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Customer integration and operational performance: The mediating role of information quality

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ABSTRACT

Much supply chain integration literature tends to be biased towards its positive impact on operational performance. However, inconclusive results demand investigation of the mechanisms through which supply chain integration can lead to superior operational performance. The purpose of this study is to identify empirically the mediating role of information quality on the relationship between customer integration and operational performance, and the direct relationship between customer integration and operational performance. The study is based on a questionnaire sent to 228 manufacturing companies in the Republic of Ireland, and the relationships between the constructs are analyzed through regression analysis. The results indicate that information quality partially mediates the relationship between customer integration and quality, delivery and flexibility. Further, information quality was found to fully mediate the relationship between customer integration and cost.
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1. Introduction

Supply chain (SC) integration is a fundamental principle of supply chain management (SCM), and represents a departure from traditional functional business processes to integrated structures of processes [21]. While the SC integration literature describes various integration characterizations and dimensions (e.g. [97,120]), customer integration emerges as a critical integration competency [116]. Customer integration refers to the collaboration and information sharing practices, between a focal firm and its critical customers, in order to become more responsive to customer needs and requirements [128]. It has been suggested that the literature on SC integration tends to be biased towards its positive impact on operational performance; however inconclusive results (e.g. [29,114]) demand investigation of the mechanisms through which SC integration can lead to improved performance [117].

Information quality has been implicitly proposed by the literature as such mechanism; which can largely determine the success of the SC integration effort [76]. Information quality refers to information richness, rather than the amount, and thus it emphasizes the quality and nature of information shared between buyers and suppliers [135]. Despite this, studies that address the mediating role of information quality on the SC integration literature are mostly exploratory (e.g. [6,70]). Empirical studies that investigate the mediating role of information quality on the SC integration–operational performance link are rather scarce and have produced mixed results (e.g. [26,48]). For instance, while Cousins and Menguc [26] did find support for supplier's communication performance mediating the relationship between SC integration and operational performance, Gulati and Sytch [48] did not find sufficient evidence to support the mediating role of information quality for the relationship between buyer–supplier joint dependence and operational performance. This mixed support calls to further establish the mediating role of information quality on the SC integration–operational performance link. In addition to the proposed mediating role of information quality, the literature suggests a direct relationship between SC integration and operational performance (e.g. [32,39,44,104,122,128]), which has offered inconclusive and, sometimes, contradictory results (e.g. [29,33,114]), which suggests the need to further investigate the mechanisms through which SC integration leads to superior performance.

The mixed support in the SC integration literature has been attributed to operational performance being often measured as an aggregated construct, which not only disregards the individual performance dimensions, but also builds on the assumption that integration has "universal" effects on performance [117]. In view of this argument, this present research extends and complements the existing studies by explicitly investigating the indirect (through information quality) and direct relationships between customer integration, as an important dimension of SC integration, and four key individual dimensions of operational performance [20], namely quality, delivery, flexibility and cost.

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We have adopted social capital theory to explain the relationship between the constructs. Social capital has been regarded as the "relational glue" between suppliers and manufacturers, and thus the underling component that facilitates collaboration between trading partners in the SC [80]. Social capital theory posits that social structures constitute a valuable asset, which enables social actors to generate and exchange social assets [62,88]. Furthermore, like any other form of capital, social capital (i.e. social structures and social assets) creates value, and thus it makes possible the achievement of benefits [24]. Based on social capital theory and the SCM literature, we represent social structures such as buyer–supplier relationships [5,84] in the form of customer integration. Social structures (such as customer integration) enable interaction between buyers and suppliers, which generates social assets such as information quality [58,62]. Finally, this process of interacting and exchanging information quality can generate an understanding of the parties' mutual needs, and the necessary adjustments to improve operational performance [5,26].

In view of the previous argument, this research adds to the body of knowledge on SC integration, operational performance and social capital theory by addressing two research questions:

(1) To what extent is the relationship between customer integration and operational performance mediated by information quality, and
(2) To what extent does customer integration associate directly with operational performance (partial mediation).

The answer to these questions will contribute to supplement previous studies by explaining some mechanisms through which customer integration promotes operational performance. Further, through disaggregating operational performance into its individual components, this paper will be able to identify the potentially different effects of customer integration, and thus elaborate more on inconclusive empirical results. The above research questions will potentially illuminate the "black box" of the relationship between SC integration efforts and performance [48]. Furthermore, our study contributes to the building of social capital theory in the SCM context since there is little research that draws on this view in the area [27]. Finally, this paper is also important for practitioners to understand how their SC integration efforts can be more effective for the operational performance measures that they choose to compete.

2. Theoretical background and hypotheses development

2.1. Social capital theory and SCM

The central position of social capital theory suggests that social structures constitute a valuable asset in themselves, which in turn facilitate the creation of "collectivity-owned" social assets [62,88]. Social capital thus refers to both social structures that enable actions between social actors, e.g. individual persons or groups, and social assets that can be generated through the interaction between social actors [58,88]. Based on social structures and social assets, the literature describes various characterizations of social capital. For instance, Coleman [24] describes three dimensions of social capital: trustworthiness, information sharing and relational norms and sanctions. Note that these three forms of capital are consistent with factors associated with SC integration [59]. Nahapiet and Ghoshal [88] propose three forms of social capital: cognitive capital (resources that provide parties with shared representations, i.e. type of language), structural capital (social capital that results from relationship network configuration, i.e. information sharing) and relational capital (e.g. social capital that emerges from relationships that develop through time, i.e. trust and norms). Koka and Prescott [62] decided to differentiate between social structures and social assets, arguing that the literature has often confused social assets with social structures. Specifically, Koka and Prescott [62] argued that social structures in the form of buyer–supplier relationships or strategic alliances enable firms to exchange social assets such as information richness, which emphasizes the nature of information (i.e. information quality). This latter view is also shared by various studies that suggest that firms in close relationships are more likely to obtain and generate richer information since the parties involved perceive more cooperation and mutual benefit in the relationship (e.g. [28,50,57,92,119]).

In addition to social structures and social assets, the literature has also conceptualized social capital using a broader view, which includes the expected benefits resulting from the social actors leveraging their relationships. According to Coleman [24], like any other form of capital, social capital creates value, and thus it makes possible the realization of benefits. In other words, social actors who decide to invest in social structures obtain benefits through the process derived from social structures and social assets [5]. This broader view of social capital has been applied recently to the context of SCM since relationships across the supply chain refer essentially to relationships between social actors, who ultimately leverage their relationships to improve performance [5,62]. For instance, Cousins et al. [27] and Cousins and Menguc [26] examined the association between socialization process (between buyers and suppliers) and the creation of relational capital, which, in turn, led to improved supplier performance. Studies have also incorporated the structural and cognitive aspects of social capital, and investigated their association with buyer and supplier performance (e.g. [15,63,69,123]).

Our study adopts this broader view of social capital theory and represents social structures such as the buyer–supplier relationship [5,84] in the form of customer integration. It has been argued that SC integration (i.e. customer integration) and collaboration practices represent a higher level of buyer–supplier relationship [54]. Accordingly, customer integration could represent a form of social structure. Social structures (such as customer integration) enable firms to generate and exchange social assets such as information quality [58,62]. According to Cousins and Menguc [26], integrated SC structures and socialization structures are linked closely together, which could represent the means through which SC actors interact with one another. This interaction can reduce in turn the perceived risk between buyers and suppliers, and thus increase information flow and information richness [26]. Finally, it is through the process of interacting and exchanging information quality that an understanding of the parties' mutual needs can be generated and operational performance improved [5,26]. Accordingly, drawing from the logic expressed in social capital theory and the SCM literature we present a conceptual framework that models customer integration as antecedent to information quality and operational performance. We then add that information quality can be antecedent to operational performance, which is also consistent with the tenants of social capital theory.

2.2. Customer integration and information quality

SC integration refers to the fundamental shift away from managing individual functional processes, to managing integrated processes in the SC [101]. The literature on SC integration is extensive and provides various dimensions such as horizontal integration, vertical integration [100], internal integration and external integration [104]. Another characterization of SC integration suggests two major interrelated forms: forward and backward integration [14,44]. Forward integration involves integrating the forward physical flow of delivery schedules, capacity and product information from suppliers and customers. Backward integration is instead aimed at the backward integration of information (through information technology), and the flow of information such as customer orders and demand forecasts from customers to suppliers. A further classification of integration involves the intent of integration, which ranges from arm's length relationships to more strategic and collaborative activities [114]. Furthermore, some authors have described SC integration at multiple levels: customer integration, information

sharing, logistics and distribution integration, supplier integration, and purchasing integration [21,101,120].

It emerges from the literature though, that customer integration is often seen as a necessity and a critical competency for successful integration efforts [23,116]. Traditionally, competitive advantage in companies has been the result of cost reduction strategies; however, today's competitive environment demands a more 'customer-driven' approach, which integrates the customer as a fundamental part of the SC [86].

Customer integration is commonly associated with collaboration activities such as frequent customer contact and the evaluation of customer satisfaction and customer future expectations [114]. According to Vickery et al. [122], manufacturing plants use customer integration practices to assimilate and incorporate customer preferences and needs, and then become more responsive. All this is achieved through communication not only to understand customer's preferences but also to build long-term relationships [114,128]. Accordingly, just like the broader concept of SC integration, customer integration refers to more than managing individual functional processes, and it is defined as the collaboration and information sharing practices, between a focal firm and its critical customers, in order to become more responsive to customer needs and requirements [114,128].

Our literature review on customer integration highlights the importance of information sharing for SC integration. It has been suggested that SC collaboration processes always contain some form of information sharing [125]; however, the type of information can ultimately determine how successful the integration effort is [76,78,79,98]. Similarly, it has been argued that information sharing has different functions in the SC, and is not simply sharing information but when, how and with whom it is shared, which has different effects on the participants [52].

The concept of information sharing has two broad aspects: quantity and quality, which are differentiated in the literature [45,72,135]. While the quantitative aspect of information sharing relates to the amount of information shared, the qualitative aspect refers to the type of information actually shared between integration partners [127]. Mason-Jones and Towill [79] indicate that information flow of itself may have limited value, observing that what matters is the type of information delivered. Specifically, information quality refers to information richness, rather than the amount, and thus it emphasizes the quality and nature of information shared between a firm and its trading partners [62,135]. This definition of information quality is compatible with the social capital view and refers to information enriched with context, fine-grained in terms of products/markets information, and geared towards problem solving [118]. As such, information quality includes aspects such as accuracy, timeliness, completeness, currency, ease to access and compatibility of information [51,85,91,98,130,134,135]. For instance, timely information refers to information received at the right place, to the right receiver and to the right time, whereas complete information is related to right quantity [42]. Lee et al. [136] explain that information can be highly distorted in the SC, resulting in what the authors first coined as the "bullwhip effect". This is the result of demand distortion from downstream SC members, who in order to optimize their operations may send distorted signals upstream the SC. According to Lee et al. [136], demand distortion can be mitigated by a combination of relevant types of information (e.g. accurate and compatible).

As SC relationships move from arm's length to fully integrated, richer information is expected to be shared since there is a mutual feeling that the relationship is beneficial for the parties involved [85,97]. This argument is compatible with the social capital view, which suggests that, in a SC context, integration can provide the mechanism to facilitate information exchange [26]. In support of this assertion, there is evidence in the literature that investigates the relationship between forms of SC integration and information quality (e.g. [73,97,110,119,131]). For instance, conducting case studies in the fashion industry, Uzzi [119] found that information sharing in collaborative buyer–supplier relationships is more related to tacit information than information that is exchanged in arm's-length relationships (e.g. price and quantity data). Uzzi [119] explained that close ties act as a platform for fine-grained information transfer, which in turn allow firms to jointly identify and prevent problems. Similarly, conducting a case study for fast-moving consumer goods, Siemieniuch et al. [110] found that SC collaborative practices resulted in the willingness to share relevant and mutually beneficial information. Yli-Renko et al. [131] found that close interaction between innovative suppliers and their key customers facilitate knowledge acquisition, which considered strategic aspects of information such as customer needs and trends as well as technical know-how. In a study examining the relational antecedents of information flow integration; Patnayakuni et al. [97] found that relational interaction routines (e.g. partner's involvement in quality improvement initiatives) enabled information flow integration between buyers and suppliers. Although, Patnayakuni et al. [97] did not specifically address the construct of information quality, they conceptualized information flow integration as the extent to which operational, tactical and strategic information is shared, which considered aspects of accuracy and ease to access information. Similarly, investigating the implications of inter-organizational relationships, Li and Lin [73] found that aspects such as the level of trust and shared vision (i.e. relational capital) between buyers and suppliers facilitate the sharing of information quality, which considered aspects such as information timeliness, accuracy, completeness, adequacy and reliability. The above empirical evidence highlights the association between different forms of SC integration and information quality. However, the literature also examines the association between information quality and operational performance, which will be discussed in the following section.

2.3. Information quality and operational performance

Sharing enriched or information quality has been associated with superior operational performance such as quality, flexibility, customer service and cost improvement [79]. Operational performance refers to the strategic dimensions from which a company chooses to compete [89]. There is general agreement in the operations management literature that quality, delivery, flexibility and cost are the core and most often mentioned competitive areas [90,124], and it has been indicated that similar operational performance dimensions can be extended to the area of SCM [96]. Furthermore, various SCM empirical studies have used a combination of cost, quality, delivery, and flexibility (e.g. [18, 104,109,114]). This combinative approach towards competitive capability can be the result of a general trend where world-class manufacturers tend to combine performance measures simultaneously [64,107]. According to Narasimhan and Das [89], research has indicated that successful organizations engage in multiple performance objectives with companies more interested in aggregate performance measures. In this research, we test multiple operational performance objectives, namely quality, delivery, flexibility and cost.

Quality has received substantial attention in the literature. Traditionally, quality in manufacturing has been regarded as conformance quality, which is described as the degree to which products meet manufacturing specifications [68,111]. However, there are other important characteristics of quality that go beyond product specifications (e.g. performance, reliability and durability) such as service quality, and thus quality is not solely related to the product itself but also to the service that comes with it [19]. *Delivery* is a time-based performance measure defined as the ability to deliver products at the specified time [124]. Delivery is assessed by speed and dependability [19,68]. Speed is described as the ability to deliver products faster than competitors, which must be considered in order to win orders [124]. Dependability refers to doing things on time and whether a company can deliver products on promised due dates [68,111]. *Flexibility* is another important operational performance measure, which is described as the ability of the company to adapt and respond to diversity or change, to give customers individual treatment, or to introduce new products/services [19,111]. Chan [19] indicates that flexible systems can respond to special service

requirements, product innovativeness and product variety, and thus achieve a variety of operating attributes. *Cost* is defined as "doing things cheaply, producing goods and services at a cost that enables them to be priced appropriately for the market while still allowing a return to the organization" ([111], p. 40). Chan [19] indicates that cost is the most significant direct kind of operational performance measurement and that the whole performance is influenced by cost. However, Beamon [8] warns against considering cost as a sole performance measurement because it may undermine other aspects (e.g. quality, delivery and flexibility) of performance in the system.

With regard to *quality*, it was found that information quality, including aspects such as information timeliness, accuracy, adequacy, completeness and credibility, was positively associated with quality improvement [87]. Monczka et al. explain that when suppliers participate actively in new product development (NPD) efforts with customers, timely and credible information often translates into improved quality. Similarly, investigating the benefits of internal and external communication methods, Carr and Kaynak [17] showed that aspects such as information detail, frequency and timeliness were positively associated with superior quality. Using modeling techniques, Sum et al. [113] found that data accuracy was an important determinant of improved quality among other operational measures. In a study that examined the effect of SCM spanning capabilities, Tracey et al. [116] found that information dissemination (including aspects that reflect information readiness and information relevance) was positively associated with perceived product value and customer loyalty.

With regard to *delivery*, Monczka et al. [87] explain that NPD requires suppliers to provide credible and timely information in order to reduce delivery measures such as product cycle time. Sum et al. [113] found that sharing accurate data resulted in enhanced customer service such as shorter delivery lead-time and better meeting of delivery promises. Similarly, Boulard et al. [9], Larson and Kulchitsky [67] and Ahmad and Shroeder [1] found that sharing timely demand information (through EDI) improved on-time delivery. More recently, Zhou and Benton Jr. [135] found that information quality, including aspects such as information accuracy, availability, completeness, relevance and accessibility, has a significant and positive effect on delivery. Rossin [105] also found that poor information quality in responsive supply chains resulted in missing product units and delayed orders.

With regard to *flexibility*, Sum et al. [113] found that data accuracy has a positive impact on the ability to meet changes in volumes and products. Similarly, Gosain [46] found that the transmission of coordination information with little distortion, prioritizing the quality of the information shared, was associated positively with the ability to cope with product changes. This can be exemplified by Dell's effective strategy to improve flexibility. Breen and Aneiro [11] explained that, despite a major 10-day disruption in American docks, Dell kept improving its speed and flexibility due to the exchange of relevant and strategic information with its key suppliers.

With regard to *cost*, Rossin [105] found that, for responsive supply chains, poor information quality resulted in an increase in total costs. Also, in a study of Mexico's manufacturing industry, as one of the preferred production settings for American companies, Fawcett et al. [35] demonstrated that the relevance of the information shared was critical for cost improvement. Examining the relationship between the different forms of information integration and operational performance, Kulp et al. [65] found that sharing relevant information was related to a positive change in profit margin (i.e. unit price less unit costs).

The above research evidence (the positive association between SC integration and information quality, and between information quality and multiple operational performance dimensions) suggests implicitly that information quality may act as a mediating variable. However, studies that have suggested that information quality can have an impact on the benefits gained through SC collaborative efforts are mostly exploratory (e.g. [6,70,76,121]). For instance, in a case study developed to explore inter-firm collaboration in the UK red meat industry, Bailey and Francis [6] found that despite the high levels of information sharing, there were still significant information discrepancies between buyers and suppliers. Bailey and Francis [6] attributed this to information sharing alone not being sufficient, and that there is a need to consider greater alignment and integration between the parties involved. In another case study, Vermer [121] argued that poor information quality might be a reason for the increasing number of negative results reported from information sharing and collaboration efforts. While Vermer [121] found initially that information sharing positively impacted on processing time, subsequent prevention and corrective activities in the ordering process due to poor data quality (e.g. wrong net prices and data entry errors) resulted in negative process performance. In another exploratory study, Legner and Schemm [70] found that poor data quality (e.g. outdated product information) had a negative impact on the benefits of buyers and suppliers who pursue inter-firm integration forms. Conducting 16 case studies with enterprises in the IT industry; Malhotra et al. [76] found that companies involved in collaborative efforts, which show operational efficiency and knowledge creation, were also characterized by advanced inter-firm integrative processes such as the exchange of high information quality.

Although the above studies have significantly furthered our understanding of the importance of information quality for SC integration, their exploratory nature demands further empirical investigation. On the empirical front, research evidence that investigates the mediating role of information quality is relatively scarce and with mixed support in their results (e.g. [26,48]). For instance, Gulati and Sytch [48] did not find sufficient evidence to support the mediating role of information quality on the relationship between buyer–supplier joint dependence and operational performance. Furthermore, Gulati and Sytch [48] concentrated on a single industry and thus potentially limiting the generalization of their findings. While Cousins and Menguc [26] found support for the mediation effect of supplier's communication performance (e.g. quality initiatives) on the relationship between SC integration and supplier's operational performance, their study used a composite construct that did not differentiate between information sharing and information quality. As noted previously, there are important distinctions between information sharing and information quality [72,135].

The mixed support in the latter studies can be attributed to operational performance being measured as an aggregated construct. In a recent study, Turkulainen and Ketovivi [117] suggest that the lack of association between SC integration and operational performance can be attributed to operational performance being often measured as an aggregate construct, which, on the one hand, disregard the individual components of operational performance, and, on the other hand, recognizes integration as a "best practice" approach. According to Turkulainen and Ketovivi [117], the integration concept tends to evoke a positive connotation in the literature; however, there is still empirical evidence that offers inconclusive and, sometimes, contradictory results (e.g. [29,33,114]), which suggest the need to further investigate the specific mechanisms through which integration leads to superior performance. Accordingly, in view of the above argument and mixed findings, this present research extends and complements the existing work by explicitly investigating the mediating role of information quality on the relationship between customer integration, as an important dimension of SC integration, and four key individual dimensions of operational performance, namely quality, delivery, flexibility and cost. Therefore, the following hypotheses are stated:

H1. Information quality mediates the relationship between customer integration and (a) quality, (b) delivery, (c), flexibility and (d) cost.

2.4. Customer integration and operational performance

Our hypotheses proposed the association between customer integration and operational performance being mediated by information

quality; however, it has been suggested that customer integration can be directly and positively associated with operational performance.

In recent years, there has been an increasing interest in understanding the role of SC integration in improving operational performance [128,132]. Growing evidence suggest that SC integration has a positive impact on operational performance (e.g. [32,39,44,104,122,128]). Despite this evidence, studies have found inconclusive and, sometimes, contradictory results (e.g. [29,33,114]). As noted previously, according to Turkulainen and Ketovivi [117], these mixed results in the integration literature could be attributable to operational performance being measured as an aggregated construct (e.g. [29,44]). As an exception, Wong et al. [128] investigated and found support for the positive association between customer integration and multiple operational performance measures, namely quality, delivery, flexibility and cost; however, they focused on a single industry, which can potentially decrease the generalizability of their results.

This paper aims to contribute to the literature by considering a partial mediation effect. This effect is also consistent with the expectations of the social capital view, which suggests that social actors who decide to invest in social structures obtain benefits through the process derived from both social structures (e.g. customer integration) and social assets (e.g. information quality) [5]. This means that although customer integration leads to better information quality, which in turn leads to better operational performance, based on the results of Flynn et al. [39] and Wong et al. [128], customer integration (i.e. frequent interactions and information sharing) can also lead to operational performance improvement. For instance, Flynn et al. [39] argue that customer integration, through collaborative attitudes and mutual problem solving, can result in cost and customer service improvement. Furthermore, customer integration promotes the coordination of tasks and joint identification of problems, which not only reduce waste [114] and facilitate cost and inventory reduction, but also helps to identify and solve quality problems [128]. Therefore, the following hypotheses are stated:

H2. Customer integration is positively associated with (a) quality, (b) delivery, (c) flexibility and (d) cost.

3. Research methodology

3.1. Sampling and data collection

The research design of this study is a cross-sectional design using a quantitative (self-completion) questionnaire as the data collection technique. Cross-sectional design involves the collection of information using data gathering instruments on more than one case at a single point in time with the aim of detecting patterns between the variables involved in the analysis [41]. Cross-sectional design was chosen for a number of reasons. Firstly, this study is concerned with variability that assumes than more than one case will be selected. In order to establish variability between cases, it is necessary to have standardized quantitative instruments for better comparison [38]. These instruments allow determining finer distinctions between cases and provide the means for a more precise estimation of relationships between variables. Secondly, this study does not seek to find changes in patterns between cases over time, and thus it focuses on data that is produced and supplied at almost the same time by the respondents. Accordingly, this study does not include a longitudinal approach. Thirdly, generalization (external validity) is a main objective in this study, and external validity, reliability and replicability have been described to be the main strengths of this research design [12]. Overall, the research design follows the empiricist tradition in that it tests existing theory using a deductive approach of research.

A postal questionnaire was used to collect the data using a mailing list obtained from Kompass Ireland (one of Ireland's most accurate and up-to-date business data providers). The main population from which our sample was selected was the top 2500 Irish companies in terms of turnover, profitability and size. However, this group of companies contained a broad range of sectors, and since the different constructs in this study (their proposed relationships, and the validated scales we used from the literature) focused on manufacturing practices, only manufacturing firms were selected from this group. This excluded from the sampling frame other sectors not directly involved in the visible transformation of products such as primary extraction, agriculture, forestry, fishing and services. A total of 705 manufacturing companies were selected out of which 655 were contacted and subsequently sent a copy of the questionnaire (some companies have gone into liquidation or were manufacturing abroad). The main reasons for focusing on the Republic of Ireland are threefold. Firstly, the Republic of Ireland is considered a small but open and trade-dependent economy, which has changed rapidly from being an agriculture-dependent economy to having one of the highest GDPs per capita in Europe [34]. Secondly, there has been a growing trend to outsource activities, mainly labor intensive activities to lower cost Eastern European countries and Asia due to Ireland's high labor costs [56]. This makes the effective use of the SC a key issue to business success in the Republic of Ireland. Finally, the current economic crisis requires a more effective and efficient use of resources, which justifies the strategic role of SCM in securing savings.

The unit of analysis is the manufacturing plant and only knowledgeable individuals holding relevant managerial roles were chosen as the key respondents in our study [77]. In order to increase the response rate, respondents were contacted personally to obtain their consent to participate in the survey [31,124]. Furthermore, a benchmark score of each company's practices relative to their industry sector was offered as an incentive. After three follow-up contacts, a total of 236 questionnaires were received and 228 were usable. This results in a response rate of 36%, which can be regarded as satisfactory in this type of survey-based studies [43,77]. Table 1 provides details of the sample characteristics.

3.2. Non-response bias and common-method bias

If respondents differ substantially from individuals who do not respond, then responses cannot be generalized to the population [83]. However, it has been suggested that people responding in later waves can be assumed to be more similar to people who do not respond at all due to the extra stimulus used by the researcher to encourage completion of surveys [4,66]. Responses between early and late respondents were compared across all items of the constructs [15]. The items were compared using the chi-square test [18,126]. Table 2 shows that all

Table 1
Demographics of the sample.

Characteristics	Sample (%)		Sample (%)
Respondent's job title		*No. of employees*	
Production manager	32.6	Under 100	44.1
Operations manager	25.0	100–299	33.9
Supply chain manager	18.4	300–499	8.3
General manager/Director	17.0	500+	13.7
Other managerial areas	7.0	*Majority ownership*	
Industry sector		Irish	43.0
Manufacturing of food	16.8	USA	29.0
Machinery	12.8	Continental Europe	17.9
Pharmaceuticals	12.0	UK	5.4
Electronics	10.2	Other countries	4.7
Medical devices	9.7	*Annual turnover*	
Plastics	8.4	Under 25 m	43.7
Chemicals	7.5	25 m but less than 50 m	18.4
Fabricated metal products	7.1	50 m but less than 100 m	13.4
Motor vehicles and parts	4.4	100 m but less than 200 m	6.1
Wood/products of wood	4.0	200 m+	18.4
Basic metals and other minerals	3.5		
Textiles and apparel	1.8		
Pulp, paper and paper products	1.8		

Table 2
Non-response bias across all construct items.

Variables	Chi-square	Df	Sig.
Customer integration			
We frequently interact with this customer to set reliability, responsiveness, and other standards for us	6.829	9	0.659
We frequently measure and evaluate this customer satisfaction	4.722	9	0.858
We frequently determine this customer future expectations	9.324	9	0.408
We inform this customer of changing needs	11.140	9	0.266
This customer shares proprietary information with us	9.147	9	0.424
Information quality			
Information exchange between this customer and us is accurate	13.333	9	0.148
Information exchange between this customer and us is complete	8.694	9	0.812
Information exchange between this customer and us is adequate	7.944	9	0.789
Information exchange between this customer and us is reliable	6.622	9	0.676
Information exchange between this customer and us is relevant	3.033	6	0.805
Quality			
High product performance	7.278	12	0.838
High product reliability	3.422	9	0.945
Conformance of final product to design specifications	1.767	4	0.779
Delivery			
Short delivery time	7.056	9	0.631
Delivery on due date (ship on time)	6.074	9	0.732
On-time delivery (range of days/hours before and after due date/time)	5.453	9	0.793
Flexibility			
Ability to introduce new products into production quickly	7.868	9	0.547
Ability to adjust capacity rapidly within a short time period	6.956	12	0.860
Ability to make design changes in the product after production has stared	8.897	12	0.712
Cost			
Production cost	8.757	6	0.850
Labor cost	14.250	12	0.285
Capacity utilization	13.194	16	0.658
Productivity	8.757	12	0.724

the significance values of the items were above 0.01, which suggests that non-response bias may not be a concern in this study. Since the data were collected from single respondents the potential for common-method bias was assessed. In order to identify the potential effects of common-method bias, the literature suggests the use of statistical techniques such as Harman's single-factor through exploratory factor analysis (EFA) [10,99]. To conclude that common method bias is present either (a) a single factor will emerge from loading all variables into an EFA, or (b) one general factor will account for the majority of the covariance among measures [99]. The results of the EFA revealed six distinct factors and that the first factor explained 28.5% of variance, which does not represent the majority of the total variance. To further assess common method bias, confirmatory factor analysis (CFA) was applied to Harman's single-factor model [39,99]. After conducting CFA, the model fit indices were poor (χ^2/df (1109/209) = 5.30, RMSEA = 0.14, CFI = 0.82 and NNFI = 0.80) and significantly worse than those of the measurement model (see Table 5). This suggests that a single factor model is not acceptable and that common method bias is unlikely.

3.3. Validation and measurement scales

The validation process for the survey instruments was completed in three steps: content validity, construct validity and reliability [95].

Firstly, a draft questionnaire was pre-tested with academics and practitioners (executive MBA students holding relevant managerial positions) to determine its content validity. As a result, a number of modifications were proposed to the questionnaire's layout and wording. The modified version of the questionnaire was pilot-tested with the target population to verify its appropriateness for this group. A total of thirty questionnaires were sent to the target audience and ten were returned. Terminology was again adapted to better suit the target population. Apart from these changes, no difficulty in completing the questionnaire was reported.

Secondly, construct validity was established through unidimensionality and discriminant validity. The implicit condition that a measure should satisfy in order to be considered unidimensional is that the measure must be associated with only one latent variable [95]. Unidimensionality was established through the use of EFA with principal axis factoring, Varimax rotation and extracting factors with eigenvalues greater than 1.0 [115]. Based on the EFA, factor loadings for all items ranged from 0.463 (customer integration) to 0.832 (cost) (see Table 4). While two items of customer integration fell slightly bellow the minimum of 0.5 as a common cut-off point [2], we still satisfied the criteria of 0.4 set by other work such as Hair et al. [49]. More importantly, we decided to keep these items because they are very important for the concept of customer integration [133]. Other items displayed lower factor loadings, which were not considered

Table 3
Mean, standard deviation and correlations of the constructs.

Construct	Mean	S.D.	1	2	3	4	5	6
Customer integration (1)	2.001	0.568	**0.632**					
Information quality (2)	2.268	0.575	0.474**	**0.632**				
Quality (3)	1.895	0.595	0.342**	0.262**	**0.721**			
Delivery (4)	2.089	0.694	0.317**	0.272**	0.409**	**0.800**		
Flexibility (5)	2.395	0.716	0.326**	0.257**	0.374**	0.474**	**0.663**	
Cost (6)	2.545	0.747	0.222**	0.364**	0.417**	0.476**	0.474**	**0.640**

The data on the diagonal (in bold) is the square root of AVE of the construct.

Table 4
EFA for customer integration, information quality and operational performance.

Construct	F1	F2	F3	F4	F5	F6
Customer integration						
We frequently interact with this customer to set reliability, responsiveness, and other standards for us	0.609					
We frequently measure and evaluate this customer satisfaction	0.648					
We frequently determine this customer future expectations	0.463					
We inform this customer of changing needs	0.641					
This customer shares proprietary information with us	0.484					
Information quality						
Information exchange between this customer and us is accurate		0.674				
Information exchange between this customer and us is complete		0.591				
Information exchange between this customer and us is adequate		0.561				
Information exchange between this customer and us is reliable		0.626				
Information exchange between this customer and us is relevant		0.623				
Quality						
High product performance			0.551			
High product reliability			0.715			
Conformance of final product to design specifications			0.587			
Delivery						
Short delivery time				0.577		
Delivery on due date (ship on time)				0.751		
On-time delivery (range of days/hours before and after due date/time)				0.785		
Flexibility						
Ability to introduce new products into production quickly					0.600	
Ability to adjust capacity rapidly within a short time period					0.611	
Ability to make design changes in the product after production has stared					0.485	
Cost						
Production cost						0.558
Labor cost						0.711
Capacity utilization						0.540
Productivity						0.832
Eigenvalue	6.571	2.544	1.779	1.319	1.238	1.133
% of variance	28.571	11.060	7.734	5.735	5.384	4.928
Cumulative explained variance (%)	28.571	39.631	47.365	53.100	58.485	63.413
Reliability (α)	0.751	0.782	0.704	0.816	0.682	0.810

for further analysis to ensure the quality of the measures [25]. The eigenvalues for the six factors are above 1.133 and the cumulative explained variance is 63.413%. A Kaiser–Meyer–Olkin (KMO) statistic of 0.858 confirmed the suitability of the items for factor analysis since KMO values greater than 0.60 can be considered as adequate for applying factor analysis [49].

We also used CFA to further test unidimensionality [133]. Lisrel 9.1 was used to carry out CFA. The CFA factor loadings (unstandardized and standardized) and t-values are illustrated in Table 5. The average variance extracted (AVE) values were computed as the average squared standardized factor loadings [49]. Table 5 illustrates that value for some constructs are below 0.50 as a common cut-off value [49]. Although some items have relatively low factor loadings, which reflected the relatively low AVE, we still keep these items because they are very important for constructs such as customer integration [133], information quality, flexibility and cost [72]. CFA also allows examining the measurement model adequacy. The overall fit for the measurement model was good: of χ^2/df (401.89/215) = 1.865 and RMSEA = 0.062. An RMSEA between 0 and 0.05 indicates a good fit, and less than 0.08 suggest a reasonable fit [13,49,55,109]. Table 5 reports all other relevant measures (RMR = 0.050; NNFI = 0.947; CFI = 0.955; IFI = 0.955, GFI = 0.912, AGFI = 0.923, NFI = 0.909), which are also within an acceptable range [53,61]. Next, discriminant validity was tested to measure the extent to which individual items, which intend to measure one latent construct, do not, at the same time, measure a different latent variable [30]. Discriminant validity was tested through inter-factor correlation [2], while it is expected a degree of correlation, a very strong correlation between factors indicates that they are measuring the same construct [3]. Table 3 indicates that discriminant validity is given [2]. As an alternative test, the correlation between two constructs was compared with the square root of AVE [40]. According to this test, the correlation between each pair of constructs should be less than the square root of AVE for each individual construct [74]. Table 3 shows that none of the correlations is higher than the square root of AVE for each individual construct. Taken together, this provides evidence for the validity of our constructs.

Thirdly, in order to estimate reliability, the Cronbach's alpha coefficient was used, as it is a common method for assessing reliability in the empirical literature [16]. Table 4 illustrates that all the scales show alpha values above or marginally below 0.7, which indicates high levels of reliability [93].

Customer integration was measured using a five-item scale, based on those developed by Li et al. [72] and Swink et al. [114]. The scale included questions on customer interaction, information sharing and the evaluation of customer satisfaction and expectation. *Information quality* was measured with scales based on Li et al. [72], and included five questions on information accuracy, completeness, adequacy, reliability and relevancy. For the above scales items, respondents were asked to evaluate the extent to which they agree or disagree with respect to their business using a five-point Likert scale (being 1 = strongly agree and 5 = strongly disagree). *Operational performance* was measured by scales developed by Ward et al. [124], who focused primarily on a production line as the unit of analysis, and thus on internal operational performance measures to develop their scales. We included scales addressing four internal operational performance dimensions: quality, delivery, flexibility and cost. For the latter scales, respondents were asked to evaluate how their firm compares to their major industrial competitor using a five-point Likert scale (being 1 = superior and 5 = poor or low end of the industry).

This study includes industry type as control variable. Research has suggested that firms in some industries are more likely to obtain better performance from the implementation of certain SCM practices

Table 5
CFA and AVE for customer integration, information quality and operational performance.

Construct	Unstandardized factor loading	Standardized factor loading	t-Value
Customer integration (AVE: 0.40)			
We frequently interact with this customer to set reliability, responsiveness, and other standards for us	0.50	0.66	10.14
We frequently measure and evaluate this customer satisfaction	0.52	0.60	9.06
We frequently determine this customer future expectations	0.49	0.60	9.03
We inform this customer of changing needs	0.43	0.70	10.83
This customer shares proprietary information with us	0.52	0.56	8.26
Information quality (AVE: 0.40)			
Information exchange between this customer and us is accurate	0.46	0.63	9.55
Information exchange between this customer and us is complete	0.48	0.63	9.42
Information exchange between this customer and us is adequate	0.61	0.73	10.29
Information exchange between this customer and us is reliable	0.46	0.59	8.67
Information exchange between this customer and us is relevant	0.44	0.55	7.97
Quality (AVE: 0.52)			
High product performance	0.53	0.65	9.40
High product reliability	0.49	0.67	9.66
Conformance of final product to design specifications	0.48	0.69	10.05
Delivery (AVE: 0.64)			
Short delivery time	0.54	0.64	10.24
Delivery on due date (ship on time)	0.71	0.86	15.19
On-time delivery (range of days/hours before and after due date/time)	0.65	0.87	15.44
Flexibility (AVE: 0.44)			
Ability to introduce new products into production quickly	0.69	0.66	9.96
Ability to adjust capacity rapidly within a short time period	0.69	0.80	12.19
Ability to make design changes in the product after production has stared	0.40	0.49	6.96
Cost (AVE: 0.41)			
Production cost	0.52	0.61	9.60
Labor cost	0.64	0.74	12.19
Capacity utilization	0.65	0.69	11.21
Productivity	0.74	0.88	15.66

Fit indices: χ^2/df (401.89/215) = 1.865, RMSEA = 0.062, RMR = 0.050, NNFI = 0.947, CFI = 0.955, IFI = 0.955, GFI = 0.912, AGFI = 0.923, and NFI = 0.909.

(e.g. [81]). We therefore include four dummy variables (the four largest industries in our sample) to control for the impact of different industries: manufacturing of food, machinery, pharmaceuticals and electronics. These industries represent more than 50% of our industry sample.

4. Results

Ordinary least square (OLS) analysis was used to formally test our hypotheses. Prior to carrying out the regression analysis, the data was tested for linearity and multicollinearity. Firstly, linearity and equality of variables were assessed and confirmed through plotting the standardized residuals against the standardized predicted values [37]. Secondly, to test whether multicollinearity is present between the independent variables, the correlation coefficients were calculated. To indicate an absence of multicollinearity, a common cut-off value of 0.70 has been suggested [3]. Table 3 shows that the correlation coefficients between our independent variables are below this level. Furthermore, multicollinearity can be also concluded if the maximum variance inflation factor (VIF) exceeds ten as the common threshold [94]. All variables in the model were consistently within this value (Max VIF = 1.314 in Table 6), which indicates and absence of multicollinearity.

To test whether information quality mediates the relationship between customer integration and operational performance (quality, delivery, flexibility and cost), and the direct relationship between customer integration and operational performance, four different models were used, one for each operational performance dimension [109], which is a commonly used practice [103,126]. For each model, three steps were carried out following the approach adopted by Carey et al. [15]. In the first step, our control variables and the predictor variable (customer integration) were regressed against the mediator variable (information quality). In the second step, the predictor variable was regressed against each dependent variable (quality, delivery, flexibility and cost). Finally, in the third step, we regressed the dependent variables on both the mediator and predictor variables. All these effects must be significant in order to indicate a mediation effect, with the significance of each association between the predictor and outcome variables reduced by adding the mediator variable [7]. Table 6 presents the results of the OLS regression analyses.

The fist step of the analysis indicates that customer integration is positively associated with information quality ($\beta = 0.476$, $p \le 0.001$). Next, the results of the second step of the analysis reveal that customer integration is positively associated with quality ($\beta = 0.336$, $p \le 0.001$), delivery ($\beta = 0.313$, $p \le 0.001$), flexibility ($\beta = 0.320$, $p \le 0.001$) and cost ($\beta = 0.217$, $p \le 0.001$), which established that there was an effect to be mediated in each of the four models, and thus satisfying step two of the mediation test. With regard to the mediation effect in the third step, the quality model shows that, upon the inclusion of information quality ($\beta = 0.120$, $p \le 0.05$), customer integration continued to be significantly related to quality ($\beta = 0.279$, $p \le 0.001$), providing evidence of partial mediation and thus partial support for H1a, and full support for the direct relationship between customer integration and quality (H2a). With regard to the delivery model, the association between customer integration and delivery continued to be significant ($\beta = 0.237$, $p \le 0.001$) once the mediator was included ($\beta = 0.159$, $p \le 0.05$), which indicates ($\beta = 0.150$, $p \le 0.05$), the flexibility model shows that the association between customer integration and flexibility continued to be significant ($\beta = 0.248$, $p \le 0.001$), which indicates that information quality partially mediates the relationship between customer integration and flexibility (partial support for H1c and full support H2c). The cost model provides evidence of full mediation of information quality for the relationship between customer integration and cost (H1d), since the association between customer integration and cost became non-significant ($\beta = 0.052$, ns) by adding information quality ($\beta = 0.348$, $p \le 0.001$). However, the lack of association between customer integration and cost indicates that H2d is not supported.

Table 6
Results of OLS analyses.

Standardized coefficients														
	Information quality		Model 1 — Quality			Model 2 — Delivery			Model 3 — Flexibility			Model 4 — Cost		
Variables		Step 1		Step 2	Step 3		Step 2	Step 3		Step 2	Step 3		Step 2	Step 3
Control														
Industry type:														
Food	−0.029	−0.029	0.032	0.031	0.034	−0.123	−0.124	−0.119	−0.038	−0.039	−0.035	0.026	0.026	0.036
Pharma	−0.083	−0.090	−0.051	−0.056	−0.045	0.092	0.087	0.101	0.184*	0.179*	0.193*	0.025	0.022	0.053
Machinery	0.067	0.062	0.084	0.080	0.072	0.084	0.080	0.070	0.055	0.051	0.042	−0.029	−0.032	−0.053
Electronics	−0.020	0.005	−0.122	−0.104	−0.105	−0.042	−0.025	−0.026	−0.048	−0.031	−0.031	−0.096	−0.085	−0.086
Direct effects														
Customer integration		0.476***		0.336***	0.279***		0.313***	0.237***		0.320***	0.248***		0.217***	0.052
Mediating effects														
Information quality					0.120*			0.159*			0.150*			0.348***
R^2	0.013	0.239	0.028	0.141	0.151	0.037	0.135	0.154	0.044	0.146	0.163	0.012	0.059	0.152
Adjusted R^2	−0.005	0.222	0.011	0.121	0.128	0.020	0.115	0.131	0.027	0.126	0.140	−0.005	0.038	0.129
F	0.774	13.927***	1.602	7.259***	6.572***	2.156	6.916***	6.706***	2.546*	7.571***	7.167***	0.699	2.808*	6.580***

Max VIF = 1.314.
* $p \le 0.05$.
** $p \le 0.01$.
*** $p \le 0.001$.

As an additional test for mediation, it has been suggested that the Sobel test is superior in terms of power and intuitive appeal [7,75]. Using the interactive tool provided by Preacher and Leonardelli [102], the Sobel test lends additional support for the mediated relationships hypothesized through a change in significance of the indirect effect. Specifically, we found support for information quality fully mediating the association between customer integration and cost ($t = 4.559$, $p \le 0.001$), and partially mediating the relationships between customer integration and quality ($t = 3.513$, $p \le 0.001$), delivery ($t = 3.724$, $p \le 0.001$) and flexibility ($t = 3.630$, $p \le 0.001$). We discuss these results in the Discussion section next.

To alleviate concerns that our result is driven by endogeneity bias, we perform a two-stage least squares (2SLS) analysis [47,129]. Using an OLS approach in our study may result in biased estimates because information quality variable is used as a dependent variable in the first stage model and an independent variable in the second stage model, which may create endogeneity concerns [106,129]. The results of 2SLS analysis are reported in Table 7 (see Appendix A). As shown in the table, the 2SLS regression results are consistent with the OLS results reported in Table 6. Thus, we conclude that the current conceptual model is strongly supported by the data.

5. Discussion

The main objectives of this study were to identify empirically the mediating role of information quality on the relationship between customer integration and operational performance (quality, delivery, flexibility and cost), and the direct relationship between customer integration and operational performance. While partial support was found for some of the hypothesized relationships, our findings provide insights into how customer integration and information quality can enable multiple operational performance improvement. The significance of these contributions will be discussed in the following paragraphs.

5.1. Theoretical implications

Empirical evidence that investigates the mediating role of information quality on the relationship between SC integration and operational performance (e.g. [26,48]), and the direct relationship between SC integration and operational performance (e.g. [29,33,114]) has produced mixed results. This mixed support has been attributed to operational performance being often measured as an aggregated construct in the SC integration literature [117]. Our study extends the existing work by means of incorporating a disaggregated measure of operational performance, and thus identifying the potentially different effects (indirectly and directly) of customer integration, as an important SC integration dimension, on multiple operational performance measures, namely quality, delivery, flexibility and cost.

Our results suggest that when customer integration practices, i.e. frequent interaction with customers, are employed, quality, delivery and flexibility improvement can be achieved (independently of information quality). With regard to *quality* improvement, the above findings corroborate the traditional view that well-established customer relationships (e.g. customer feedback and the determination of current and emerging customer requirements and expectations) provide an input to quality (e.g. [71,108]). With regard to *delivery*, our findings reinforce the notion that companies who integrate customers in their operations are more able to identify and eliminate activities that add no value, and therefore improve delivery (e.g. [44,104]). With regard to *flexibility*, our findings support the argument that flexible operations require high interdependence between customers and suppliers, and thus reinforce the view that in order to react successfully to change, companies need to be aware of their customers' views and needs (e.g. [33,104]). Our results are also consistent with the recent work of Wong et al. [128], who have found in an integrated model that customer integration is consistently associated with quality, delivery and flexibility.

In addition the above verification, perhaps the most important contribution of this study is the partial mediation effect of information quality (partial support for H1a, H1b and H1c). What can be inferred from this finding is that, when organizations want to pursue quality, delivery and flexibility, information quality alone is less effective in realizing these objectives. Instead, organizations will need to complement information quality with other integration resources, namely customer integration. This finding supports the exploratory work of Bailey and Francis [6], who found that information transparency is not sufficient since demand distortion still existed, and that there is a need to consider greater alignment and integration between the parties involved (e.g. strong inter-firm relationships and socio-technical factors). We also support the exploratory work of Vermer [121], who found that, even when information is exactly what the user wants, there might still be problems due to information misinterpretation (information quality may not be 100%). In order to mitigate this effect, Vermer [121] suggests that the context of both, senders and receivers, need to be better aligned and integrated when discrepancies in the information occur.

An alternative explanation to the, apparently, lower relevance of information quality in its own right, especially for delivery and

flexibility performance lies in the excess of information. For instance, Mendelson [82] and Williams et al. [127] suggests that too much information can make decision-making process even more complicated, especially in information-rich environments. Another interpretation suggests that information quality may deteriorate in time, and thus its benefits will not increase proportionately once a threshold is reached [113]. In other words, significant changes in information quality beyond a certain limit will not make a major difference in terms of performance.

Overall, this finding (the partial mediation effect of information quality in the customer integration–performance relationship) is important in providing a better understanding of the relationship between information quality and operational performance in the sense that information that is relevant, accurate and timely may not be enough. Only when companies emphasize the relevance of the information to be shared (information quality) and use integration processes, as a platform to share relevant information, can firms achieve performance improvement in terms of quality, deliver and flexibility.

Another significant contribution of this research is the full mediation effect of information quality on the relationship between customer integration and cost (H1d). In other words, information quality is the means by which customer integration is translated into cost improvement. Customer integration efforts are not enough to materialize cost superiority. Instead, customer integration makes parties more open to communication (less inclined to withhold critical information), which not only enhances information exchange but also the exchange of relevant and fined-grained information. This in turn enables firms to process information more effectively, as opposed to deal with irrelevant information, providing unique advantages that have an impact on performance improvement [48]. This finding supports the exploratory work of Legner and Schemm [70], who found that, despite the existence of integration efforts, prevention and corrective activities due to poor data quality (e.g. wrong and outdated product information) resulted in a negative impact on the benefits of buyers and suppliers pursuing tighter integration. The main implication of the full mediation effect for the customer integration–cost relationship is that, from the supplier's perspective, only through information quality, customer integration may be desirable for cost improvement.

Furthermore, our findings (i.e. the partial and full mediation effect of information quality on the customer integration–operational performance link) are generally consistent with the expectations of social capital theory. Specifically, our findings are consistent with a broader perspective of social capital theory, which suggest that value/benefits could be obtained through the process derived from social structures and social assets [5]. Our study has represented social structure in the form of customer integration (e.g. customer interaction, frequent information sharing and evaluation of customer satisfaction and expectation), since SC integration could act as a social infrastructure for buyer–supplier interaction [26]. Such alliance structure facilitates information flow since information is available at a shorter distance to well-integrated firms [62]. Further, dense interaction could reduce the perceived risk between buyers and suppliers, increase trust [91] and translate into information sharing and information quality (i.e. sharing accurate, complete, adequate, reliable and relevant information) [26]. With regard to the full mediation effect of information quality, it can be interpreted that through the exchange of information quality a thorough understanding of the parties' mutual needs is generated and performance improved (i.e. cost). For instance, information quality provides relevant information for the identification, prevention and solving of problems, which are generally associated with performance improvement [5,26]. Cooperative behavior (between similar partners) leads to exploitative learning that results in increase in efficiency and productivity [62]. With regard to the partial mediation effect of information quality, it can be interpreted that operational performance improvement could be generated from both customer integration and information quality. According to Coleman [24], both forms of capital (social structures and assets) create value, and thus make possible the realization of benefits. Accordingly, companies could either concentrate first on their customer integration efforts before exchanging information quality, or complement customer integration with information quality for operational performance improvement (e.g. quality, delivery and flexibility). Finally, according to Autry and Griffis [5], social capital theory has a lot of potential to explain SCM phenomena since a SC is essentially a link between firms leveraging their relationships to improve performance. Accordingly, this research adds to the growing number of studies that build on social capital theory in the context of SCM.

5.2. Managerial implications

Our study has also important managerial contributions. Our research has demonstrated that both customer integration and information quality can be associated with operational performance improvement. According to Moberg et al. [85], while information exchange is an important aspect of the overall integration concept, more research is needed that isolates communication processes from other factors that define integration. In doing so, managers can be given more detailed recommendations not only on how independent integration aspects interact with one another but also on how they impact on performance. More specifically, our findings show that when the objective is to improve quality, delivery and flexibility, sharing information quality alone may not be very beneficial. Instead, information quality should be complemented by customer integration efforts. However, when the objective is cost, sharing information quality will generate the means by which customer integration is translated into cost superiority. In other words, managers that are willing to invest in integration efforts with their key customers can enjoy expected cost advantage, via their capability to obtain and exchange relevant information. For instance, many managers mistakenly concentrate on integration investments such as EDI with customers; however, results demonstrate that only through the sharing of appropriate and relevant information is that firms achieve performance improvement [135].

6. Conclusion

While reach on SC integration is voluminous, empirical results are sometimes inconclusive. Accordingly, research on integration should concentrate on both empirically demonstrate how exactly SC integration produces higher performance, and which aspects of performance in particular are improved [117]. We believe we have addressed both issues in our study. Firstly, our study contributes positively to theory by strongly suggesting the value of information quality for the success of customer integration. Secondly, our research also implies that the effect of integration mechanisms depend on which dimension of operational performance is being considered. Furthermore, our study expands the social capital perspective in SCM by explaining how enhanced information exchange complements SC integration to improve performance.

While this study contributes to theory and practice, there are certain limitations that should be considered. In this study, we focused on the scope of the information shared and information quality. However, there are some studies that considered IT as a third aspect of information sharing (e.g. [135]). Future research may consider the latter aspect for testing a wider perspective of information sharing. Also, we focused on the sharing of strategic information rather than operational information such as production or inventory-holding information. According to Patnayakuni et al. [97], sharing strategic information not only allows buyers and suppliers to develop common forecasts, synchronize production, and coordinate inventory stocking, but also creates synergies that go beyond the sharing of operational information. Nevertheless, future research may also consider operational information for testing a wider perspective of information sharing. Finally, when we defined

quality, as an operational performance dimension, we have adopted a more product/operational perspective [111], which focuses on the degree to which products meet manufacturing specifications. However, there are other perspectives of quality, which includes service quality as key indicator of success [20]. Future research may also consider this characteristic of quality.

Appendix A

Table 7
Results of 2SLS analyses.

Standardized coefficients														
	Information quality	Model 1 — quality			Model 2 — delivery			Model 3 — flexibility			Model 4 — cost		
Variables	Step 1		Step 2	Step 3		Step 2	Step 3		Step 2	Step 3		Step 2	Step 3
Control													
Industry type:													
Food	−0.029	−0.029	0.032	0.031	0.040	−0.123	−0.124	−0.111	−0.038	−0.039	−0.029	0.026	0.026	0.044
Pharma	−0.083	−0.090	−0.051	−0.056	−0.028	0.092	0.087	0.120	0.184*	0.179*	0.208**	0.025	0.022	0.071
Machinery	0.067	0.062	0.084	0.080	0.061	0.084	0.080	0.062	0.055	0.051	0.033	−0.029	−0.032	−0.062
Electronics	−0.020	0.005	−0.122	−0.104	−0.106	−0.042	−0.025	−0.025	−0.048	−0.031	−0.032	−0.096	−0.085	−0.085
Direct effects														
Customer integration		0.476***		0.336***	0.189*		0.313***	0.155†		0.320***	0.174*		0.217***	−0.031
Mediating effects														
Information quality					0.309**			0.330**			0.306**			0.520***
R^2	0.013	0.239	0.028	0.141	0.163	0.037	0.135	0.163	0.044	0.146	0.170	0.012	0.059	0.141
Adjusted R^2	−0.005	0.222	0.011	0.121	0.140	0.020	0.115	0.140	0.027	0.126	0.147	−0.005	0.038	0.188
F	0.774	13.927***	1.602	7.259***	7.132***	2.156	6.916***	7.115***	2.546*	7.571***	7.496***	0.699	2.808*	6.036***

† $p \le 0.10$.
* $p \le 0.05$.
** $p \le 0.01$.
*** $p \le 0.001$.

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