Portfolios of buyer–supplier exchange relationships in an online marketplace for IT services

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ABSTRACT

Most studies on the role of IT for economic exchange predicted that under a given set of exchange attributes buyers would choose a certain mode of relationship with suppliers. Our study of an online IT services marketplace revealed that buyers do not have a single, uniformly preferred type of relationship, but rather maintain a portfolio of relationships. Furthermore, different buyers arrange their portfolios of exchange relationships in different ways. We found four clusters of buyers' portfolios of relationships labeled Transactional buyers, Recurrent buyers, Small diversifiers and Large diversifiers, that differ in their usage of auction or negotiation mechanism, their supplier relations as well as their usage of preferred suppliers. Our results thus paint a richer picture of how buyers organize their supplier networks online.

1. Introduction

There are different perspectives on how IT shapes the way buyers deal with suppliers. These perspectives cover an entire spectrum of buyer–supplier relationships from distant and arms-length to closely intertwined and collaborative [12,26,28]. Early transaction costs analysis of electronic markets and hierarchies saw the main effect of IT as reducing coordination costs of exchange by decreasing asset specificity and complexity of product description [28]. In a number of exchange situations, IT was predicted to initiate a shift from hierarchical governance of transactions towards market procurement of goods from independent suppliers.

A different set of arguments focused on explicit coordination of market transactions, which is costly due to the efforts needed to control transaction risks [12]. IT lowers the costs of explicit coordination by decreasing the specificity of assets required for explicit coordination and diminishing the costs of monitoring. The result is a trend towards long-term outsourcing relationships with a limited number of suppliers, rather than arms-length or hierarchical governance [12]. A complementary approach stressed the importance of suppliers' investments into non-contractible attributes of exchange, such as quality, supplier responsiveness, information sharing and innovation that are needed to create value in many exchange situations [3,4]. The supplier is likely to make such investments only when he can expect to appropriate part of the resulting value, which is less likely to happen when buyer plays a large number of suppliers

against one another. As a result, in situations where the effect of non-contractible attributes is important for value creation, limiting the number of suppliers to few "partners" is the best strategy [3,4].

Empirical studies into this debate have found mixed results that suggest that in practice, the effects of IT on economic exchange are more nuanced. For instance, Holland and Lockett found that rather than sticking exclusively to market or hierarchical governance, firms use both modes in parallel with several exchange partners, and the degree to which one mode prevails depends on market complexity and asset specificity involved [21]. This suggests that it may be fruitful to look at the portfolio of supplier relationships maintained by a buyer. In our study we aim to further this line of inquiry by investigating an online market for IT services, to see if even in this almost perfect market setting, we still find added value from a portfolio approach.

A new impulse into the discussion on the role of suppliers in exchange relationships resulted from the recent wide-spread adoption of online reverse auctions in corporate procurement. A reverse auction is an auction, where suppliers bid for fulfilling buyer's contract [22]. Reverse auctions enable buyers to boost competition among suppliers and considerably cut contract prices as a result [6]. What consequences this has for buyer–supplier relationships is subject of hot debate. Not surprisingly, the party that suffers from the new procurement practice is incumbent suppliers: a number of studies report incumbent suppliers losing their buyer accounts to aggressive new suppliers [15,23]. Reverse auctions do not seem to contribute to good buyer–supplier relationships neither with incumbent suppliers nor with the new ones — both types report increased suspicions of buyer opportunism after taking part in reverse auctions [23]. For the buyer, instead of savings, switching to a new, barely known supplier may result in problems with contract execution, e.g. low quality level [15,40].

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However, other evidence shows that auctions do not necessarily harm buyer–supplier relationships but can be used as a part of sourcing strategy that involves other considerations beyond purchasing price reduction. Jap suggests that buyers often use reverse auctions as a "wake-up call to the complacent supplier base" rather than to obtain a lower price [22] and can allocate long-term contracts via reverse auctions [14]. According to recent studies, incumbent suppliers are much more likely to win contracts than new suppliers and also enjoy price premiums over the latter [14,45].

The diverse results of the studies on the effect of reverse auctions on buyer–supplier exchange relationships highlight the lack of a comprehensive picture. In particular, systematic evidence is needed on how buyers use reverse auctions over multiple transactions [24]. Literature calls for more research in similar directions. For instance, Pinker et al. [31] ask: "How does that option of saving through auctions compare to the option of building a relationship with a supplier and achieving cost reduction through integration?" [31: 1478]. A similar question comes from Elmaghraby [14]: "…if a buyer has used an auction once with success, should she continue to use it regularly, or should auctions be used infrequently and in combination with other procurement mechanisms?" [14: 18–19].

Triggered by the questions posed by the previous studies, we are going to address the following research question: what portfolios of exchange relationships are formed by buyers with their suppliers over multiple transactions involving online reverse auctions?

In this study we take an exploratory approach to theory-building. We will aim at developing a taxonomy of buyer–supplier exchange relationships and the accompanying use of online reverse auctions by investigating patterns of exchange relationships that form in practice.

The exploratory approach to empirical research is used along with the confirmatory approach in the literatures on inter-organizational relationships and information systems research. Confirmatory approaches take a taxonomy deduced from extant literature and test for the occurrence of pre-defined constructs and types, whereas exploratory approaches derive the taxonomy inductively from the data and then relate the resulting types back to theory. While traditionally the confirmatory approach has tended to dominate, exploratory approaches have been used effectively as well, particularly, in situations where existing theory was deemed insufficiently detailed to do justice to the richness of the field setting. In the studies on inter-organizational relationships the exploratory approach has been employed to extract and analyze empirical patterns of inter-organizational relationships and sometimes to relate them to their antecedents and performance characteristics [7,9]. In the information systems literature the exploratory approach has been used to develop the taxonomy of eBay bidders and relate buyer types to auction winning likelihood and surplus [5] as well as to develop a taxonomy of industrial bidders at online reverse auctions [45].

The advantage of the exploratory approach over the confirmatory approach is that the former allows for uncovering empirical patterns that can depict the limits of existing theories, while its disadvantage is that often there is little or no theoretical guidance for the selection of variables [7]. This disadvantage of the inductive method will be mitigated in our study by drawing on extant theories in selecting taxonomy dimensions as well as in explaining the resulting configurations and their properties.

By using the exploratory approach in this study we aim at developing an empirical taxonomy of buyers' portfolios of exchange relationships with suppliers at an online marketplace for IT services. Carrying out the empirical study at an online marketplace (specifically, within two categories of services — Web design and Web programming) allows us to control for context factors that are normally believed to affect the boundary of a firm, such as market complexity and asset specificity. This enables us to focus on inherent heterogeneity of buyers' portfolios of supplier relationships.

The scientific contribution of this study consists in revealing the heterogeneity of buyer–supplier exchange relationships and explaining the empirical types of relationships portfolios and the role of online reverse auctions. This provides a valuable addition to the literature on exchange relationships and exchange governance, as most previous studies predicted exchange relationships to be homogenous under a fixed set of exchange attributes. We also find that online reverse auctions are primarily an attribute of arms-length exchange relationships, where buyer stimulates supplier competition and switches suppliers often. In portfolios with more enduring exchange relationships that recur through multiple transactions and where one supplier gets a considerable proportion of buyer's business, non-competitive negotiations are preferred to auctions. However, our findings do not contradict previous studies that suggested that reverse auctions can be used for supplier screening in long-term relationships and for allocation of long-term contracts.

From a managerial perspective, we provide insights into how online markets for IT services could serve exchange relationships that rely on longer-term considerations.

The paper is organized as follows. In the next section, we discuss previous research on buyers' portfolios of supplier relationships. Then, we discuss the taxonomy dimensions as well as antecedents and outcomes of portfolio configurations. This is followed by a discussion of the methodology, data, analytical procedures, and empirical results. Finally, we discuss findings and formulate conclusions and contributions.

2. Portfolios of exchange relationships

The concept of relationships portfolio has been used in marketing for a comprehensive analysis of supplier or customer base of a firm. The portfolio of relationships "captures the fact that relationships, like products, vary in their intensity and in the role that a firm plays relative to its stakeholders in the relationship" [37] p. 316.

Some of the notable applications of the concept of relationships portfolio (and similar approaches) have been analyzing buyer–supplier relationships from the viewpoint of their strategic importance, supplier attractiveness and the strength of supplier relationships [30]; costs and benefits of firm's customers [25,41], management of supplier relationships over time, as well as associated processes and technology [37], maximization of the value from supplier relationships through supplier investments into non-contractable exchange attributes [3,4], as well as to develop a typology of buyer–supplier relationships based on contextual factors and analyze portfolio properties and performance implications [8].

The objective of this paper is to explore empirical configurations of buyer–supplier relationships and buyers' use of exchange mechanisms. Therefore, focusing on buyer's portfolio of supplier relationships as a unit of analysis is a logical option. Using this concept will enable us to capture key dimensions of interest in the taxonomy development.

The portfolio properties we intend to analyze need to reflect the characteristics of exchange relationships, exchange mechanism and underlying business transactions. Reliance on these properties makes the taxonomy dimensions theoretically motivated in light of the literature reviewed above [5]. Below, we discuss the portfolio characteristics used as taxonomy dimensions and elaborate on their theoretical underpinning. We also identify several antecedents of portfolio configurations that are likely to influence portfolio formation and discuss portfolio performance.

2.1. Taxonomy dimensions

2.1.1. Buyer–supplier exchange relationships

Our conceptualization of buyer–supplier exchange relationships is rooted in the studies of the effect of IT on the governance and

organization of exchange transactions [3,4,12,21]. One-time exchange transactions with independent suppliers in a market setting represent the case of distant, arms-length exchange relationships. Such transactions are characterized by search for and competition among suppliers, low costs of procurement (due to low production costs of market suppliers) and high costs of coordination. Market exchange is opposite to transactions that take place in hierarchies, i.e. within organizational boundaries or in closely coupled bilateral relationships. Hierarchal form of exchange governance is characterized by low coordination costs that come at the expense of high costs of production.

Other empirically motivated investigations identified a multitude of intermediate governance forms and structures beyond pure market or hierarchies, where different governance mechanisms can be used in parallel or in combination [13,21,32]. A number of studies addressed governance forms referred to as "partnerships", "networks" or "close and long-term buyer–supplier relationships" [3,12]. On the face of it, such relationships are characterized by buyer working with a limited number of stable suppliers for a longer period of time. Such relationships, more so than market relationships, encourage parties' investments in non-contractible attributes of exchange such as quality, responsiveness, information sharing, trust, and innovation [3,4,12]. Thus, the first dimension consists of the extent to which the buyer employs arm's-length *vs.* close partnership in governing the exchange relationships.

2.1.2. Exchange mechanism usage

Auctions and bilateral negotiations are key mechanisms used in economic exchange that are widely discussed in the literature [1,16]. An auction is defined as "a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from participants" [29]. In reverse auctions suppliers compete online for a contract to supply goods or services to the buyer and the prices go down, thus stimulating competition among suppliers [11,23] but also raising concerns about buyer's opportunistic behavior [23]. While reverse auctions are argued to be in principle compatible with several dimensions of relational exchange and can be used to source long-term contracts [14,33] in which collaboration can take place [38], empirical evidence suggests that overall, negotiations tend to be used more for complex projects [1]. Therefore, the extent of the use of reverse auctions (as opposed to bilateral negotiations) by buyers is the second dimension of our taxonomy.

2.1.3. Transaction characteristics

Transaction cost economics regards transaction characteristics as a determinant of exchange governance [43]. High level of transaction attributes such as frequency of transactions, asset specificity and technological uncertainty require hierarchical governance to minimize the transaction costs. While hierarchies are efficient in keeping down the costs of coordinating complex transactions, market governance is advantageous when transactions are less complex and exchange efficiency is achieved due to low costs of production [43].

In a similar fashion, transaction attributes become important for the choice of an exchange mechanism. For instance, more complex construction projects, where ex-post negotiations are likely, are found to be more appropriate for negotiations, while less complex contracts with no ex-post negotiations can be subject to competitive bidding [2]. Therefore, our third dimension is related to the complexity of IT projects.

2.2. Antecedents and outcomes of portfolio taxonomy

Several other theoretically relevant constructs serve as antecedents and outcomes of the taxonomy of buyers' portfolios of supplier relationships: buyer experience, evaluation costs and portfolio performance. We draw on these constructs to shed more light on the emergence of buyer portfolios of supplier relationships and explain their configurations.

At the same time, it should be understood that with an exploratory approach, it is not possible to formulate a priori hypotheses regarding the effects of these antecedents or how different clusters will affect the outcomes, since the number and properties of clusters are not known *a priori*.

2.2.1. Buyer experience

Taking into account buyer's experience at the marketplace is important as more experience means, ceteris paribus, that a buyer has worked on more projects and with larger overall budget. More experience and time associated with it provides room for the development of close exchange relationships with suppliers.

2.2.2. Evaluation costs

Several studies addressed the issue of bidding and bid evaluation costs at online markets for IT services. Snir and Hitt found that high value projects attract many low quality bidders, thus driving the overall quality of bidders down [39]. Carr suggested that when bids are numerous and the buyer expects their quality to be low, she might decide to withdraw from the auction process altogether, without selecting a winner [10]. Radkevitch et al. identified several evaluation cost reducing tactics that can help buyers bring their evaluation costs down and increase their project award propensity [34]. In the present study we suggest that buyers who prefer reverse auctions to bilateral negations (and, therefore, have more offers to evaluate) have higher
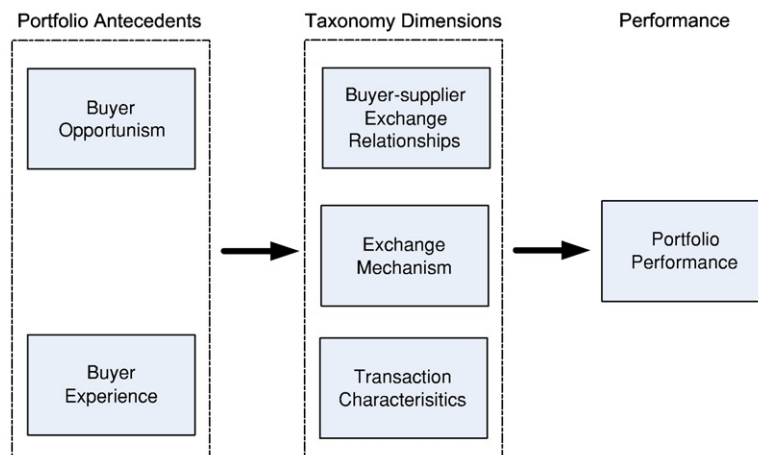

Fig. 1. Taxonomy dimensions, antecedents and performance.

bid evaluation costs, which results in a lower proportion of awarded projects.

2.2.3. Portfolio performance

Previous studies found a connection between buyer–supplier exchange relationships attributes and exchange performance [19,32]. Similarly, in the present study we intend to investigate how different configurations of exchange relationships are related to exchange performance.

The conceptual framework in Fig. 1 summarizes the relationships between portfolio taxonomy dimensions (in the center of the framework) cluster antecedents and performance.

3. Methodology

3.1. Empirical setting

According to Elmaghraby, "enterprising adoption of auctions for the procurement of services" is one of the key characteristics of today's landscape of online reverse auctions [14]. In line with this trend, our investigation focuses on a leading online marketplace for IT services. Such empirical setting is attractive as it is likely to contain both arms-length and close exchange relationships. On one hand, due to the development of Internet and IT outsourcing practices, especially to low-cost locations, many suppliers with similar sets of IT skills are available at the marketplace, which makes it highly competitive [10], suggesting arm's-length relationships. Therefore, buyers should be able choose between suppliers on the basis of price rather than other properties. On the other hand, IT services are highly idiosyncratic, quality of suppliers is hard to assess ex-ante [39], information asymmetry is present with regards to production costs and there is huge potential to cost-savings due to supplier learning effects [42]. This means that there is a space for value creation via non-contractible attributes of exchange, such as quality, supplier responsiveness, information sharing and innovation that are more suitable for long-term, close partnerships [3,4].

The range of services transacted at the online marketplace encompasses IT services and other professional services (e.g. translation, accounting, etc). Services related to web site development represent the most popular area. The online marketplace is used by around 60,000 buyers and contains over two thousand active projects at any point of time across all service categories and data on tens of thousands of auctions completed to date. By early 2006 the overall value of transactions facilitated by the marketplace exceeded USD 90 million. Buyers are businesses and individuals predominantly from the US, while suppliers are small/medium-sized IT companies and freelancers located in India, Eastern Europe and Russia. Some of the most active suppliers have turnover over USD 2 million over the time of their presence at the marketplace.

The exchange process is organized as follows. Before buyers and vendors are able to enter the exchange, they are required to register at the website. Participation for buyers is free of charge while a periodic fee applies to vendors. The buyer starts an auction by posting an RFP (request for proposals). Project allocation mechanism comes in two basic types: open auctions (all suppliers can bid) and invite-only auctions (only invited suppliers can bid). In over 99% of cases there is only one supplier in the invite-only auctions, therefore we consider the invite-only auctions to be bilateral negotiations. In open auctions the different suppliers are bidding and the buyer chooses the winner (which might not necessarily be the one with the lowest price).

After the auction starts, vendors can bid. Bids specify price and estimated delivery time, contain information on vendor rating and earnings and a text field where the bidder can provide other relevant information. Once a bid has been submitted, it becomes visible to the buyer and other vendors. During the auction, the buyer can decline or shortlist bids and communicate with vendors via message boards.

There is no obligation for the buyer to allocate the project to any of the vendors, which results in quite a low project allocation rate of 30–40% [39]. When a project is awarded, the parties can use a virtual "working space" to communicate, exchange documents, track milestones, and settle payments via an escrow account. Upon project completion the buyer is able to rate supplier performance. The accumulated supplier rating is a part of the reputation and trust mechanism at the marketplace.

3.2. Quantitative data

We collected data on buyer activity from the Website Development category of the marketplace. This is the most populated sub-marketplace that allowed us to amass a substantial dataset of buyers busy with relatively homogenous projects. The homogeneity is important in order to isolate potential effects of service type and complexity on exchange relationships. There were several stages in data collection and processing. First, we focused on repeat buyers with a considerable exchange track record at the marketplace to ensure that each buyer had done enough projects to make up a reasonable portfolio. We identified most active buyers using a cut-off level of 20 awarded projects (this included all projects awarded at the marketplace, not only IT-related). This resulted in a sample of 530 buyers that awarded 20 to 300 projects each, starting from the launch of the marketplace in 1999 until May 2006.

Second, we filtered out projects from non-IT categories and we removed projects with incomplete data, e.g. where buyer feedback on supplier performance was absent. In case the feedback on at least 70% of projects was available (which is the cut-off level we chose to ensure a reasonable amount of data in a portfolio), the portfolio was included in the further analysis.

The final check was to make sure that portfolios contain data only from either of two subgroups within Web Development: 1) Web Programming or 2) Web Design and Development combined with Simple Website projects. The two latter sub-categories were combined into a single group because an initial examination of the data had shown that the same suppliers tend to be active in both sub-categories.

The procedure resulted in 104 portfolios containing data on 2163 projects worth a total of USD 1,103,213. The data were standardized in order to avoid disproportional impact of nominally higher variables in the cluster analysis. See Table 1 below for descriptive statistics and Table 2 for correlations between the variables.

To extract data from the website of the online marketplace we used Kapow RoboSuite, a web data extraction agent; MS Excel and SPSS were employed at the stage of data processing and analysis.

Table 1
Cluster dimensions, antecedents, outcomes — descriptive statistics.

	Min	Max	Mean	Median	St. Dev.
Share of projects per preferred supplier (%)	.08	1.000	.54	.5	.29
Duration of relationships with preferred supplier (days)	.00	1566	500	452	348
Share of projects procured via open reverse auctions (%).	.00	1.000	.42	.37	.32
Portfolio size (USD)	940	62,730	10,608	7302	10,725
Average project value (USD)	78	2387	527	398	432
Average project length (days)	.55	178	49	39	40
Number of awarded projects divided by number of posted projects	.40	1.00	.83	.86	.14
Overall number of awarded projects	21	210	69	51	46
Overall spent, USD	3611	130,619	32,357	21,354	30,163
Duration of presence at the marketplace (days)	120	2353	1519	1576	476
Average satisfaction rating	3.83	5.0	4.87	4.98	.2

Table 2
Correlations (Pearson).

	1	2	3	4	5	6	7	8	9	10
1. Share of projects per preferred supplier (%)										
2. Duration of relationships with the preferred supplier (days)	.609***									
3. Share of projects procured via open reverse auctions (%)	− .721***	− .535***								
4. Portfolio size (USD)	− .068	.309***	− .183*							
5. Average project value (USD)	.051	.265***	− .131	.721***						
6. Average project length (days)	− .183*	.116	.162	.162	.230**					
7. Number of awarded projects divided by number of posted projects	.353***	.196**	− .357***	.107	.020	− .208**				
8. Overall number of awarded projects	− .344***	− .099	.056	.409***	.031	.043	.166*			
9. Overall spent	− .219**	.064	− .062	.759***	.510***	.071	.229**	.689***		
10. Duration of the presence at the marketplace (days)	− .264***	− .025	.236**	.043	− .008	.061	− .244**	.160	.097	
11. Average satisfaction rating	.429***	.238**	− .428***	.089	.031	− .281***	.240**	− .036	.059	− .089

*p<0.1, **p<0.05; ***p<0.01.

3.3. Operationalization

3.3.1. Buyer–supplier exchange relationships

As discussed in the section on portfolio dimensions, our conceptualization of buyer–supplier exchange relationships relies on studies of the effects of IT on transaction governance [3,4]. These studies drew a distinction between market-driven, arms-length transactions and close buyers–supplier relationships based on what can be described as two types of criteria that we refer to as "form" (number of suppliers and relationships duration) and "contents" of exchange relationships (investments in non-contractible exchange attributes and relationship-specificity of other assets, including IT). Our data allow assessing the form of buyer–supplier exchange relationships but do not contain systematic details on their contents.[1] However, knowing whether a buyer allocates a significant portion of business to one or few suppliers or works with a wide range of suppliers as well as about duration of supplier relationships already provides substantial basis to judge about exchange relationships.

Two variables operationalize the "form" of exchange relationships. We use *Share of projects per preferred supplier*[2] to assess the extent to which one preferred supplier is important in buyer's portfolio of exchange relationships. We define "preferred" supplier as a supplier who gets the largest proportion of buyer's business in terms of the number of projects compared with other suppliers. A high share of projects allocated to the preferred supplier would indicate that at least one supplier has a high relative importance for the buyer. A low share would indicate that the buyer is likely to use an arms-length approach without favoring any supplier over others. It is important to note that this measure characterizes the whole portfolio of supplier relationships, rather than a buyer–supplier dyad. For instance, a high proportion of projects allocated to the preferred supplier (e.g. 75%) would mean that other suppliers, regardless of their number, have little weight and importance in the portfolio. On the other hand, if the preferred supplier receives a relatively small proportion of projects (e.g. 25%), this would provide an indication that the buyer has an arms-length approach and treats all suppliers in an equally distant way, suggesting a portfolio more towards the arm's-length end of the spectrum.

The second measure, *Duration of relationships with the preferred supplier*, provides an indication of a time perspective of the relation-ships with the preferred supplier. Suppliers who are doing business with the buyer for a longer time, are likely to develop closer relationships with the buyer [36]. Preferred supplier however does not necessarily mean an incumbent supplier. We look at buyer's portfolio of projects over a period of several years — and the supplier who has been awarded most projects during that time might be not the supplier with whom the buyer was doing projects at the moment of data collection, i.e. an incumbent.

3.3.2. Exchange mechanism

In order to assess the use of reverse auctions in buyer's portfolio, we use *Share of projects procured via open reverse auctions* as a straightforward measure. Since a buyer has only two options for the allocation mechanism – reverse auction or negotiations – the converse of this measure accounts for the use of negotiations.

3.3.3. Transaction characteristics

Two variables account for transaction characteristics. Variables *Average project value* and *Average project length* serve as proxies for project size and complexity [39].

3.3.4. Evaluation costs

We use *Number of awarded projects divided by number of posted projects* as a proxy for the evaluation costs at the portfolio level, as buyers with lower level of this ratio are more likely to be suffering from higher evaluation costs than buyers who award higher proportion of projects [34].

3.3.5. Buyer experience

In order to capture different aspects of buyer experience at the online marketplace we operationalize the experience via four variables: *Duration of the presence at the marketplace*, *Portfolio size*, *Overall number of awarded projects* and *Overall spent* (the volume of transactions).

3.3.6. Portfolio performance

We proxy portfolio performance as an average of buyer's evaluations of projects performed by suppliers (*Average satisfaction rating*). This is similar to previous studies that operationalize relationships performance as buyer's overall evaluation of suppliers performance [24,27]. Data on project evaluation is readily available at the marketplace as a rating the buyer assigns to the supplier after a project has been accomplished.

Table 3 summarizes the variables that operationalize taxonomy dimensions.

3.4. Analysis

Cluster analysis consists of two stages — identification of the number of clusters and clustering observations in the sample. While

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[1] Anecdotal qualitative information about the contents of exchange relationships is available. We will draw on it in the analysis section.
[2] An alternative way to operationalize this dimension would be via the number of suppliers used by a buyer. One disadvantage of this measure, however, is that it cannot elicit suppliers that are relatively more import for the buyer when overall number of suppliers is high, e.g. if one supplier has 60% of business. In addition, our analysis showed that the number of suppliers and the percentage of projects allocated to the preferred supplier are highly (and negatively) correlated (− .782**). Since only using one of these two highly correlated variables would be appropriate for taxonomy development by means of cluster analysis, we chose to focus on the Share of projects per preferred supplier.

Table 3
Cluster dimensions, antecedents, outcomes, underlying variables and measurements.

Taxonomy dimensions	Variables	Measurements
Buyer–supplier exchange relationships	Share of projects per preferred supplier (%)	First, a supplier with the higher number of projects is identified in buyer's portfolio. Second, share of this supplier's projects in the portfolio is calculated
	Duration of relationships with preferred supplier (days)	Calculated as a difference between the starting dates of the last and the first projects with the preferred supplier
Exchange mechanism	Share of projects procured via open reverse auctions (%)	Calculation is straightforward
Transaction characteristics	Average project value (USD)	Average of project values in a portfolio. Project value is operationalized as the price paid by the buyer to the supplier
	Average project length (days)	Difference between the date when buyer's feedback for the project is assigned and the auction end date. The feedback is normally supplied right upon the end of a project
Cluster antecedents		
Buyer experience	Overall spent (USD)	Monetary volume of all projects awarded by the buyer at the marketplace
	Portfolio size (USD)	Monetary volume of all projects in a portfolio
	Overall number of awarded projects	Calculation is straightforward
	Duration of the presence at the marketplace (days)	Difference between the date of data collection and the date of buyer's registration at the marketplace
Cluster outcomes		
Evaluation costs	Number of awarded projects divided by number of posted projects	Calculation is straightforward
Portfolio performance	Average satisfaction rating	Rating available at the marketplace

there is normally little uncertainty with regard to the second stage, the first one can be realized in a variety of ways. In the present study we chose to apply rather simple and elegant solution suggested in [5].

First, we applied K-means clustering method to find a number of different cluster solutions for our dataset. The method clusters objects into *k* partitions based on their attributes. The method assumes that the attributes form a vector space and aims to minimize the total within-cluster variance. It is commonly used in the IS and marketing studies as a part of the procedure to develop taxonomies of actors, e.g. bidders [5] or buyers [9].

Second, as advised by [5], for each cluster solution we calculated average distance from points in a cluster to the relevant cluster center (intra-cluster distance) and minimum distance between cluster centers among all clusters (intercluster distance). Better cluster solutions have smaller intra-cluster distances (the clusters are more homogeneous) and larger intercluster distances (the clusters are situated more apart from each other). Then, we established the optimal solution by dividing the intercluster difference of a cluster by intra-cluster difference of the same cluster, which produces the dissimilarity ratio [5], and comparing them. The optimal cluster should have the highest dissimilarity ratio. According to the results in Table 4, the best solution is the one with four clusters containing 47, 32, 13 and 12 portfolios respectively.

Based on the cluster characteristics, i.e. the means of the variables used for clustering as presented in Table 5, we interpreted these as overall organizing principles for the different portfolios and assigned the following names for the buyers in these clusters accordingly: *Transactional buyers*, *Recurrent buyers*, *Small diversifiers*, and *Large diversifiers*.

Fig. 2 provides an illustration of the four types of buyer's portfolios. The central node of each portfolio represents the buyer. The buyer is connected to other nodes — the suppliers. The connecting lines are either firm or dotted, which means that respectively reverse auctions or negotiations dominate as an exchange mechanism. Thus, for example, most lines belonging to Transactional buyers are firm, while the lines of the relational suppliers are dotted. The size of the buyer nodes illustrates the monetary turnover of the portfolios. Dark

color of one of the supplier nodes denotes the preferred supplier. The size of the preferred supplier node relative to other supplier nodes in the same portfolio indicates an approximate proportion of business allocated to the preferred supplier. Thus for instance the size of preferred supplier node in the Recurrent portfolio is larger than that of the preferred supplier in the other three portfolios.

Cluster 1. *Transactional buyers.* We label buyers who form the first portfolio cluster "Transactional buyers" because the patterns of behavior displayed in this portfolio are similar to arms-length, market-driven exchange relationships. Most projects in this portfolio are procured via open reverse auctions (65%). Transactional buyers allocate few projects with a single preferred supplier, 33%, which is the lowest level among all clusters and also have the shortest duration of relationships with preferred supplier, 240 days. It is interesting to note that although the average project value here is almost the same as with Recurrent buyers (USD 379 vs. 377), the projects of Transactional buyers take almost twice as long to accomplish (44 days vs. 24 days). A possible explanation is that it takes longer for Transactional buyers to set up sound communication and coordination with new suppliers.

Cluster 2. *Recurrent buyers.* The label "Recurrent buyers" was chosen because buyers in this cluster assign high importance to preferred suppliers, with whom they have exchange relationships for a relatively long period of time. A key factor distinguishing *Recurrent buyers* from the other three clusters is the allocation of a very high

Table 4
Dissimilarity ratio.

Number of clusters in a solution	2	3	4	5	6	7
Dissimilarity ratio	1.583	1.661	1.796	1.478	1.516	1.481

Table 5
4-cluster solution (means).

	Transactional buyers (1)	Recurrent buyers (2)	Small diversifiers (3)	Large diversifiers (4)	Scheffe differences $p<0.1$
Share of projects per preferred supplier, %	33	83	52	65	(1; 2,3,4) (2; 3,4)
Duration of relationships with preferred supplier (days)	270	647	699	787	(1; 2,3,4)
Share of reverse auctions, %	65	14	47	25	(1; 2,3) (2; 3)
Average project value (USD)	379	377	485	1,468	(4; 1,2,3)
Average project length (days)	44	24	123	65	(1; 2,3) (2; 3,4) (3; 4)
N	47	32	12	13	

Transactional Buyers   **Large Diversifiers**

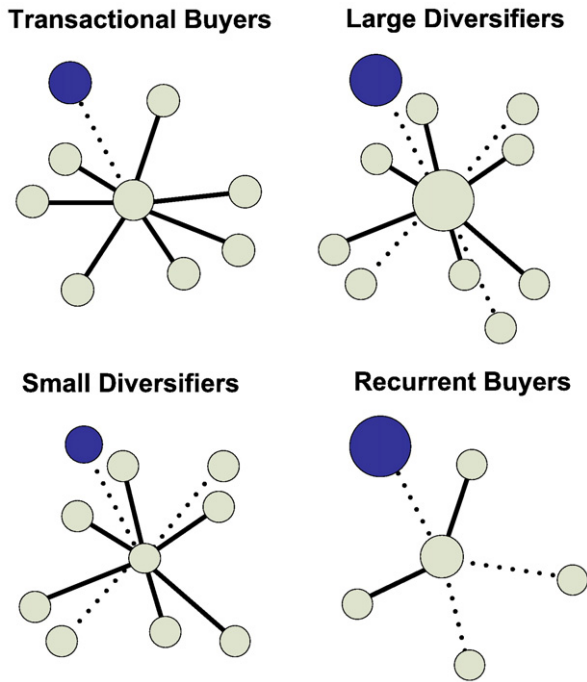**Small Diversifiers**   **Recurrent Buyers**

Fig. 2. Clusters of buyers' portfolio of supplier relationships.

share of projects (83%) to their preferred supplier. The duration of relationships with the preferred supplier is twice as high as that of *Transactional buyers*. These buyers use open reverse auctions the least of all four types (14% of projects) — in 86% of cases they use negotiations.

Clusters 3 and 4. *Small diversifiers* and *Large diversifiers*. The two remaining clusters share a key defining characteristic, therefore we analyze them together. Buyers in these clusters do not demonstrate preferences for one or many suppliers or for exchange mechanisms to the extent *Transactional* and *Recurrent buyers* do. Here, buyers use negotiations somewhat more often than auctions, which are used in 47% and 25% of cases respectively. Similarly, they favor single preferred suppliers (allocating to them 52% and 65% of projects), although to a lower extent than *Recurrent buyers*. Therefore, we label these clusters "diversifiers". The duration of their relationships with the preferred supplier is almost equally long — 699 and 787 days respectively (the difference is not significant). The differences between *Small* and *Large diversifiers* lie in the average project value, in which *Large diversifiers* are far ahead any other cluster (USD 1468) and the project length. With regard to the latter, *Small diversifiers* have the lead with 123 days, which is almost twice as high as the project length of *Large diversifiers*, whose project value is over three times higher. Although beyond the scope of this paper, we could speculate that small firms perhaps may lack some skills to successfully manage outsourced software development project compared to larger firms.

In summary, the analysis of the four resulting clusters of buyers' portfolios of supplier relationships showed considerable heterogeneity among buyers in terms of the three taxonomy dimensions — exchange relationships, allocation mechanism and transaction characteristics. *Transactional* and *Recurrent buyers* demonstrate opposing approaches towards arranging their portfolios of relationships. *Transactional buyers* display characteristics of arms-length exchange relationships. Preferred supplier (supplier with the highest proportion of awarded projects) has little weight in their portfolio because of low portion of projects it receives and short relationships duration. Their projects are dispersed among multiple vendors. These buyers allocate projects mostly on a competitive basis, via reverse auctions. *Recurrent buyers* show a pattern of much closer exchange relationships as they allocate a much higher proportion of their business to preferred

suppliers via non-competitive negotiations; their exchange relationship duration is also longer. Two other portfolio clusters are somewhere in-between Recurrent and Transactional buyers in terms of the preferences for preferred supplier and allocation mechanism use.

The variation in transaction characteristics does not seem to explain the difference in the way buyers organize exchange relationships in their portfolios. First, the proxy for project value is not significantly different for *Recurrent* and *Transactional buyers*, whose ways of organizing exchange relationships are drastically different. Second, the clusters of *Small* and *Large diversifiers* have quite different transaction characteristics (the differences in project value and duration are significant), while their relationship patterns are quite similar — there are no significant differences in terms of transaction mechanism use, use of preferred supplier and duration of relationships with the preferred supplier. In other words, transaction characteristics appear to be largely unrelated to the configuration of buyer–supplier relationships, which suggests that the transaction cost economics approach that is traditionally used in this literature stream may have limited applicability in this setting, as other factors seem to be driving the configurations.

The next step in the analysis is to identify the links between clusters and their antecedents and portfolio performance. We conduct Scheffe test for significance of the pairwise differences between the means of the variables that underlie the antecedents and outcomes (see Table 6, last column). Scheffe test is a procedure recommended for use in case of unequal groups sizes. With regard to *Number of awarded auctions/Number of posted projects*, there are significant differences between Transactional and Recurrent buyers. No differences in the *Number of awarded projects* are significant. *Large diversifiers* are significantly different from all other clusters in *Overall spent* and *Portfolio size*. Finally, *Transactional* and *Recurrent buyers* are significantly different with regard to the *Duration of presence at the marketplace and Average satisfaction*. Below we discuss these results and their implications in more detail.

3.4.1. Evaluation costs

The analysis shows a significant difference in project award rate between *Transactional buyers* and *Recurrent buyers*. For *Transactional buyers* the award rate is significantly lower than for *Recurrent buyers*. This result cannot be explained by transaction characteristics such as project size or codifiability (as all projects come from a rather homogenous service category) unless we assume that non-awarded projects have characteristics quite different from the awarded ones. One plausible explanation of the difference in the award rate is that as *Transactional buyers* deal with more suppliers than the other clusters,

Table 6
Antecedents and outcomes of cluster variables.

	Transactional buyers (1)	Recurrent buyers (2)	Small diversifiers (3)	Large diversifiers (4)	Scheffe differences $p < 0.1$
	Mean (st. dev)				
Number of awarded auctions/number of posted projects	0.78 (0.15)	0.89 (0.10)	0.80 (0.13)	0.86 (0.17)	(1; 2)
Number of awarded projects	76 (47)	60 (46)	61 (39)	71 (54)	NS
Overall spent USD	28,488 (23,837)	26,536 (31,454)	24,101 (15,961)	68,294 (35,011)	(4; 1,2,3)
Portfolio size (USD)	8244 (6791)	7600 (6595)	7523 (1946)	29,406 (16,010)	(4; 1,2,3)
Duration of presence at the marketplace	1622 (521)	1345 (445)	1536 (408)	1559 (347)	(1; 2)
Average satisfaction	4.82 (0.24)	4.95 (0.11)	4.81 (0.23)	4.92 (0.12)	(1; 2)
N (listwise)	47	32	12	13	

they receive more bids and hence bear consistently higher costs to evaluate suppliers and their offerings, and therefore sometimes fail to allocate their projects when evaluation costs become prohibitively high [34], whereas *Recurrent buyers* suffer less from this effect.

3.4.2. Buyer experience

The only significant difference between *Transactional* and *Recurrent buyers* in terms of experience is the duration of their presence at the market, 1622 vs. 1345 days. However, it is difficult to see Relational buyers convert into Transactional buyers after they spend more time at the marketplace, as this would essentially throw away the investments that have been made over time in non-contractible exchange attributes [3,4]. Therefore, we can conclude that experience is unlikely to explain the observed heterogeneity in the portfolios of exchange relationships.

3.4.3. Portfolio performance

Recurrent buyers enjoy higher performance than *Transactional buyers* (the levels of the variable that operationalizes portfolio performance, *Average satisfaction*, are significantly different).[3] This result is in line with the extant literature in that close buyer–supplier relationships and high level of relational attributes (such as trust) lead to higher performance [19,32].

In summary, the results of this analysis enhance the validity of our taxonomy of buyer portfolios of exchange relationships by identifying theoretically sound differences between different clusters of portfolios. So far though, the analysis of the taxonomy has not discussed the mechanisms that underlie close exchange relationships adopted by *Recurrent buyers* and, to a lesser extent, by *Small* and *Large diversifiers*. In other words, we focused more on the form of relationships, rather than on their contents. As it is still somewhat surprising to see close relationships between buyer and supplier in such an open, competitive marketplace, we provide some qualitative evidence on the contents of such close relationships in the following sub-section.

3.5. Qualitative evidence of non-contractible elements

Previous studies described the contents of close exchange relationships as displaying the properties of cooperation and coordination [12], trust and relational norms [17,20,32] as well as other non-contractible attributes such as quality, responsiveness, information sharing, and innovation [3,4]. As discussed above, the online marketplace we study provides a favorable environment for the emergence of non-contractible exchange attributes (quality, responsiveness, information sharing, trust and innovation) to manifest themselves, as supplier quality can be hard to determine ex-ante, IT services are idiosyncratic and there is potential for economies based on learning. Although it was not possible to systematically collect large-scale quantitative evidence on these non-contractible attributes of exchange, we were able to find some anecdotal evidence thereof. We studied comments that *Recurrent buyers* in our sample leave for projects accomplished by their incumbent suppliers. After screening the feedback of several *Recurrent buyers* we identified a number of quotes, in which buyers refer to one of the five non-contractible attributes. These quotes are not unique but rather typical for the feedback Relational buyers give to their suppliers at this online marketplace.

The qualitative evidence of the presence of the non-contractible exchange attributes is presented in Table 7. We argue that these quotes provide support (although anecdotal) for the intuition that at

least in some cases recurrent transactions between buyers and incumbent suppliers are motivated by suppliers' investments into non-contractible attributes. This result is in line with Bakos and Brynjolfsson [3,4], according to whom a supplier will be willing to invest in non-contractible attributes only if it expects to be able to appropriate a share of the created value. In the case of the online marketplace of IT services such value comes in the form of new business from the same buyer awarded on a non-competitive basis, i.e. via negotiations rather than online reverse auctions. In the next section we discuss theoretical implications of the developed taxonomy and research limitations.

4. Discussion

The taxonomy development resulted in four types of exchange relationships portfolios — *Transactional buyers*, *Recurrent buyers*, *Small diversifiers* and *Large diversifiers*. In these portfolios, buyers employ distinct ways of organizing exchange relationships with their suppliers. Clearly, the picture we observe in practice is different from the predictions of the literature [3,4,12] — we find not only portfolios based on close buyer–supplier relationships, but also portfolios of arms-length relationships, as well as mixed portfolios. In other words, within one setting, we observe several forms of organizing buyer–supplier relationships. This suggests that the effects of IT on the economic of exchange relations are non-deterministic as there is no uniformly dominating portfolio configuration. Rather each portfolio

Table 7
Qualitative evidence of non-contractible exchange attributes at the online marketplace for IT services.

Attribute	Qualitative evidence
Quality	"A very complex project, multiple flash applications, complex photoshop work, many complex html pages and custom programming. All done on time, within budget. I have now done more than 10 projects with triguns and they are becoming increasingly complex so that must speak for itself" [nippi]
	"Once again, the team at Onix Systems have excelled themselves. What was an excellent site already, has now been added to and with its improved functionality, now becomes one of the premier sites of its class. Well done team, long may our relationship continue." [auctionpix]
Innovativeness	"This project is another perfect example of where the WINIT team was able to go above and beyond by providing not only the solution I was looking for, but also identifying problems with the original scope and coming up with creative solutions to address them that resulted in a much better end result. I have used this team for three years now and I'm very pleased to be able to WIN with WINIT" [gopro]
Responsiveness	"Sonic Web Graphics did a first rate job designing and coding our project. They were very responsive to comments and turn around work with impressive speed. We will continue to use them extensively." [clandesm]
	"This was a very difficult project with an extremely difficult client. Client demanded large changes mid-project. Triguns was able to handle these changes with good grace and speed. Another job well done." [nippi]
Information exchange	"I relied heavily on the WinIT team on this project as it was our first .NET application. As always, WinIT offered suggestions and pointed out potential hurdles to me well in advance, before the issues had a chance compromise project timelines and budget. WinIT is a valued business partner and they work very heard to foster the long-term relationship and joint success that we are both experiencing. Cheers!" [gopro]
Trust	"Excellent service and skill. This project turned out perfectly. Quick turnaround and great price. Would highly recommend for any project size. Very professional and dependable provider. Thanks again!!!." [lilesa]
	"This project originally had a very tight deadline and I knew I could count on WinIT to do whatever was necessary to deliver the project on time… I have worked with this team for over a year now and I really consider them to be my "virtual" production department. If you're contemplating using them for the first time, just do it. You'll be glad you did! Thanks!" [gopro]

[3] The small size of the difference in the level of satisfaction between the clusters may be due to the fact that at online markets for IT service supplier performance ranking is used by buyers mostly to reward or punish suppliers for good or bad performance respectively, rather than to objectively rank the performance. Over 90% of ranked projects have the highest possible rating.

follows its own theoretical logic, presumably in line with the buyer's sourcing strategy.

Transactional buyers' style of organizing their exchange relationships corresponds to market governance as described in the transaction costs literature. This form of exchange is applied to non-specific transactions and is subject to governance by classical contracts, where all contract contingencies can be explicitly specified [44]. Parties to this type of exchange have a strong incentive to perform, which is rooted in the availability of market substitutes to the supplier and buyer ability to quickly switch from one supplier to another. This type of exchange is of short-term nature and is characterized by intensive bargaining and competition.

The pattern of relationships displayed by *Recurrent buyers* has properties similar to recurrent contracting transactions discussed in [35]. Recurrent contracting, according to Ring and van de Ven, is contingent on prior performance, contains emerging elements of non-contractible exchange attributes such as trust and is subject to neo-classical contract governance [35].

From the perspective of recurrent exchange, it is likely that reverse auctions that are present in small proportion in the portfolio of *Recurrent buyers* serve them early in their transactions trajectory to identify suppliers with whom to build closer exchange relationships in further recurrent projects. As supplier quality becomes known after pilot projects, the buyer starts using non-competitive bilateral negotiations to allocate further projects. This explanation is in line with emerging business practices, where online reverse auctions are used to choose long-term partners [23]. Further, as relationships develop and the level of non-contractible attributes in the exchange increases, buyers become unwilling to jeopardize their relationships with the incumbents by requesting them often to participate in auctions [14].

Finally, *Small* and *Large diversifiers* demonstrate properties somewhat close to those described by Holland and Lockett in their empirical investigation of mixed mode networks. In mixed mode networks, buyers can have close relationships with some firms and arms-length relationships with others [21]. Similarly, in our setting buyers in these two clusters are likely to use different exchange mechanisms for different exchange relationships.

This finding also implies that studies that focus solely on a dyadic view of exchange relationships (as is commonly done in the literature, e.g. [36]), may provide a limited perspective on firm's exchange relationships. The few existing studies at the portfolio level, e.g. [25] and [18], suggest that dyadic relationships make more sense when considered in the context of a portfolio of relationships.

Finally, this discussion brings us to a key implication of the present study. Although the resulting portfolio clusters are similar to some of the theoretical types discussed in the literature, the extant theory is not capable to explain the diversity of buyers' portfolios of exchange relationships. The drastically different relationships portfolios found in our analysis emerge in an environment characterized by rather homogenous services and in which transaction attributes have no statistically significant effect of the portfolio configurations. This result points to an inherent heterogeneity of buyer preferences for close or arm's-length supplier relationships based on their sourcing strategy or alternatively simply to the existence of some others, unobservable factors that define the nature of exchange relationships.

An important direction for further research is the analysis of the evolution of portfolios of exchange relationships over time, since it is likely to help gain insights into the sources of the relationships heterogeneity. Another important direction for further research is testing the generalizability of the presented findings across other online marketplaces and industries as well as across firms of larger sizes.

The present study comes with a number of limitations. First, the online marketplace did not provide an opportunity to collect systematic data on non-contractible attributes of exchange relationships, which limits the depth of the analysis of the contents of exchange relationships. Second, the relationships portfolios were analyzed in an aggregated fashion despite the fact that projects in these portfolios are often conducted years apart. This might result in a somewhat blurred picture of otherwise dynamic and evolving exchange patterns. Third, in this study we focus only on online exchange relationships, which might provide an incomplete picture of buyers' exchange activities; future studies should extend the scope by gathering and analyzing data on offline exchange relationships along with online relationships.

5. Conclusions

We conducted an exploratory investigation of empirical configurations of buyer–supplier exchange relationships at an online marketplace for IT services and the accompanying use of online reverse auctions. We used buyers' portfolios of supplier relationships as a unit of analysis and employed a clustering technique to develop a taxonomy of relationship portfolios. Further, we analyzed connections between clusters of buyers' portfolios and cluster antecedents and outcomes.

There are several key findings in the present study. First, the resulting taxonomy of exchange relationships revealed considerable heterogeneity of buyer–supplier exchange relationships at an online marketplace for IT services. This heterogeneity cannot be explained by the variation in transaction attributes, thus suggesting that further theorizing moves beyond a purely transaction cost economics-based approach. Four clusters of portfolios of exchange relationships were identified – *Transactional buyers*, *Recurrent buyers*, *Small diversifiers* and *Large diversifiers* – that possess distinct mixes of exchange relationships, exchange mechanisms and transaction characteristics. *Transactional buyers* prefer arms-length relationships and tend to switch suppliers often, while *Recurrent buyers* have a relational approach as they develop longer and closer exchange relationships with incumbent suppliers that, based on the additional qualitative evidence, exhibit investment in non-contractible exchange attributes. The two other clusters, *Small* and *Large Diversifiers*, do not show such strong preferences either for arms-length or for recurrent exchange or for any exchange mechanism. Buyers in these clusters seem to combine arms-length relationships with some suppliers and recurrent relationships with other suppliers.

The high level of buyer experience across different portfolios indicates that they are not simply intermediary stages of the evolution of one single portfolio type but rather deliberate stances defined by an inherent intention of different buyers to pursue specific exchange relationship strategy. In fact, all buyers exhibited high performance levels, although *Recurrent buyers* were found to enjoy higher performance of their portfolios than buyers in other clusters, while *Transactional buyers* have the lowest level of performance (although still high).

Second, reverse auctions are found to be associated with short-term, arms-length exchange relationships, while bilateral negotiations support longer-term, recurrent exchange relationships that display non-contractible elements of exchange, which supports some of existing studies on reverse auctions that suggested similar conclusions based on anecdotal evidence [15,40].

Third, the presence of a large cluster of *Recurrent buyers* can have far-reaching consequences for the online marketplaces. Given their reliance on non-contractible elements, it would mean that buyers in such relational dyads would experience less need for the mechanisms of formal governance (e.g. formal terms and conditions, arbitration, rating systems) [35] and at some point might choose to abandon the marketplace to avoid service fees. To prevent relational dyads from leaving, online marketplaces need to cater for close buyer–supplier relationships. They must address key characteristics of such relationships, such as their longer-term nature; intensive information exchange and accumulation and re-use of knowledge. One way to address this issue would be by providing more value-added, collaboration-oriented functionality to support project execution,

learning, information exchange and communication between long-term partners, which would enable such marketplaces to become a truly multi-functional platform for all stakeholders involved.

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