2009) and combat criticisms of an over-emphasis on psychometric testing to the potential detriment of conceptual rigour (Finn and Kayande, 2005). It was hoped that this would reduce the attrition rate of items during scale purification, minimise the potential emergence of illusory or bloated factors, and maximise survey response rate (Hensley, 1999).

In this phase, four service organisations in the UK, ranging in size and procurement activity, were invited to participate in the research (Table 2). The e-procurement software in all four organisations supports purchase ordering, authorisation, receipting, invoicing, payment, and reporting. The purchasing departments are responsible for training internal customers across their organisations to use e-procurement software, as well as providing on-going support. For reasons of confidentially, the organisations cannot be named. The unit of analysis was at the level of the internal customer's perception of e-procurement quality within their respective organisation.

Table 2: Organisational characteristics

	Org1	Org2	Org3	Org4
Annual budget (goods and services)	£600 million	£16 million	£6 million	£15 million
Requisitions per annum	150,000	4000	2000	2900
Active suppliers	13,000	2500	800	2300
E-procurement system users	156	44	41	54

3.1. Semi-structured interviews (Organisation 1)

The qualitative study began by carrying out face-to-face semi-structured interviews, lasting between forty-five minutes and two hours, with twenty e-procurement users and three service providers in one organisation. These interviews employed a critical incident technique (Bitner,

1990; Howard et al., 2007) to identify the best and worst aspects of e-procurement provision, and to explore recommendations for improvement. Transcribed interviews were coded based on three sources – a provisional 'start list' of codes derived from the literature review, notes taken during interviews, and post-interview contact summary sheets (Miles et al., 2013). Initial analysis used a process of open coding to 'describe' e-procurement quality as perceived by internal customers. Axial coding was then deployed to group codes with similar characteristics into broader categories. This was an iterative process in which open codes from interview transcripts and the list of potential items from the literature review were added to code boards and sorted over several rounds. To ensure a more comprehensive perspective, nine expert practitioners were involved in the coding process in addition to the researcher. This approach to improving domain and content validity bears strong similarities with the Q-sort methodology seen in a number of OSM scale development papers (Koste et al., 2004; Roth et al., 2007).

3.2. Structured interviews (Organisations 2, 3, and 4)

In the second part of the qualitative study, thirty-five structured interviews were conducted in three organisations. E-procurement users were asked for their opinions of the different facets of e-procurement quality, as defined by axial codes, and encouraged to identify any elements that had not been addressed by questions. Having coded interview transcripts, axial codes were re-visited and refined, a process known as selective coding (Miles et al., 2013). Selective codes were then reviewed in four meetings with the nine expert practitioners. Figure 3 illustrates the transition from 83 open to 33 selective codes whilst appendix 1 provides illustrative interviewee quotes for each of these selective codes.

3.3. Summary of phase two qualitative empirical research

In summary, this study placed significant emphasis on qualitative data collection to generate a set of thirty-three items representing e-procurement quality that could be considered conceptually rigorous and empirically grounded. The paper now turns to phase three of the study, a survey examining internal customer perceptions of e-procurement quality.

Figure 3: Phase two coding – open codes to selective codes

Open Code	Selective Code
Support Reliability	Support Reliability
Responsiveness	Support Responsiveness
Knowledge	Knowledge
Talking Users' Language	Talking Users' Language
Flexibility	Support Flexibility
Dealing with Problems	Problem Resolution
Helpfulness	
Confidentiality	Confidentiality
Friendliness	Friendliness
Empathy	Empathy
Training: timing	Timely Training
Training: delays / politics	
Training: availability	
Training: approach	
Training: amount	
Training: content	Appropriate Training
Training: self learning	
Training: super user	
Training: resource issues	
Training: user knowledge	
Training: refreshers	
Communication	
Inform of new suppliers	Information Provision
Communication Cascade	
Communication Problems	
Use of Intranet	
Encouraging Feedback	Encouraging Feedback

Open Code	Selective Code
Loaded Suppliers	Loaded Suppliers
Accreditation	
Catalogue Content	Loaded Catalogues
Number of Catalogues	
Search	Ease of Search
Terminology	
Language	
Pictures in Search	
Search: frequency of use	
Speed of Processing	
Order Cloning	Order Processing
Efficiency	
Authorisation: ease	
Authorisation: speed	
Self-Authorisation	Ease of Authorisation
Authorisation: rules	
Budget Codes	
Order to supplier: speed	
Order to supplier: reliability	Orders to Suppliers
Supplier Training	
Order to supplier: accuracy	
Lead-time	Order Lead-Time
On-time Delivery	On-Time Delivery
Order Accuracy	Order Accuracy
Support Availability	
Availability: 1 point of call	Support Availability
Advertised Support	
Advanced Queries (EGS)	

Open Code	Selective Code
FMS Integration	FMS Integration
Improved Budgeting	
Goods Receipting	
Auto-Payment	Invoice Reconciliation
Payment: currencies	
Late Payment	
Advance Payment	
Customisation	System Configurability
System Flexibility	
Management Information	
Reporting	Reporting Capability
Reporting Searching	
Complex Orders	Complex Service Orders
Processing Services	
Security	System Security
Sharing Information	
Reliability: service	
Reliability: system	System Availability
Access	
Reliability: information	
Server Speed	Screen Loading
Navigation	
User Friendliness	System Navigation
Rules	
Navigation: terminology	
Navigation: no. stages	
Visual Appeal	Visual Appeal

4. Phase three - quantitative research (United Kingdom)

The objective of phase three was to triangulate qualitative data in order to examine the validity of the proposed e-procurement quality items and to explore the construct's latent structure. This quantitative empirical work allows a greater emphasis to be placed on the psychometric properties of proposed construct measures.

4.1. Survey design and pilot testing

The survey consisted of paired-statements relating to the final thirty-three selective codes that emerged from the phase two. To increase reliability, statements used 1-7 Likert scales ranging from 'strongly disagree' to 'strongly agree' with all mid points labelled (Zhou and Benton Jr., 2007). All statements were positively worded to avoid confusion among respondents (Watson and Johnson-Laird 1972), reduce the likelihood of method factors (Podsakoff et al., 2012), and increase scale reliability (Hinkin, 1995). In addition, single-item measures for system compliance, contract compliance, and a surrogate measure called 'overall e-procurement quality' were included to assess predictive validity (Koste et al., 2004).

Prior to data collection, pre-testing involved feedback on the survey by several academics with experience of both survey design and the research context, as well as with e-procurement users not involved in the main study to gauge completion times, refine question wording, and assess content (Shah and Ward, 2007). Beyond minor re-phasing, no significant changes were required to the survey. This is in sharp contrast to a number of other OSM scale development studies that have been forced to cut survey length significantly on the basis of pilot testing. Arguably, this adds support to the view that greater emphasis on the qualitative front-end in scale development significantly minimises item attrition during pre-testing because it typically leads to a smaller set of scale items when compared to more traditional 'literature-dominant' approaches to item generation.

4.2. Data collection

295 e-procurement end-users (internal customers) formed the survey population for this phase of the study. In line with other scale development studies, it was not appropriate at this stage to survey e-procurement users in a broader range of organisations, until proposed construct components had been examined in the original research setting (Parasuraman et al., 1988). Given the small population size, and therefore the criticality of a high response rate, all potential respondents were contacted by telephone to encourage cooperation with the research prior to sending surveys (Dillman et al., 2010). Initially, hard copies of the cover letter, survey

and a pre-paid return envelope were posted to potential respondents, with reminder e-mails sent two and three weeks later. A second hard copy of the questionnaire was sent after four weeks alongside a final phone call to non-respondents. 274 usable questionnaires were returned, representing an extremely high response rate of 92.9%. The absolute sample size exceeds most suggestions found in the literature and compares favourably with other recent e-business studies (Mishra et al., 2013).

4.3. Data pre-testing

Prior to factor analysis and scale refinement, non-response bias was examined through wave analysis (Stanton, 2007). Comparison of early and late waves of returned surveys using two tailed t-statistics revealed no statistically significant differences among any variables ($p>.05$). T-tests between missing and non-missing groups for each variable and an overall test of randomness indicate that missing data are 'missing completely at random' (Little's MCAR test: Chi-Square 116.900, DF 1537, Sig. 1.000). Normality screening indicates data exhibit multivariate normality, with limited skew and kurtosis. Considering common method bias, Harman's one-factor test revealed the presence of 15 factors with eigenvalues greater than 1.0 rather than a single factor, with only 25.6% of the total 72.8% variance explained by the first factor.

4.4 Factor analysis

At this stage of the scale development process, no a priori factor structure of e-procurement quality was hypothesised. Therefore, data were subjected to exploratory factor analysis with the number of factors was determined by the latent root criterion of eigenvalues >1, supported by scree test and examination of interpretability (Hair et al., 2009). Total variance extracted is 74.8% and common variance extracted is 68.8%. Principal axis factoring was favoured over principal component analysis, given its more restrictive assumptions concerning variance extraction (i.e. avoiding mixing common and unique variance) and the objective of identifying latent factors (Hair et al., 2009). Oblique rotation was used given the assumption that construct dimensions should be correlated (Shah and Ward, 2007). Based on 274 usable respondents from the exploratory survey, all loadings greater than .35 are considered significant (Hair et al., 2009). Of the items entered into the factor analysis, just three were deleted during scale purification due to no significant loading (*visual appeal*) or cross-loading (*talking users' language* and *encouraging feedback*). All remaining variables load on a single factor and have item-to-total correlations above .50. Table 3 shows the final factor solution for this phase of the

study, with six dimensions of e-procurement quality – *Training, Professionalism, Processing, Content, Usability,* and *Specification.*

Table 3: Phase 3 factor analysis based on UK survey data

Item Name	Training	Professionalism	Processing	Content	Usability	Specification
appropriate training	.973					
timely training	.918					
information provision	.777					
Cronbach alpha	**.919**					
support responsiveness		.889				
knowledge		.857				
confidentiality		.844				
problem resolution		.841				
concern shown		.838				
support reliability		.829				
support availability		.824				
support flexibility		.808				
friendliness		.799				
Cronbach alpha		**.954**				
orders to suppliers			.823			
order lead time			.802			
order processing			.771			
on-time delivery			.765			
ease of authorisation			.693			
order accuracy			.686			
processing complex service orders			.650			
system security			.610			
Cronbach alpha			**.897**			
loaded catalogues				.846		
loaded suppliers				.778		
ease of search				.643		
Cronbach alpha				**.796**		
system navigation					.782	
screen loading					.725	
system availability					.570	
Cronbach alpha					**.751**	
invoice reconciliation						.784
reporting capability						.752
FMS integration						.701
system configurability						.647
Cronbach alpha						**.818**

Total Variance Explained = 70.91%	Shared Variance Explained = 64.00%

Extraction: Principal Axis Factoring. Rotation: Promax with Kaiser Normalization.

4.5 Assessment of e-procurement quality scales based on UK survey data

Based on guidelines of Bagozzi et al (1991), the six dimensions of e-procurement quality were examined in relation to the following measurement properties: (1) reliability, (2) content validity, (3) construct validity, and (4) predictive validity.

4.5.1. Reliability

Reliability is determined by the extent to which a scale yields consistent measurement of the construct and is free from error (Churchill, 1979). Given that the research was not longitudinal (test-retest) and that no alternative construct measure (parallel forms) exists, assessment of reliability focuses on the scale's internal consistency (Power and Singh, 2007). Cronbach alphas for the six scales range from 0.80 to 0.95, exceeding the recommended values for either exploratory or confirmatory work (Nunally, 1978; Vaidyanathan and Devaraj, 2008). In addition, corrected item-to-total correlations are high, ranging from .539 to .869 (Churchill, 1979). These results indicate a high level of item homogeneity for the six dimensions of e-procurement quality. Thus, one is able to move forward to an assessment of scale validities.

4.5.2. Content validity

Content validity is demonstrated if it is generally agreed that scale items accurately reflect the construct domain and is evaluated through a rational judgemental process (Ahire et al., 1999). Item representativeness has been ensured through the phase one literature review, phase two interviews with e-procurement users and expert involvement in data coding, and phase three survey pilot testing (Miles et al., 2013). Rosenzweig and Roth (2007), argue that "using multiple studies […] for construct measurement [helps to] overcome potential problems and bias inherent in the use of a single method" (p1321). The consistency of results between qualitative and quantitative data analysis at this stage of the study lends additional support for content validity.

4.5.3. Construct validity

Construct validity measures the extent to which a scale is a good operational definition of a construct and incorporates discriminant and convergent validity. Given the very low level of cross-loading, the rules of discrimination appear to hold good for phase three data (Malhotra and Grover, 1998). Considering convergent validity, of the thirty-three items entered into the factor analysis, all but three load on a single factor (Bagozzi et al., 1991). In addition, each dimension exhibits high Cronbach alphas, high item-to-total scores (ranging from .539 to .903, with an average of .716), and average variance extracted (AVE) above the recommended 0.50 cut off (Rosenzweig and Roth, 2007). Convergent validity for the entire scale is established when correlations exist between different measures of the same construct (Spector, 1992). Given the absence of an alternative construct measure, a single-item surrogate measure of e-procurement quality, the overall e-procurement quality rating, was compared with the six dimensions (Churchill, 1979; Hensley, 1999; Koste et al., 2004). The high correlations, ranging from .40-.67, provide further evidence of convergent validity.

4.5.4. Predictive validity

Predictive validity was initially assessed by comparing a composite value for the six dimensions of e-procurement quality with the single-item surrogate measure, overall e-procurement quality, an approach recommended by a number of OSM researchers (Koste et al., 2004; Malhotra and Grover, 1998). As expected, individuals with positive perceptions of e-procurement quality typically rate overall e-procurement quality as excellent (r = .70, p = .01). Further, OLS regression indicates that the composite value predicts a high level of variance in the overall e-procurement quality rating (R^2 = .486).

Predictive validity is also established when a construct exhibits relationships with other constructs in line with theory (Malhotra and Grover, 1998; Stratman and Roth, 2002). In this case, theory suggests that perceptions of quality are positively associated with behavioural intentions (Croson et al., 2013), which in an e-procurement context can be observed through system and contract compliance. Therefore, the composite value for the six dimensions was compared with two single-item measures of e-procurement use, system compliance and contract compliance. As e-procurement quality increases, so do the reported levels of both system compliance (r=.722, p=.01) and contract compliance (r=.407, p=.01). In addition, OLS regression was used to assess the extent to which the proposed multi-item measures of e-procurement quality predict both system compliance (R^2 = .507) and contract compliance (R^2 =

.140). The strength and significance of both correlations and regressions provides good evidence of predictive validity (Hair et al., 2009).

4.6. Summary of phase three quantitative empirical research

In summary, of the thirty-three items taken forward from the qualitative phase of this study, just three were dropped during scale development based on analysis of UK survey data in phase three. The resulting factor solution suggests thirty items loading on six dimensions representing the construct of e-procurement quality.

5. Phase four – replication study (Netherlands)

Robust scale development requires replication of measures to assess psychometric properties and re-examine factor structure (Schmidt and Hunter, 2014). Though essential for establishing the validity of constructs, replication research remains disappointingly rare in OSM and across business disciplines more broadly (Bryman and Bell, 2015). Therefore, the replication phase of this study was used to explore e-procurement quality in a different context and to identify construct items or dimensions that may have been specific to the original research setting.

5.1. Replication data collection and pre-testing

A questionnaire was designed incorporating the thirty items retained from phase three of the study along with single-item measures for system compliance, contract compliance, and overall e-procurement quality. Contact was made with 311 e-procurement users in a single Dutch organisation inviting them to participate in the study and, having sent out questionnaires and reminders in line with the approach taken in the UK study, 154 usable questionnaires were retrieved. The two quantitative datasets in this study (n=295 and n=154) are comparable with the one other identified study in OSM to collect separate data sets for scale development - a study developing measures of lean production, in which Shah and Ward (2007) undertake an extensive pilot study (n=63), followed by a large-scale survey (n=280).

Having removed 21 respondents due to general data omission, *'ability to process complex service orders', 'working alongside the FMS', 'reporting capability of the system', 'ease of invoice reconciliation', 'ability to configure the system',* and *'confidentiality of support'* items were identified as having high levels of missing data and were therefore excluded from further analysis. Three cases were identified as outliers and were removed from the data set. There was no evidence of non-linearity or heteroscedasticity, and all but one of the values for skewness and kurtosis were smaller than ± 2.0.

5.2. Factor analysis

Given that the four items relating to the *specification* dimension were removed prior to analysis, extraction was constrained to five factors *a priori* with oblique rotation producing a solution that was easily interpretable. *'System security'* and *'order accuracy'* had to be excluded because of non-significant loadings in the pattern matrix. The replication phase factor solution is shown in Table 4. In terms of essential content, both solutions provide the same broad dimensions of e-procurement quality: *Training, Professionalism, Processing, Content,* and *Usability*, with the UK data suggesting one additional dimension, *Specification.* The remaining issue is what items to include in the measurement scales for these e-procurement quality dimensions. Analysis suggests a choice of three scales of varied length – the original 30-item scale from the UK study; the 22-item scale derived from the Dutch replication analysis; and a 'robust' scale comprising only the 19 items that are consistent across both countries.

Table 4: Phase 4 factor analysis based on Dutch survey data

Item Name	Training	Professionalism	Processing	Content	Usability	Specification (N/A)
appropriate training	.945					
timely training	.859					
Cronbach alpha	**.945**					
problem resolution		.933				
concern shown		.904				
support reliability		.884				
knowledge		.875				
support flexibility		.858				
support availability		.843				
friendliness		.838				
support responsiveness		.835				
information provision	(.529)	.811				
Cronbach alpha		**.963**				
order processing			.944			
orders to suppliers			.759			
order lead time			.730			
on-time delivery			.715			
Cronbach alpha			**.857**			
loaded catalogues				.900		
loaded suppliers				.619		

Cronbach alpha					**.699**		
system navigation						.819	
ease of search					(.523)	.794	
screen loading						.741	
ease of authorisation				(.439)		.702	
system availability						.651	
Cronbach alpha						**.851**	
Total Variance Explained = 78.32%	**Shared Variance Explained = 71.83%**						

Extraction: Principal Axis Factoring. Rotation: Promax with Kaiser Normalisation. Only the highest factor loadings per item are reported in this table, except for the three items that load on a different factor compared to the UK study (marked with an asterisk), for which the loading of that item on the expected factor is indicated in parentheses.

5.3. Assessment of alternative e-procurement quality construct measures

5.3.1. Reliability

Reliability alphas for the three scale options are shown in Table 5. For the UK 30-item scale, the alpha is .949 and coefficients range from .751 to .954 for the six dimensions. In the Dutch replication, the 22-item scale has high alphas, ranging from .699 to .963 for the five dimensions and .930 for the entire scale. The 'robust' e-procurement quality scale also performs well with alphas from .751 to .947 when applied to the UK data, and from .699 to .961 for the Dutch data, with scale alphas .925 and .918 respectively. The high scores for all scale options provide strong evidence of internal consistency.

5.3.2. Content validity

The level of missing data in the replication phase of this research suggests that six of the thirty items may be context-specific and highlights the value of replication studies in exploring OSM phenomena. Considering the four items related to *Specification,* discussions with Dutch respondents indicate that only those with budgetary control are concerned with how an e-procurement system works alongside their financial management system or with the ability to reconcile invoices through the system. Equally, reporting capabilities and system configurability appear only relevant to higher-level users. The *'ability to process complex service orders'* also appears to have limited applicability to some e-procurement contexts. Finally, *'confidentiality of support'* is concerned with the privacy of internal customer-supplier interactions, which some individuals may find hard to gauge.

Table 5: Comparison of alternative EPQ scale reliabilities

EPQ Variables	UK 30-item	Dutch 22-item	'Robust' EPQ Variables	UK 19-item	Dutch 19-item
TRAINING			**TRAINING**		
appropriate training	.903	.896	appropriate training	.899	.896
timely training	.859	.896	timely training	.899	.896
information provision*	.755	N/A		N/A	N/A
Cronbach alpha	**.919**	**.945**	**Cronbach alpha**	**.946**	**.945**
PROFESSIONALISM			**PROFESSIONALISM**		
support responsiveness	.869	.815	support responsiveness	.871	.818
knowledge	.840	.865	knowledge	.834	.857
confidentiality	.817	†		N/A	N/A
problem resolution	.824	.904	problem resolution	.814	.914
concern shown	.793	.871	concern shown	.782	.875
support reliability	.818	.868	support reliability	.821	.869
support availability	.807	.842	support availability	.814	.841
support flexibility	.791	.844	support flexibility	.787	.826
friendliness	.763	.808	friendliness	.755	.809
information provision*	N/A	.817		N/A	N/A
Cronbach alpha	**.954**	**.963**	**Cronbach alpha**	**.947**	**.961**
PROCESSING			**PROCESSING**		
orders to suppliers	.744	.656	orders to suppliers	.781	.656
order lead time	.756	.658	order lead time	.756	.658
order processing	.721	.836	order processing	.744	.836
on-time delivery	.724	.674	on-time delivery	.646	.674
ease of authorisation*	.644	N/A		N/A	N/A
order accuracy	.636	‡		N/A	N/A
processing complex service orders	.608	†		N/A	N/A
system security	.574	‡		N/A	N/A
Cronbach alpha	**.897**	**.857**	**Cronbach alpha**	**.872**	**.857**
CONTENT			**CONTENT**		
loaded catalogues	.689	.550	loaded catalogues	.656	.550
loaded suppliers	.666	.550	loaded suppliers	.656	.550
ease of search*	.571	N/A		N/A	N/A
Cronbach alpha	**.796**	**.699**	**Cronbach alpha**	**.792**	**.699**
USABILITY			**USABILITY**		
system navigation	.565	.738	system navigation	.565	.672
system availability	.539	.580		N/A	N/A
screen loading	.639	.651	screen loading	.639	.673
ease of authorisation*	N/A	.610		N/A	N/A
ease of search*	N/A	.739	system availability	.539	.443
Cronbach alpha	**.751**	**.851**	**Cronbach alpha**	**.751**	**.758**
SPECIFICATION					
invoice reconciliation	.692	†		N/A	N/A
reporting capability	.674	†		N/A	N/A
FMS integration	.599	†		N/A	N/A
system configurability	.592	†		N/A	N/A
Cronbach alpha	**.818**	N/A		N/A	N/A
Total scale Cronbach	**.949**	**.930**	**Total scale Cronbach**	**.925**	**.918**

Notes: * item with inconsistent loading; † item deleted prior to data analysis; ‡ item failed to load on any factor

5.3.3. Construct validity

To assess discriminant validity, correlation matrices for the three scale options have been analysed. With very few exceptions, correlations between items within a factor are higher than correlations between items across factors. The first assessment of convergent validity examined the extent to which variables in the replication study load on their hypothesised dimensions. Of the 24 items used in the Dutch replication analysis, 19 (79%) load on the same dimension as the UK study. With the exception of the *Specification* dimension, the high number of items loading as hypothesised provides strong evidence of construct validity for the items and dimensions of e-procurement quality. Despite some item shift between the two settings, the essential content of the dimensions is consistent across the two e-procurement contexts within this study.

The items that do not load as expected or fail to load sufficiently have then been examined. Considering *information provision*, if this item is interpreted as factual information about the system to aid learning prior to adoption, it is likely to load on *Training*, whereas if it is interpreted as information provided to answer queries, it is more likely to load on *Professionalism*. In phase three, *ease of search* loads on the *Content* dimension - i.e. you can't use the search because there are insufficient suppliers or catalogues loaded on the system. However, the item can also be interpreted as an aspect of *Usability*, in terms of a good search function being part of a system designed for ease of use. For e*ase of authorisation*, if the item is interpreted as the speed with which others in the order fulfilment process authorise an order, it should load on *Processing*, whereas if it is interpreted as the efficiency of authorisation, it may be more likely to load on *Usability*. *System security* and *order accuracy* items, despite low levels of missing data, have non-significant loadings. For *system security*, some internal customers may refer to financial issues (e.g. protection from fraud / budgetary misuse), some to non-financial concerns (e.g. privacy of information), and others to the impact of security functions on order processing (e.g. auto-logout). For *order accuracy*, it appears that some internal customers perceive order accuracy as a facet of e-procurement quality, and others perceive it as a supplier issue, i.e. however good e-procurement provision is, a supplier may still deliver the incorrect goods or services.

Convergent validity was also assessed by examining the correlation between the e-procurement quality factors, the composite score, and responses to a single question regarding perceptions of overall e-procurement quality (Table 6). The high correlations between the measures in both settings provide further evidence of the convergent validity of the three e-procurement quality scale options.

Table 6: Comparison of alternative EPQ scale correlation matrices

	OEPQ rating	Comp. EPQ score	Training	Professionalism	Processing	Content	Usability	Specification
OEPQ rating	1	.559** / .520**	.283** / .283**	.336** / .306**	.367** / .367**	.416** / .416**	.655** / .627**	x / x
Composite EPQ score	.698** / .717**	1	.648** / .630**	.859** / .819**	.712** / .722**	.536** / .560**	.769** / .745**	x / x
Training	.549** / .524**	.701** / .662**	1	.594** / .580**	.259** / .259**	.198** / .198**	.360** / .423**	x / x
Professionalism	.669** / .666**	.756** / .755**	.623** / .579**	1	.454** / .441**	.275** / .267**	.465** / .410**	x / x
Processing	.561** / .535**	.779** / .717**	.379** / .324**	.478** / .416**	1	.437** / .437**	.476** / .429**	x / x
Content	.397** / .321**	.706** / .629**	.270** / .178**	.351** / .335**	.513** / .396**	1	.419** / .362**	x / x
Usability	.414** / .414**	.762** / .762**	.401** / .400**	.443** / .442**	.596** / .551**	.480** / .400**	1	x / x
Specification	.527** / x	706** / x	.332** / x	.463 / x	.641** / x	.479** / x	.558** / x	1 / x

** Significant at the .01 level (two-tailed)
Below diagonal: First line original EPQ / UK data; second line robust EPQ / UK data
Above diagonal: First line adapted EPQ / Dutch data; second line robust EPQ / Dutch data

5.3.4. Predictive validity

To assess predictive validity, regressions were carried out for each scale option between the composite e-procurement quality score and the 'overall e-procurement quality rating' (Table 7). For the UK data, the e-procurement quality score explains nearly half of the variance in the overall e-procurement quality rating. The predictive power of the e-procurement quality score based on the 19 'robust' items is marginally better than from the original 30 items (R^2 .513 compared with R^2 .486). The Dutch regressions are also good, with the composite score explaining 32% of the overall e-procurement quality rating using the 22-item scale and 31% using the robust 19-item scale. Subsequently, multiple regressions were undertaken between the e-procurement quality dimensions and the overall e-procurement quality rating. For the UK data, the combination of six dimensions predict 55.1% of variance in the overall e-procurement quality rating, while the five dimensions of the robust e-procurement quality scale still predict 53.6% of variance. There is also high predictive validity for the Dutch data set: the adapted e-

procurement quality scale (five dimensions with 22 items) predicts 43.3% of variance, and the robust e-procurement quality scale (five dimensions with 19 items) predicts 41.4% of variance.

Table 7: Comparison of alternative EPQ scale predictive validities

Regression model		R	R^2	Adjusted R^2	Std. error of the estimate
Composite EPQ to OEPQ rating	Original EPQ scale in UK setting [a]	.698	.487	**.486**	.897
	Robust EPQ scale in UK setting [a]	.717	.515	**.513**	.873
	Adapted EPQ scale in Dutch setting [a]	.570	.325	**.320**	.937
	Robust EPQ scale in Dutch setting [a]	.561	.315	**.310**	.944
EPQ Dimensions to OEPQ rating	Original EPQ scale in UK setting [b]	.749	.561	**.551**	.838
	Robust EPQ scale in UK setting [c]	.738	.545	**.536**	.852
	Adapted EPQ scale in Dutch setting [c]	.675	.455	**.433**	.855
	Robust EPQ scale in Dutch setting [c]	.661	.437	**.414**	.870

a Predictors: (Constant), Composite EPQ
b Predictors: (Constant), Usability, Training, Content, Specification, Professionalism, Processing
c Predictors: (Constant), Usability, Training, Content, Professionalism, Processing
Dependent Variable: OEPQ Rating

6. Discussion and conclusion

The purpose of this study was to explore the concept of e-procurement quality from an internal customer perspective using a mixed methods approach. This section summarises the main research findings, presents key contributions, and concludes by discussing limitations and future research opportunities.

6.1. Defining and measuring e-procurement quality

In this study, the concept of e-procurement quality is introduced as a second-order latent construct that captures the quality of e-procurement provision as perceived by an internal customer (user) within an organisation. The initial framework combines multiple literature streams to establish the conceptual boundaries of e-procurement quality and generate potential scale items. During the qualitative part of the study, coding of data (open coding > axial coding > selective coding) collected during fifty-five interviews over two stages, resulted in a proposed set of thirty-three items encapsulating the system and support properties of e-procurement quality. Subsequently, data analysis of survey respondents during the two quantitative phases of this study in different e-procurement contexts has refined these items further, explored the dimensionality of e-procurement quality, and validated alternative construct measures. Figure 4 illustrates the items and dimensions of e-procurement quality that have emerged from the research.

In sum, the study points to the existence of five universal dimensions of e-procurement quality that are important to internal customers – *Training, Professionalism, Processing, Content,* and *Usability. Training* considers the approach to training (e.g. online tutorials, group sessions, advanced training, refresher courses, or one-to-one help), the timing of training, and the provision of additional information, such as system enhancements or newly available contracts. *Professionalism* is concerned with the on-going support provided to internal customers of e-procurement, including availability, reliability, responsiveness, knowledge, and attitude. *Processing* focuses on order-processing speed, ease of authorisation, how long requisitions take to reach suppliers, overall lead-time, and order accuracy. *Content* is concerned with the suppliers and catalogues loaded on a system, and how searchable this content is. *Usability* relates to perceptions of system availability, server speed and the ease of navigating through the system. A sixth factor, *Specification*, considers perceptions of system functionality, including reporting, configurability, and how well e-procurement integrates with financial management systems. Based on replication data analysis, it appears that *Specification* applies to a sub-set of internal customers, who, in addition to ordering, use e-procurement systems for budgeting, payment and reporting.

It is clear that, with the exception of the *Specification* dimension, the majority of items identified in the qualitative and quantitative phases in the UK e-procurement setting are also applicable in the Dutch replication context. However, one concern is that the 19-item 'robust' e-procurement quality scale has only two items representing both *Training* and *Content* dimensions. Therefore, additional items may be beneficial in developing more reliable and valid measures of these two dimensions.

6.2. Contributions

This study makes three substantive contributions to the existing OSM academic and practitioner community. Firstly, arguably it represents the most comprehensive empirical examination of e-procurement quality from an internal customer perspective to date. In the first phase of the study, the literature review sought to develop a conceptual definition capturing the innate complexity of e-procurement quality. Therefore, potential items have been drawn from studies across internal service quality, information systems, e-service operations, and e-business literatures. This allows for concept travelling in order that e-procurement quality can be considered in a variety of research settings, while minimising the risk of concept stretching (Shah and Ward, 2007). The qualitative phase of the study combined open codes from

Figure 4: E-procurement quality items and dimensions
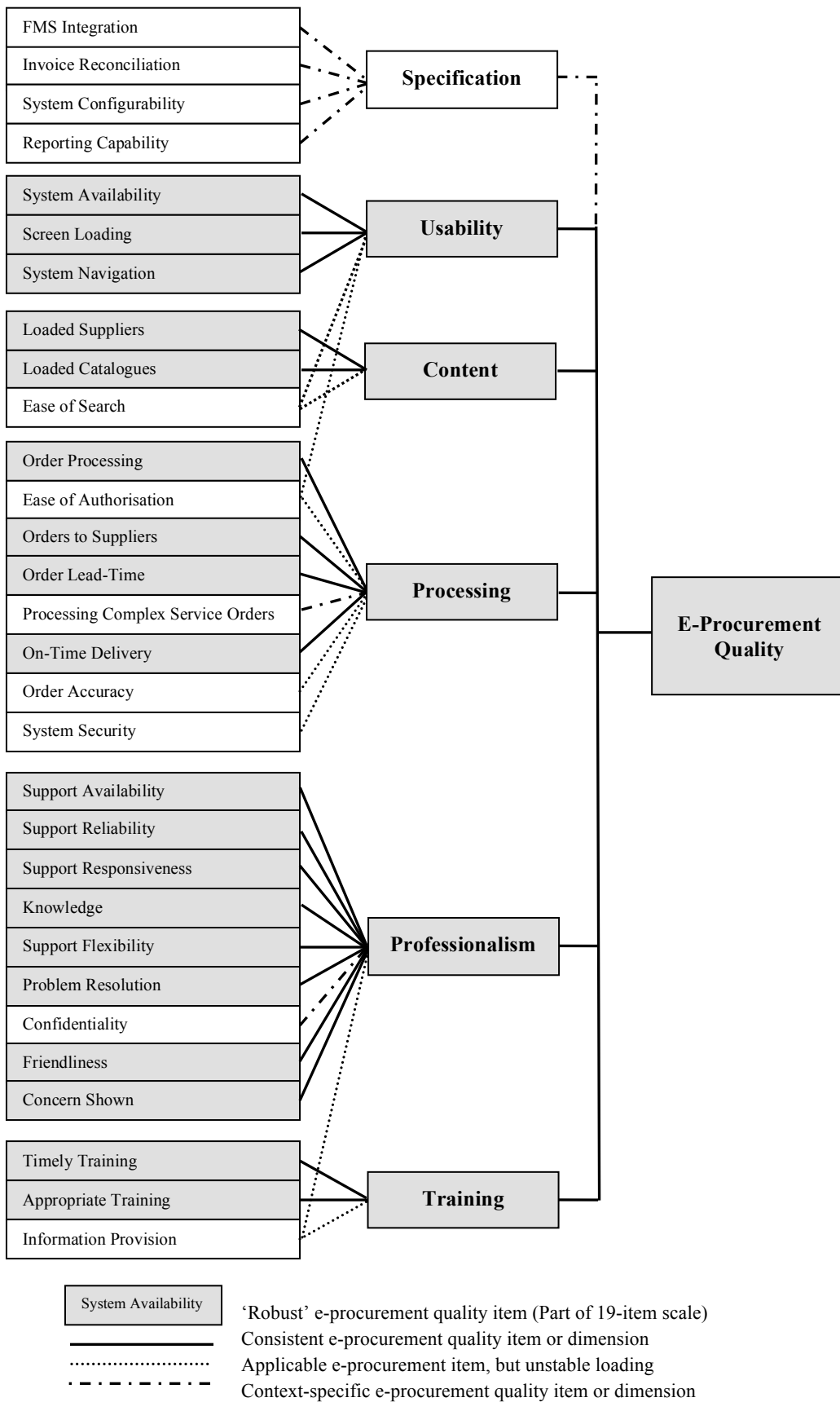
interview transcripts and potential items from literature through several stages of coding to generate a small set of items representing the various facets of e-procurement quality. Finally, the two quantitative phases of this study have then helped to establish the underlying dimensional structure of e-procurement quality with five universal dimensions (*Training*, *Professionalism*, *Processing*, *Content*, and *Usability*) and one context-specific dimension (*Specification*). These dimensions, though not entirely unrelated, are conceptually distinct.

Secondly, it addresses the lack of specific measures in the domain of e-procurement quality by developing new multi-item scales based on a rich mixed-method approach. The e-procurement quality scales presented here reflect the totality of the construct by including both system (*Processing*, *Content*, *Usability*, and in some contexts *Specification*) and support (*Training*, *Professionalism*) dimensions. Furthermore, these dimensions incorporate both pre- and post-installation aspects of e-procurement provision, something called for in existing e-business research (For example, Rosenzweig and Roth, 2007; Schoenherr and Mabert, 2008). The reliability and validity of the proposed measures of e-procurement quality are demonstrated through empirical replication testing and validation in a new but related context. For OSM academics, the availability psychometrically sound measures, such as those developed here, allows for the advancement of the field by shifting the emphasis from anecdotal studies towards hypothesis testing work (Shah and Ward, 2007; Vaidyanathan and Devaraj, 2008). In doing so, the study answers calls to undertake more quantitative or theoretically grounded research in e-business (Bendoly and Cotteleer, 2008; Cullen and Taylor, 2009; Deveraj et al., 2007). Given the fact that only one replication has been carried out to date, academics wishing to measure e-procurement quality are advised to use the 30-item scale from the original UK setting, but to be aware of items that may be context specific when carrying out their analysis. For practitioners, this study illustrates the critical importance of e-procurement quality as perceived by internal customers in influencing the overall success of organisational e-procurement projects. By measuring e-procurement quality, managers are able to pinpoint problem areas and therefore focus their improvement efforts.

Finally, the study is a relatively rare example in OSM of a genuinely mixed methods approach to scale development, which combines the two primary empirical methods of the discipline, interviews and surveys. By placing stronger emphasis on qualitative empirical data collection in the development of construct measures, the resulting scales have the potential to be conceptually stronger than those that move more quickly from conceptualisation (based predominantly on extant literature) to quantitative verification. As such, the study provides an illustration of the value of triangulating data when exploring various OSM phenomena (Boyer

and Swink, 2008; Singhal and Singhal, 2012a, 2012b). The approach taken has helped reduce the risk of overlooking important facets of e-procurement quality and has ensured lower than normal item attrition rates during quantitative phases of the study. Supplementing the extra effort placed in the front-end of the scale development process, the incorporation of a replication phase with a new sample in an alternative e-procurement context reduces the risk of context dependency. In this case, it is only through replication work that possible context-specific items and dimensions have been isolated. Despite the fact that replication studies are widely acknowledged as important, they remain limited in OSM. Splitting field datasets into calibration and holdout samples, as seen in some studies (Froehle and Roth, 2004; Shah and Ward, 2007), naturally increases robustness but does not diminish the need to explore phenomena using genuinely different datasets. It is hoped that OSM researchers will find this paper a useful guide to combining methods to generate understanding of various OSM phenomena, while the scales that emerge from such a mixed methods process can provide more robust building blocks for subsequent the research seeking to develop and test theories.

6.3 Conclusion

The advent of e-procurement has created significant opportunities to improve organisational purchasing. However, non-compliance by internal customers (users) arising from low levels of e-procurement quality continues to hamper such potential. The objective of this research was to empirically examine the concept of e-procurement quality from an internal customer perspective and to develop psychometrically robust measures of its different dimensions. The study indicates that e-procurement quality is a second-order construct comprising five universally applicable dimensions of *Processing*, *Content*, *Usability*, *Professionalism*, and *Training*, and one context-specific dimension of *Specification*. The multi-item measurement scales for these dimensions, exhibit high levels of reliability and validity and should prove useful researchers looking to build, test, and refine theory. They also have diagnostic value for practitioners seeking to better understand internal customer perceptions of e-procurement quality in order to pinpoint areas for improvement.

Although this study makes several contributions to OSM, there are a number of limitations that should be considered when interpreting findings and that point to opportunities for future research. Firstly, considering the overall research design, multi-methods stand accused of mixing incommensurable paradigms and epistemological commitments (Burrell and Morgan, 1979). However, frameworks for classifying research designs, based on the relationship between the kind of information and the approach to knowledge generation, often ignore the

fact that methods may be used in various ways and by researchers with very different philosophical positions (Bryman and Bell, 2015). Secondly, the scope of the research is also naturally limited by the variables used to define e-procurement quality. As such, the aim of selection has been to balance comprehensiveness and parsimony. Thirdly, whilst the mixed-methods approach described here has resulted in a clear understanding of e-procurement quality from an internal customer perspective, research is an iterative process. Therefore, additional replication studies are necessary to explore the construct and refine measures further. Having examined e-procurement quality in two different countries, future studies should extend the empirical base with variation across industries, countries, and cultures (Sanders, 2007). In addition, these replications may benefit from the use of structural equation modelling to control for any measurement error that may be present based on the statistical approaches taken in this exploratory study (See Autry et al., 2010).

It is hoped that scholars find this study useful in advancing several avenues of research. Future studies could examine how perceptions of e-procurement quality vary across industries or countries and how different dimensions change over time. Further, analysis indicates that e-procurement quality appears to be an important antecedent for behaviours, in terms of system and contract compliance. A more detailed study examining these relationships, possibly with objective secondary data, as well as the effect of e-procurement quality on overall purchasing performance would represent a valuable contribution to OSM. Finally, as noted earlier, the reason for focusing on one key technology in this study was to allow a degree of concept travelling but avoid concept stretching. Given the significant investments made by many organisations in e-procurement specifically, such a focus was deemed appropriate. However, future research examining internal customer perceptions of other e-business technologies may find some of the items and dimensions from this study applicable to these related contexts.

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Appendix 1. E-procurement quality selective codes – illustrative quotes from phase two interviews

Selective code	Illustrative interviewee quotes
Financial management system (FMS) integration	*1.2: At the moment IFS [the FMS at Org 1] and Marketplace [e-procurement system] don't seem to speak to one another. So the order has to be looked at by someone in finance.* *2.21: If everything is going to be done electronically you should be able to push a button on a budget code and it tells you how much you have spent, how much is still pending and how much we have got left to spend – it should not be hard.*
Invoice reconciliation	*1.2: Later on, Marketplace will become more automatic. They will have invoices coming in and if the invoice matches the order it will automatically be paid.* *2.14: The next stage will be when they can send their invoices electronically. Then the order will go out and as long as you invoice the order – match. The invoice will automatically pay as long as someone has told the machine that it has been received and they will accept it.*
System configurability	*1.11: The drawback for Marketplace is that it is not flexible. It is a terribly rigid system and it won't do things that we would like it to do.* *1.15: I wish we could change more of the settings on the system.*
Reporting capability	*1.3: Another good thing is you can keep tabs on what you have ordered, because you can have reports at the end of it. Or you can search under different budget codes.* *1.12: Because it is not bespoke, the reporting system does not always do what we want to do. You get round it. Again you learn by experience.*
Processing complex orders	*1.2: I guess it's about how much of the total spending can go through the Marketplace and how easy that is. There are certain jobs that don't tie up with the system and we are not using the system because it can't do it. It is not flexible enough to do what they want to do.* *1.6: The functionality of it needs to be appropriate for what people are ordering. The system isn't particularly good at doing a service order - it is a goods commodity system which we knew from the start.*
System security	*1.3: It's secure, because you each have your individual password and all information is encrypted when it goes to the supplier.* *2.9: It times out on a security thing, which is good, because we have open offices.*
System availability	*1.8: With it being Internet-based it has to be available with very limited down time, so that it is accessible.* *1.23: There are problems for some users not in [head office], because they have got remote dial access they are not constantly linked to the Internet.*
Screen loading	*1.16: You have completed screen and you click continue, then you have to wait for ages whilst its moves to the next screen. It's annoying, because I can access the system ok, but it's so slow when I'm there.* *2.6: It is slow at lunchtime but that is because everybody is going on the Internet.*
System navigation	*1.10: Once you start an order, up comes the front page and you take the number off it. It works in a logical way and if you make a mistake you can go back a stage. If it does not recognise that cost code it will flag it up.* *2.7: From a beginner's point of view it is not the easiest system to work with. I don't think it is overly self-explanatory.*
Visual appeal	*1.3: It's not too bad, but it could be better. Just a bit more colourful I think.* *1.15: The visuals don't really matter as long as it works.*
Loaded suppliers	*1.6: What is happening now is we are asking to set the supplier up on Marketplace and the first thing they do is check creditors and if they are not on they say they can't set them up.* *2.21: The finance people and the procurement guys worked so hard to talk to all of us to try to get us to give them our suppliers that we use on a regular basis so that it was all set up so we*

	would not have to worry about setting up new suppliers.
Loaded catalogues	*1.16: I know there are issues around catalogues but the longer term is when we get them improved. We will have more catalogues on because it is quicker to order from a catalogue if you know what you are doing and the catalogues are of a decent quality.* *1.17: So there were a lot of items that we might have used that were never put on there. Which could have led to the problem of searching.*
Ease of search	*1.7: There's only 22,000 suppliers – you're not dealing with the World Wide Web! It does not seem easy to find anything. That is why it is too time-consuming - searching electronically instead of manually. CDS for example that is what everybody calls them but their name is Corporate Document Services and that is how they were put on the system. If we put in CDS we don't find it.* *1.12: When you search using the catalogues if you put in pen you get sheep pens or something like that!*
Order processing speed	*1.8: It has now reached a point where it is quicker to use the system than it is to do a paper order.* *2.23: Office services for example may do a weekly stationery order that is similar week on week. So ability to clone an order makes things much quicker.*
Ease of authorisation	*1.7: I am not being funny but every manager gets the right ache about this approval system. They [managers] are saying it takes them so long to get into the system to read everything through and they will all turn their E-mail thing off. We have even had an E-mail round from our top manager saying 'whenever you send me something like that, can you come and tell me because I am not going to bother looking', so the whole thing is self imploding.*
Orders to suppliers	*2.2: The main advantage that I have found is the fact that you have done away with the postage time. How ever urgent an order was in the past the order had to be typed and posted – via an internal post room. So if you're dealing with a large firm you know that the opposite happens at the other end – it goes into their post room and is slow. With the electronic system it goes from me to my colleague who authorises it, and to the supplier*
Order lead-time	*1.3: The time it takes to get orders is quicker now. Firstly, I can process a big order quicker, then the supplier gets it immediately on his e-mail.* *2.12: Orders take longer now – they shouldn't! The trouble is that we don't know if they got it, so we're hanging around waiting for an order that they [supplier] might not have.*
On-time delivery	*1.1: Orders seem to arrive on time more now. I don't know if it's the suppliers getting better or the fact that all these electronic systems have made everyone a bit less slack!* *1.12: If an order arrives on time, we praise the supplier. If it's late we blame the system. It's not right, I know, but there it is.*
Order accuracy	*2.6: Since adopting e-procurement I'm sure we've had an improvement in accuracy of the orders coming in. I guess there's less chance of a mistake because once it's on the system it won't be re-typed.*
Support availability	*1.16: She [e-procurement support] is not always in the office though.* *2.10: But on the occasions that XX [lady in charge of EP support] is not at her desk you will phone up and the person will say 'I am sorry I don't actually deal with Marketplace'. It would be worth the procurement centre communicating a list of contacts.*
Support reliability	*2.31: When we e-mail across for some guidance we do get it. If they can't answer it, they let me know when they will – they're pretty good at that.*
Support responsiveness	*1.18: I could not fault e-procurement support. When we had a problem we phoned up and they came straight down and it was that one-to-one training that you needed.* *1.23: I e-mail them and they e-mails back. They are usually quite quick.*
Knowledge	*1.1: We have the people here – the support has the knowledge, so if we ask them a question they actually seem to know the answer.*

	2.24: People want to talk to somebody quickly who knows what they are talking about, rather than being passed around.
Talking user's language	*2.3: And if I have a problem she will talk me through it.*
	2.34: We get three sentences where one would do sometimes.
Support flexibility	*2.7: Every department has different needs and they [the purchasing department] need to be more flexible. Sometimes we have an urgent order and don't have time to get the supplier approved with creditors – we need them to let it go through and we'll sort it out afterwards.*
	2.13: A lot of the problem is that some departments haven't got their act together and then complain when they [the purchasing department] say 'no, you can't just do what you want'. They don't realise that e-procurement is about doing normal procurement properly.
Problem resolution	*1.3: I felt the problem resolution was more than reasonable. The e-mail had been through to two or three other people like trying to figure out what had happened there so it was not a case of yes I am looking at it – it was this is what has happened I have spoken to this person and this person and it is all OK here*
	2.2: They [purchasing department] hadn't loaded a supplier we requested. That was annoying, but to be fair they resolved it quickly and we got the order off that day.
Confidentiality	*1.3: It's important to they [support personnel] don't go talking about what we've just discussed.*
	1.22: I assume what we talk about is kept confidential. It doesn't usually matter, because I'd say anything in the open, but still, I think it does matter.
Friendliness	*2.5: You get the feeling that when you had a query that it was all still friendly.*
	2.23: In the training there was an element of encouraging people. She [the trainer] was very friendly.
Concern shown	*1.8: There are some people who have a lot of problems and get to be a bit 'moany'. I want to do this and I can't. Yes well you should not be able to so you are not going to get it! I do tend to deal with them quite quickly.*
	2.1: You have to treat everybody as an individual.
Timely training	*2.10: If you are getting some training after you have used it a little bit you know what the problems are and then you are able to answer those queries in the training.*
	2.21: It would be better if you said 'You are going live on the 7th April. I'm going to come up and I'll train four people on the 7th April. Then I'll come up and I'll train another four on the 8th'. As it was, there was a huge gap!
Appropriate training	*1:8. Users have had training and they get a user manual but the user manual is about seventy pages long and they are not going to sit down and read it.*
	2.18: There is no reason why we could not go to someone's desk and do it with them but then you are doing a one on one or a one on two. When we do training we can do ten people in one go. So there is a resource issue there.
Information provision	*1.4: I book those people on the training but the office manager has not done any communication to their staff about it, people turn up for the training and say, 'what is this about and why am I here?'*
	1.13: Sometimes you are told, but sometimes they are very good at not launching the new addition on the day. The new version, 1.4 or 1.5. Sometimes I have found the explanation of what it is going to do is far more complicated than actually what it does do.
Encouraging feedback	*1.6: And we meet periodically to review the enhancements prioritise them and put the forward to the next release.*
	2.19: The users have to feel that if they do raise an enhancement or a request for a change that it is considered. I for one don't see that.