Cross-Sector Competition in Telecommunications

An Empirical Analysis of Diversification Activities

The basic framework conditions of the cross-sector competitive environment for telecommunications companies are changing as a result of convergence. Increasing integration into the value creation of ICT companies is affecting the potentials and risks of diversification activities in the telecommunications sector. Cross-sector competition in the ICT sector is analysed on the basis of a literature study and a quantitative evaluation. With regard to telecommunications companies, high level cross-sector competition with the media sector is identified in particular, in addition to strong diversification activities in the software sector. The results are used to derive the potentials and risks that have a significant bearing on the structure of the cross-sector competitive environment of telecommunications companies.

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1 Introduction

The competitive environment of a company is significantly shaped by the sector to which it belongs (Porter 1980, p. 5), that is, by the group of companies that produce closely-related substitutes. The commercial environment of telecommunications companies (TCCs) is also affected considerably by cross-sector competitive and cooperative relationships in the formerly mostly independent software, hardware, media and telecommunications sectors. These so-called convergence phenomena (Stieglitz 2003, p. 25; Katz 1996, pp. 1079–1095) continue to represent a major strategic challenge for the TCCs. Internet telephony is an obvious, contemporary example. Whilst in the past speech services were predominantly offered by TCCs on the basis of circuit switching technology, software and Internet providers are now in a position to address this market. The result of this convergence is a greater degree of interaction between the companies of the relevant sectors with regard to the adding of value (Zerdick et al. 2000, pp. 130–135). The diversification activities of a company determine the sectors in which it is competitively active and also indicate whether competitive advantages can be generated by integrating different product-specific, value-creating processes (Ansoff 1966, pp. 149–135; Porter 1985, pp. 317–363).

Articles published on cross-sector competition in the information and communications technology sectors (ICT sectors) predominantly use qualitative and argument-based deductive methodologies to demonstrate the consequences of increasing integration in the value creation activities of ICT companies and to determine the strategic implications for companies. As suggested in articles by Mayring (2001) and by Srnka and Koeszegi (2007), we make use of quantitative analysis procedures to generalise the already available qualitative results and broaden the investigation (generalisation model). By means of an examination of the hypotheses used (and to an extent contradictorily discussed) by the quoted authors, our work tests the available qualitative descriptions of cross-sector competition in the telecommunications industry. Our findings show that the results of qualitative studies can only be partially generalised and lead to the company strategic implications outlined in Sect. 4.

2 Cross-sector Competition in the Telecommunications Industry

2.1 Basic Objectives Regarding Cross-sector Competition

Diversification means the widening of corporate activities to encompass new products and/or markets (Schüle 1992, p. 8). In the context of this work, three different types of diversification are considered (Meffert 2000, pp. 245–246; Ansoff 1966, p. 152): horizontal, vertical and also lateral diversification. Under horizontal diversification, the existing product programme is extended around related products, the manufacture or marketing of which is able to make use of already available resources, thus allowing synergies to be harnessed. The addressing of marketing and/or technologically-linked product market areas is often referred to as concentric diversification although this, as Meffert (2000, pp. 245–246) has shown, can be regarded as a subset of horizontal diversification. Vertical diversification is characterised by an increase in the depth of a programme. With regard to lateral diversification (also referred to as conglomerate diversification), companies enter new product and market areas with no related links to their previous business and thereby become involved in very diverse fields of commercial activity.

With regard to diversification objectives, there are four that are given particular emphasis (Schüle 1992, pp. 10–11; Lubatkin 1983, p. 219). These objectives are growth (1), competitiveness (2), profit (3), and risk reduction (4). In cases where company markets become unattractive due to saturation or high levels of competitive intensity, diversification may be used in an attempt to reverse falling turnover and profits and allow new growth potential to be tapped (1). Diversification can help companies to enhance their competitive capacity (2). With horizontal diversification, for example, advantageous wholesale and retail pricing levels can be achieved due to economies of scale (Lubatkin 1983, p. 219). Regarding vertical diversification, the independence of upstream and downstream competitive processes is reduced and a company's relative competitive position is, therefore, increased (Ehrmann 1999, p. 44). Diversification can also be linked to the objective of increasing profit (3). If, in relation to separate production, the joint production of the diversified product programme promises increased efficiency based on economies of scope or scale, synergies can be realised and resource profitability increased (Schüle 1992, p. 15). With horizontal diversification, according to Lubatkin (1983, p. 220), synergies can be realised by means of accessing production and marketing resources and due to the existence of learning/experience curve effects. Vertical diversification can give rise to objective, temporal and spatial linkage effects (Lindstädt 2006, p. 65). Diversification can also be used to eliminate non-systematic risks (4) (Schüle 1992, p. 16).

Porter (1985, pp. 317–363) refers to value chain linkages as the justification for the development of synergies in diversified companies. Tangible linkages lie in the chances of different business units to share value creating activities, since the same consumers, marketing channels, technologies and other factors are needed. Intangible linkages arise due to the transfer of management knowledge between different value chains.

2.2 Characteristics of Cross-sector Competition in the Telecommunications Industry

The telecommunications sector has been exposed to powerful changes as a result of the deconstruction of established value chains (Li and Whalley 2002, pp. 451–472). The evaluation of the ICT sector structural analyses in this section provides an overview of value chain linkages and diversification activities in the telecommunications sector. **Table 1** summarises the evidence obtained from structural analyses of the ICT sectors in the form of the participating actors and the value creation levels. The core value-creating activities of the TCCs traditionally concentrate on network operation and the provision of data transport services which, for technical reasons, are directly linked to network operation (Dengler 2000, pp. 92–94). All authors focus their analyses of ICT sectors alongside the telecommunications industry on players from the hardware (components and equipment), software and Internet applications and media sectors. The hardware components sector includes the production of materials and components (e.g. semiconductors) required for the manufacturing of hardware equipment (Dengler 2000, p. 92). Hardware equipment manufacturers address the market for network equipment (transmission and switching systems) and terminal equipment (Dengler 2000, p. 93; Maitland et al. 2002, pp. 492–493). Software and Internet application providers are usually further segregated into middleware or platform operators and service providers (Kuo and Yu 2006, pp. 1347–1356; Fransman 2002, p. 32). Media companies devote themselves to the provision and marketing of text, graphic and multimedia content (Zerdick et al. 2000, pp. 38–268; Wirtz 2006, pp. 671–696). Some authors (Gerpott 1998, pp. 4–14; Dengler 2000; pp. 92–97; Wirtz 2006, pp. 671–696) include the roles of media, software and Internet service providers in the provider of value-added services designation. According to Zerdick et al. (2000, pp. 132–135), convergence leads to considerable linkage within value adding processes and to competitive strategy interdependencies. This is, however, limited to those sectors named. Other sectors, such as transport, health and social welfare and the energy and water industries are not included in the analyses made by any of the authors, even though ICT also has a major role in these sectors (Münchner Kreis 2010, pp. 122–127). Such restrictions are neither based on justifications or empirical evidence provided by the authors and is, therefore, questioned in the context of the present work. The hypothesis of a concentration of structural integration in the ICT sectors can be examined on the basis of company-specific diversification activities. Where there is strong structural integration between two sectors, the products manufactured are offered integrated to a large extent:

H1: *The diversification activities of companies in the telecommunications, hardware, software and media sectors are limited to a great extent to these self-same ICT sectors.* – According to the articles presented, a concentration of structural integration in the ICT sectors can be assumed. Concentration is reflected in the diversification activities of ICT companies in such a way that diversification activities outside the ICT sectors are pursued to a much lesser extent.

With regard to the question of whether business involvement outside the core value creation area for TCCs can provide business potential over the long term, the authors come to heterogeneous and partly contradictory conclusions. Ehrmann (1999, p. 46), for example, states that integrated providers would

Table 1 ICT sector structural analyses

Author	Aim of the article	Methodology	Actors	Value-adding levels
Brousseau and Quelin (1996, pp. 1205–1230)	Analysis of cooperative strategies in the value added services industry	Segmentation of 125 value added service providers	Telecommunications, communications, network control and online information service providers	Data transport, communications management, information editing and processing
Gerpott (1998, pp. 4–14)	Discussion of telecommunications service provider strategies in the German telecommunications market	Evaluation of case studies and foreign telecommunications market macro-data	Telecommunication equipment manufacturers (switching and transmission systems, terminal equipment), systems operators (network operators, basic service providers), value-adding service providers, telecommunication service retailers	–
Ehrmann (1999, pp. 33–48)	Discussion of framework conditions for a workable competitive telecommunications market in Germany	Argument-based deductive analysis of market structure determinants	Network operators, switched resellers, switchless resellers, retailers	Network management, transport, speech and data switching, speech and data services, speech and data premium rate services, branding, customer care, billing, sales
Zerdick et al. (2000, pp. 38–268)	Analysis of factors affecting competitiveness and company strategies in the multi-media market	Argument-based deductive analysis and integration of the latest academic literature and thinking	–	Contents, packaging, transmission, navigation, value added services, reception appliances
Dengler (2000, pp. 92–97)	Depiction of the strategic challenges and trading options of integrated telecommunications service providers	Synthesis of empirical theory, scientific knowledge and practical observation	Equipment manufacturers (hardware and software), network operators, value-added service providers, services retailers	Component manufacture, system manufacture, system integration, system/network operation, creation of basic services, creation of value-added services, packaging/brands/pricing policies, invoicing, customer care, sales
Maitland et al. (2002, 485–504)	Identification of the influencing factors and challenges of introducing UMTS to the European market for mobile data	Argument-based deductive analysis	Network Operators, Network Equipment and Handset Manufacturers, Internet Service Providers, Application Service Providers, Mobile Virtual Network Operators	Network & Handset Equipment Manufacturing, Middleware, Content, Application Development and Provisioning, Internet Access, Portal Development & Provisioning, Network Operation, Network Access, Sales of Service and Client Hardware
Sabat (2002, pp. 505–535)	Overview of value creation and the actors in the dynamic market for mobile packet-based services	Evaluation and segmentation of ICT company product portfolios	–	Handset supply, Network Systems and Equipment, Network Operation, Transport, Hosting, System Integration, Content Production, Content Enhancement/Aggregation, Delivery
Wirtz (2006, pp. 671–696)	Depiction of processes in media and Internet management	Argument-based deductive analysis, integration of the latest academic literature and thinking, and portrayal of case studies	Media companies, telecommunications companies, hardware and software companies, companies involved in e-commerce	Content and service creation, content and service aggregation, value creation services, transmission/connection, navigation/user interface
Kuo and Yu (2006, pp. 1347–1356)	Challenges and development options for 3G telecommunication operators involved in mobile commerce	Argument-based deductive analysis	Technology Platform Vendors, Infrastructure and Mobile Equipment Vendors, Application Platform Vendors, Application Developers, Content Developers, Content Aggregators, Mobile Portal Providers, Mobile Network Operators, Mobile Service Providers, Mobile Equipment Retailers	–
Fransman (2002, pp. 1–106)	Analysis of the new European ICT ecosystem and derivation of the implications for regulation and control	Evaluation of the financial accounts of 157 ICT companies	–	Equipment and Software Layer, Network Layer, Connectivity Layer, Navigation and Middleware Layer, Content/Application/Services Layer

benefit from advantages in efficiency and strong competition would lead to vertical company mergers. Wirtz (2006, p. 696) believes continuing sector convergence accelerates the trend towards integrated media and Internet related companies. Gerpott (1998, pp. 216–220) sees the broadening of business activities in the field of multi-media services as an important strategic option for TCCs. He makes a distinction here between communication multi-media services for facilitating the symmetrical interaction of a small number of users (e.g. telemedicine and telelearning) and the distribution multimedia services aimed at disseminating information to a large number of users with feedback options (e.g. video-on-demand and teleshopping). In addition to the range of value-adding services, Kuo and Yu (2006, pp. 1353–1354) see the following possible roles for TCCs in the context of mobile communications: invoice processing, offering of portals for personal and terminal equipment-specific information and intermediating between end customers and third-part providers through the deployment of proprietary marketing capacities, end customer access and user information. Other authors are critical of the commercial broadening of TCCs and see a concentration strategy combined with company cooperation as one promising more in terms of success. According to Maitland et al. (2002, pp. 491–492), integrated business models of European UMTS market telecommunications operators that go beyond the simple provision of access services cannot be successfully established. In contrast, the focus on data transport, based on the technological and commercial complexity of developing and operating 3G networks, could represent a stable strategy. Dengler (2000, p. 234) also sees the disintegration of previously integrated TCCs as a feasible, and for some companies an expected, alternative action. The contradictory conclusions reached by the authors regarding business potential outside the sphere of TCC core value creation justifies examination of the following hypothesis:

H2: *TCCs pursue significant diversification activities in other ICT sectors.* – Where TCCs have a high degree of diversification in other ICT sectors, characteristic multi-product strategies, which reach over into other ICT sectors, can be recognised.

Some of the authors also include in their structural analyses of the ICT sector the question of whether the core business of the TCCs, network operation and the provision of network-based services, is at all affected by the entry into the telecommunications market of players from other sectors. In respect thereof, Gerpott (1998, p. 260) identifies significant business potential for TC equipment manufacturers that, due to their high levels of technical expertise in telecommunications network development (system integration), can also gain a foothold in network operation. Furthermore, software and hardware companies can thrive in the telecommunications market, since the capacity and performance of the hardware and software deployed increases both the functionality and cost of TC networks and affects the provision of new services (Gerpott 1998, p. 258). According to Zerdick et al. (2000, p. 100), the introduction of open, decentralised and intelligent network structures facilitates the market entry of new groups of providers such as, for example, those offering cross-network management services and data mining services for processing customer information. Dengler (2000, pp. 177–183) sees competition from application and service integrators that concentrate on sales and customer contact and buy in and package third party applications and services. In contrast, Kuo and Yu (2006, pp. 1353) are of the opinion that the central competitive strategic resources of the TCCs are difficult to imitate. They identify, inter alia, network infrastructure, brand popularity and end customer access. The heterogeneous conclusions reached by the authors regarding the diversification potential within the telecommunications sector of competitors from outside the sector points to the need for a detailed examination of the following hypothesis:

H3: *A significant proportion of companies from other ICT sectors demonstrate diversification activities within the telecommunications sector.* – Some authors identify significant business potential within the telecommunications sector for companies from other sectors. This potential has the power to affect the level of diversification within the telecommunications sector.

3 Empirical Investigations

Quantitative diversification analyses have been used by various authors to evaluate cross-sector competition in other sectors (Basole 2009; Khansa and Liginlal 2009; Pennings and Puranam 2001). The authors quoted evaluate M&A activities and also, to an extent, other forms of company cooperation (e.g. alliances and joint ventures), in order to operationalise cross-sector integration. In contrast to these articles, an operationalising approach, which is also able to encompass internal diversification, has been chosen for the following analysis. The information used for the examination of the questions posed in the preceding sections is taken from the database records of Thomson ONE Banker, which lists up to 8 four-digit coded Standard Industrial Classification (SIC) classes for 34,142 stock-market quoted companies. The four-digit SIC classes are used to classify the products marketed by any one company. The SIC classes in the database company entries are arranged according to the company-specific share of turnover of the given product. In order to facilitate analysis at generic sector level, the four-digit SIC classes were allocated unique sectors.[1]

3.1 Cluster Analysis

The hypothesis of a concentration of cross-sector competition in the ICT sectors (H1) is examined using the following association measure which describes the proportion of companies in the two sectors that are active in both sectors (degree of association):

$$z(a, b) = |A \cap B| / |A \cup B|$$

With A (B) being the set of all firms active in sector a (b). So, for example, of the 1318 telecommunications companies and 1403 media companies recorded, 226 firms are active in both sectors and the degree of association z (telecommunications, media) is, therefore, 8.3%. A cluster analysis (Everitt 1993, pp. 55–89) was carried out, based on the degree of association of the individual sectors.[2] The aim of this analysis was to group the sectors with similar association profiles.

[1] A description of SIC class and sector allocation can be found in **Tables 5 and 6** of the appendices (available online).
[2] The degree of association of all sectors is given in the appendices in **Table 8**.

Table 2 Allocation of sectors resulting from cluster analysis

Cluster	Sectors
1	Hardware components, hardware equipment, software, telecommunications, media
2	Electronics retail, construction, transportation, other retail trade, real estate, miscellaneous services, business services, engineering and research, management, accounting and public relations, health, education, society and public admin
3	Agricultural production-crops, manufacturing general products, manufacturing chemicals and petroleum, wholesale trade nondurable goods
4	Mining, electric, gas and sanitary services
5	Manufacturing materials and metal products, industrial machinery, multipurpose electrical equipment, transportation equipment, instruments and apparatus, wholesale trade durable goods except hardware
6	Miscellaneous manufacturing industries
7	Banking, finance and insurance, holding and other investment offices
8	Non classifiable

Table 3 Contingency analyses of the diversification activities of telecommunications companies

Focus sector		Hardware components		Hardware equipment		Software		Media	
Cardinality of the population		7413		7462		6877		7836	
		Yes	No	Yes	No	Yes	No	Yes	No
Telecommunications	Yes	83	1235	278	1040	360	956	209	1109
		(1.1%)	(16.7%)	(3.7%)	(13.9%)	(5.2%)	(13.9%)	(2.7%)	(14.2%)
	No	981	5114	1748	4396	1198	4361	282	6236
		(13.2%)	(69%)	(23.4%)	(58.9)	(17.4%)	(63.4%)	(3.6%)	(79.6%)
X^2 (Pearson)		85*		30*		20*		248*	
C (Cramérs V)		0.107**		0.063		0.054		0.178**	

*Significance level $p < 0.001$ for $X^2 > 10.83$ (Wickens 1989, pp. 39–41); ** $C > 0.1$ (Cohen 1988, p. 224)

A hierarchical cluster analysis was carried out with a cluster methodology employing the arithmetic mean of the distances of all objects of the two clusters as the dimension for the distance between the clusters (linkage between the groups) and the quadratic Euclidian distance being used as the distance dimension. In an agglomerated procedure based on the narrowest partition, the two clusters with the smallest distance were merged in each step. The Ellbow criterion (Everitt 1993, p. 100) was used to determine the optimum cluster number.

Since the value increase of the clustering coefficient assumes a local maximum of between seven and eight clusters, the number of clusters was set to a value of eight.[3] **Table 2** shows the allocation of sectors to the eight clusters. The cluster analysis assigns the ICT sectors "hardware components, hardware equipment, software, telecommunications and media" to one cluster (Cluster 1). This shows that the ICT sectors are strongly associated with each other and, simultaneously, weakly associated to other sectors.

3.2 Contingency Analyses

Hypothesis H2 was examined using contingency analyses (Wickens 1989, pp. 17–50) based on the significant diversification activities pursued by the TCCs in other ICT sectors. It was investigated whether, in respect of their involvement in the other four ICT sectors (focus sectors), companies active in the telecommunications sector differ significantly from other ICT firms. A contingency analysis was carried out for each of the four focus sectors – hardware components, hardware equipment, software and media, as follows: the set of ICT companies with a primary SIC class not allocated to the focus sector were chosen as the population. The primary SIC class of a company is determined by the product with the greatest share of turnover. The companies making up the population were subsequently divided into four disjoint groups, based on their involvement in the telecommunications sector (telecommunications – yes or no) and in the focus sector (focus sector – yes or no). The number of companies in each group was determined and, using this value, a Pearson X^2 test was carried out (Wickens 1989, pp. 39–41) and the Cramér contingency coefficient (Cohen 1988, pp. 223–227) calculated. The group strengths and the results of the analysis are shown in **Table 3**.

The X^2 values clearly show that there is no identical strength of involvement of telecommunications companies and of other ICT firms in the respective focus sectors. Regarding the involvement in the media and hardware component focus sectors, the Cramér contingency coefficient highlights a small, though not unimportant distinction. The distinction is that TCCs are strongly involved in

[3] **Figure 2** in the appendices shows the dependence of Clustering Coefficient on Cluster Number. **Table 7** in the appendices shows the dependence of the Clustering Coefficient on the number of clusters and the respective difference to the previous value.

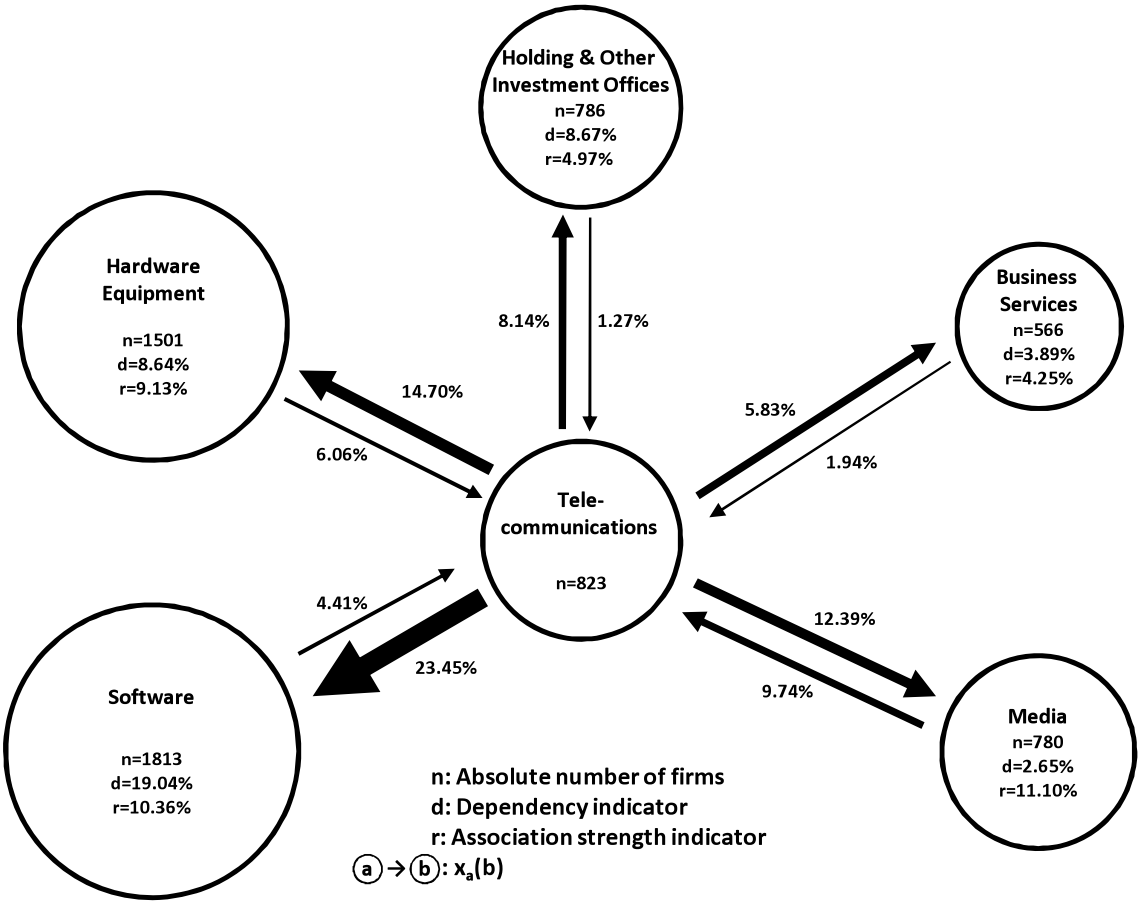

Fig. 1 Directional relationships in the telecommunications sector

the media sector. Furthermore, TCCs less frequently offer products from the hardware components sector than other ICT companies.

3.3 Dependency Analysis

A dependency analysis was carried out in order to analyse the diversification activities in the telecommunications sector of companies from external sectors (H3). For the purpose of deciding between the diversification activities of TCCs inside external sectors and those of companies from external sectors inside the telecommunications sector, the companies were assigned to individual sectors solely on the basis of their primary sectors. The assigned sector of the primary SIC class is designated as the primary sector. Directional relationships $x_a(b)$ were determined on the basis of this allocation, with these indicating the proportion of firms in a primary sector (a) with secondary activities in another sector (b):

$$x_a(b) = |A_{\text{Prim}} \cap B| / |A_{\text{Prim}}|$$

A_{Prim} is the set of all firms having primary sector "a", and B is the set of all firms active in sector "b". During the analysis, only directional relationships from or to the telecommunications sector were considered. Only directional relationships with values exceeding 5% were subsequently included in the discussion (**Fig. 1**).

Two performance indicators were determined: the dependency indicator ($d(a, b)$) represents the absolute value of the difference between the directional relationships of the two sectors:

$$d(a, b) = |x_a(b) - x_b(a)|$$

A high value indicates a disparity in the diversification-specific potential of the companies in the two sectors (one-sided dependency). The association strength indicator ($r(a, b)$) shows for two sectors the ratio of companies for which the primary SIC class is allocated to one of the two sectors and for which a further SIC class is allocated to the other sector compared to the entire set of companies having a or b primary sectors. A high value indicates strong association:

$$r(a, b) = (|A_{\text{Prim}} \cap B| + |B_{\text{Prim}} \cap A|) / |A_{\text{Prim}} \cup B_{\text{Prim}}|$$

A strong and two-sided association exists between the telecommunication and media sectors. The software sector also shows a strong association, though in this case the association is one-sided. The third strongest and somewhat one-sided association is to the hardware equipment sector. In addition, telecommunications companies are very active in holdings and other investment offices and offer general business services such as equipment rental and leasing, or personnel supply services. Since, according to the cluster analysis, these sectors cannot be allocated to the ICT sectors, they are not considered further.

4 Interpretation and Implications

The concentration of structural linkages to the media, software, hardware equipment, hardware component and telecommunications sectors was confirmed using cluster analysis, since these five sectors

Table 4 Diversification effects in the telecommunications industry

Sector	Areas of cross-sector competition	Diversification effects (Schüle 1992, pp. 10–11; Lubatkin 1983, p. 219)	Sample activities and products of telecommunications companies
Media	Preparation, packaging and marketing of textual, graphical and multi-media content - Video - Music - News	- Economies of scope under shared marketing resources - Increased competitiveness due to narrowing of the market via exclusive marketing and distribution channel usage	- Vodafone – Formula1 live - Hansenet – Alice homeTV - NetCologne – CityNetTV - Versatel – Online gaming - Deutsche Telekom – Liga total! - freenet – freenet.de Internet portal
Software and Internet applications	Software-based value-added services and platforms - Internet search - Email - Internet telephony - Content distribution - Invoice processing	- Participation in growth in software-based value-added services market - Economies of scope via cross-selling in private and business client segments - Economies of scope via joint use of the technological infrastructure	- Kabel Deutschland – Internet search - Arcor – Email - Deutsche Telekom – Webconferencing - at&t – Video Transport - BT – Wholesale Content Connect
Hardware equipment	System integration and operation of the telecommunication networks - Capacity management - Field services Management - Network monitoring - Network control	- Linkage effects due to the integration of equipment production, system integration and network operation	- Global Crossing – Network management - Deutsche Telekom – Global networks - BT – 21 Century network programme
	Production and marketing of communications terminal equipment - Set-top boxes - Netbooks - Mobile telephones	- Economies of scope due to shared marketing - Linkage effects due to the integration of data transportation and terminal equipment	- Deutsche Telekom T – Entertain Set-top box - Vodafone – UMTS stick - 1&1 – Smartpad - o2 – Xda Smartphone

are assigned to one cluster and hypothesis H1 is, therefore, confirmed. Competitive strategies of ICT companies are, therefore, concentrated to a significant degree on the ICT sectors. At the time of the assessment, it was also established that ICT-related market convergence effects remained limited to the ICT sectors. The results of the cluster analysis justify focusing the analysis of cross-sector competition in the telecommunications industry on the ICT sectors.

The extent and objectives of TCC diversification activities and the telecommunications-related diversification activities of other ICT companies is discussed below (**Table 4**).

The contingency analysis reveals a structural integration of the *media and telecommunications* sectors. Dependency analysis confirms this to be a two-sided relationship. From the diversification theory perspective, profitability increase effects can be achieved with horizontal distribution as a result of economies of scope. These come into being due to the shared use of marketing resources, such as billing relationships or information on consumer preference for the marketing of broadband access and media services to private customers. These types of market resources, often classified under the superordinate term "end customer access", are seen as central to the monetising of media services (Clemons 2009, pp. 15–41; Rams 2001, pp. 1–4) and also play a strategic role in sales of aggregation platforms and portals (Maitland et al. 2002, p. 492). Furthermore, due to market narrowing effects, the competitive position with respect to competing TCCs can be improved by the exclusive marketing of media services (Ehrmann 1999, p. 44). On the other hand, media companies – especially those in the radio and television business – have developed their own transmission capacities, since the exclusive use of distribution channels under vertical diversification can significantly strengthen market position with respect to competitors (Gerpott 1998, p. 259).

The contingency and dependency analyses point to a stronger than average, one-sided association in the *telecommunication and software* sectors. TCCs develop software-specific competences, since these types of resources, due to convergence effects, may increasingly be regarded as complementary to, or as a substitute for, existing TCC sales. Messerschmitt (1996, p. 1167–1186) has established that, in many cases, telecommunications applications no longer differ from networked computing applications and, therefore, such applications are increasingly realised based on software and programmable terminal equipment. These types of substitution effect are noticeable both in the end customer (e.g. instant messaging versus texting) and the wholesale business (e.g. content distribution versus Internet transit). The functionality and cost of the telecommunications networks and the provision of new services

Abstract

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Cross-sector competition in the information and communications technology sectors (ICT sectors) constitutes a key strategic challenge for telecommunications companies. Due to increasing convergence, value creation is resulting in a greater degree of interaction. The diversification potential of telecommunications businesses is therefore changing with respect to associated ICT sectors, such as hardware, software and media.

The article analyses cross-sector competition in the telecommunications industry on the basis of the diversification activities of ICT companies. A concentration of competitive interdependence in the ICT sectors is demonstrated using a cluster analysis of 34,142 companies. The cross-sector activities of telecommunications companies are investigated using contingency and dependency analyses, and the diversification-related competition in the telecommunications sector is also analysed. With regard to the telecommunications sector, particularly high level cross-sector competition with the media industry is identified, as well as strong diversification activities in the software sector. The results are used to derive the potentials and risks that have a significant bearing on the structure of the cross-sector competitive environment of telecommunications companies.

Keywords: Telecommunications sector, Cross-sector competition, Convergence, Vertical diversification, Horizontal diversification

are, according to Gerpott (1998, p. 258), increasingly dependent on the performance and capacity of the hardware and software deployed. With regard to service provision, software-based invoice processing, personalisation and distribution systems are increasingly being used (Jakopin 2006, p. 39; Sabat 2002, pp. 521–522; Wulf and Zarnekow 2010, pp. 3–19). In order to guarantee a significant share in value creation, TCCs are striving to offer differentiated value-added services, in respect of which the provision of software-specific resources is becoming increasingly important (Dengler 2000, p. 203; Zerdick et al. 2000, p. 101). With this rationale, TCC diversification activities are coupled with growth targets. In marketing, economies of scope can be achieved by means of cross-selling, both in the private and business customer segments. In addition, as a result of the shared use of invoice processing systems, user databases and server infrastructures, economies of scope can also be achieved at the technical resource level. It can be concluded from the weak involvement of software companies in the telecommunications sector that, for software companies, the costs of diversification, due to expenses linked with coordination, efficiency losses and reduced flexibility (Porter 1985, pp. 331–335), outweigh any diversification advantages.

Based on the results of the contingency analysis, the association of the *telecommunications and hardware equipment* sectors is less pronounced. Despite that, cluster and dependency analyses do show a certain level of significance. In the dependency analysis, it can be seen that the association is weak and one-sided. Based on the high affinity of the necessary resources for hardware equipment production, development of the telecommunications networks (system integration) and network operation, strong linkage effects may be assumed. For this reason, network component manufacturers in particular pursue integration strategies. Due to the binding of TCCs to hardware manufacturer systems, via potential product-product or product-user incompatibility and accompanying investment specifity, strong vendor lock-in effects can develop with hardware equipment being integrated into telecommunications networks (Bastian 2002, pp. 66–76). In addition to pursuing multi-vendor strategies, TCCs address these difficulties by outsourcing network operation (Chaudhury and Terfloth 2008, pp. 1–7). In the main, terminal equipment and network transport only offer customer added-value when combined. Economies of scope can therefore be achieved by means of integrated marketing. Standards are mostly used for the integration of terminal equipment and network infrastructure – for configuring the data communication of mobile telephones and TV equipment, for example. In many cases, however, the basic economic and technical conditions existing between the TCC and the terminal equipment provider are directly negotiated as, for example, is the case with Amazon's "Kindle" e-book or the Toll Collect road toll's "On board unit". In the case of non-standard integration, TCCs can make use of linkage effects by integrating data transport and terminal equipment, thereby improving their competitive position in the terminal equipment market. Deutsche Telekom's IP-TV (Telekom Entertain) is an example of the above, with the set-top box being marketed together with the data connection.

In summary, it is determined that TCCs in the media, software and hardware equipment sectors pursue significant diversification activities and that hypothesis H2 can be confirmed in respect of these activities. Regarding the involvement of companies from other ICT sectors in the telecommunications industry, it can be said that firms from the media and hardware equipment sectors have significant involvement but that hypothesis H3 has to be rejected regarding firms from the software and hardware components sectors.

5 Outlook

This article has looked at the diversification activities and their objectives in relation to the telecommunications sector. Due to the theoretical framework employed and the available data, the results obtained are subject to certain limitations. Cross-sector competition has been discussed in the context of diversification theory. In addition to the diversification objectives discussed in this article, there are other aspects that have not been considered here but which can play a role in cross-sector competition. Company-specific insourcing and outsourcing barriers (Gerybadze 2005, pp. 457–474; Picot 1991, pp. 349–353) are examples of such aspects.

Despite potentially advantageous diversifications effects, a high degree of diversification can also be detrimental. Porter (1985, pp. 331–335) emphasises that, in addition to coordination costs, there can be unfavourable levels of both efficiency and flexibility. Since the ICT sectors are characterised by high innovation dynamics and weak barriers to entry, any over-high degree of diversification can bring with it serious competitive disadvantages. In relation to vertically integrated TCCs, organisational inflexibility and a lack of customer-specific problem-solving skills are criticised (Gerpott 1998, p. 13; Maitland et al. 2002, p. 491). When presenting the advantages of telecommunications-specific diversification, it is clear that the technical advantages of vertical diversification can be claimed only in the case of a few web-based services such as, for example, IPTV. Whereas the telecommunications market was previously dominated by vertically-integrated companies, value chain disintegration is henceforth predicted. This, due to changes in the competitive environment (such as, for example, more flexible company cooperation), is leading to stronger customer orientation and the increased opening of technical platforms (Dengler 2000, p. 184; Henneking et al. 2010, pp. 17–21). Due to the high degree of specialisation involved, the competitive positions of the TCCs are crucially influenced by their cooperative relationships (Zerdick et al. 2000, pp. 177–184). Economies of scale and scope also play a strategic role (Sabat 2002, p. 533). These can be strengthened by horizontal diversification, as shown in the examples of joint marketing and access to technical resources. Although in the context of this work, concentration of competitive interdependence within the ICT sectors has been stated, this has the potential to go beyond the limits of the ICT sectors in the future, due to the increased potential of horizontal diversification. Examples in this respect are the transport sector, health and social welfare and the energy and water supply industries (Münchner Kreis 2010, pp. 122–127). Since ICT is gaining increasing influence in these sectors, cross-sector synergies could result.

In summary, stronger vertical concentration and horizontal diversification offer TCCs a multitude of strategic options. Network operation can, for example, be outsourced (Chaudhury and Terfloth 2008, pp. 1–7) or brand, pricing policies and sales can be grouped together in a business model approach, which Dengler (2000, p. 204) refers to as application and services integration. Furthermore, a focus on the intermediation between end customer and service provider, or on the provision of "infrastructure-as-a-service" services and the operation of ICT infrastructures are possible future options (Kuo and Yu 2006, pp. 1354–1355; Henneking et al. 2010, pp. 23–25).

Since the conclusions reached here regarding the future development of the TCC competitive environment are purely qualitative in nature, further research will be necessary in the analyses accompanying these developments. Here, it will be of particular interest to note in which specific combinations concentration integration and cooperation strategies will bring about commercial success.

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Appendices

SIC class and sector allocation

The SIC classes are structured in a four-digit, dendritic hierarchy based on production and market-orientated differentiation criteria. The structure is mainly orientated to generic levels of value-adding and distinguishes, inter alia, the single digit SIC classes of manufacturing, services, wholesale and retail. Since the five ICT sectors do not uniquely assign SIC classes to a higher hierarchy level (1-3), the authors adopted a four-digit SIC class allocation for the five sectors – hardware equipment, software, telecommunications, hardware components and media. The results of the literature analysis of value creation in the ICT sector was used (Table 1) to identify ICT-specific four-digit SIC classes and for sector allocation. The sector allocations (Table 5) were checked by three independent specialists in order to ensure their completeness and validity.

Table 5: Allocation of SIC classes and ICT sectors

ICT Industry Sector	Description	Exemplary Products and Services	Market Segments (SIC Codes)
Hardware Components	production of material and components required to produce hardware equipment	-semiconductors -wire products	3671, 3672, 3674, 3675, 3676, 3677, 3678, 3679, 3691, 3692, 3694, 3695, 3699
Hardware Equipment	production of communication terminals and network infrastructure components	-computers -mobile phones -routers	3571, 3572, 3575, 3577, 3578, 3579, 3651, 3652, 3661, 3663, 3669
Software	development of software and Internet applications and value adding tasks such as training and systems design	-computer programming services -information retrieval services	7370, 7371, 7372, 7373, 7374, 7375, 7376, 7377, 7378, 7379, 7382
Telecommu-nications	provisioning of telecommunication services, network operation and management	-PSTN and GSM telephony -DSL Internet access	4812, 4813, 4822, 4899
Media	production and management of text, graphical and multimedia content	-publishing of newspapers -advertising services -motion picture production	2711, 2721, 2731, 2741, 4832, 4833, 4841, 7311, 7312, 7313, 7319, 7812, 7819, 7822, 7829

In order to achieve the full allocation of four-digit SIC classes and sectors, the non ICT-specific four-digit SIC classes were also allocated to sectors when preparing the cluster analysis (Table 6). The allocations were then checked by the three independent experts. Allocation was based on the SIC hierarchy. With the objective of keeping sector size deviation to a minimum while also maintaining clear sector separation, SIC classes on the second or third hierarchy levels, as well as the remaining

four-digit SIC classes, were allocated to sectors. The size of a sector is determined by the number of active companies within it.

Table 1: Allocation of SIC classes to Non-ICT-sectors

Sector	**Products**	**SIC classes**
ELECTRONICS RETAIL	GENERAL MERCHANDISE STORES; RADIO, TELEVISION, CONSUMER ELECTRONICS, AND MUSIC STORES	53, 573, 5945, 5946, 5961
AGRICULTURAL PRODUCTION-CROPS	AGRICULTURAL PRODUCTION-CROPS; AGRICULTURAL PRODUCTION-LIVESTOCK AND ANIMAL SPECIALTIES; AGRICULTURAL SERVICES; FORESTRY; FISHING, HUNTING, AND TRAPPING	01, 02, 07, 08, 09
MINING	METAL MINING; COAL MINING; OIL AND GAS EXTRACTION; MINING AND QUARRYING OF NONMETALLIC MINERALS, EXCEPT FUELS	10, 12, 13, 14
CONSTRUCTION	BUILDING CONSTRUCTION-GENERAL CONTRACTORS AND OPERATIVE BUILDERS; HEAVY CONSTRUCTION OTHER THAN BUILDING CONSTRUCTION-CONTRACTORS; CONSTRUCTION-SPECIAL TRADE CONTRACTORS	15, 16, 17
MANIFACTURING GENERAL PRODUCTS	FOOD AND KINDRED PRODUCTS; TOBACCO PRODUCTS; TEXTILE MILL PRODUCTS; APPAREL AND OTHER FINISHED PRODUCTS MADE FROM FABRICS AND SIMILAR MATERIAL; LUMBER AND WOOD PRODUCTS, EXCEPT FURNITURE; FURNITURE AND FIXTURES; PAPER AND ALLIED PRODUCTS	20, 21, 22, 23, 24, 25, 26
MANUFACTURING CHEMICALS AND PETROLEUM	CHEMICALS AND ALLIED PRODUCTS; PETROLEUM REFINING AND RELATED INDUSTRIES	28, 29
MANUFACTURING MATERIALS AND METAL PRODUCTS	RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS; LEATHER AND LEATHER PRODUCTS; STONE, CLAY, GLASS, AND CONCRETE PRODUCTS; PRIMARY METAL INDUSTRIES; FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND TRANSPORTATION EQUIPMENT	30, 31, 32, 33, 34
INDUSTRIAL MACHINERY	ENGINES AND TURBINES; FARM AND GARDEN MACHINERY AND EQUIPMENT; CONSTRUCTION, MINING, AND MATERIALS HANDLING MACHINERY AND EQUIPMENT; METALWORKING MACHINERY AND EQUIPMENT; SPECIAL INDUSTRY MACHINERY, EXCEPT METALWORKING MACHINERY; GENERAL INDUSTRIAL MACHINERY AND EQUIPMENT; REFRIGERATION AND SERVICE INDUSTRY MACHINERY; MISCELLANEOUS INDUSTRIAL AND COMMERCIAL MACHINERY AND EQUIPMENT	351, 352, 353, 354, 355, 356, 358, 359
MULTIPURPOSE ELECTRICAL EQUIPMENT	ELECTRIC TRANSMISSION AND DISTRIBUTION EQUIPMENT; ELECTRICAL INDUSTRIAL APPARATUS;HOUSEHOLD APPLIANCES;ELECTRIC LIGHTING AND WIRING EQUIPMENT	361, 362, 363, 364
TRANSPORTATION EQUIPMENT	TRANSPORTATION EQUIPMENT	37

INSTRUMENTS AND APPARATUR	MEASURING, ANALYZING AND CONTROLLING INSTRUMENTS; PHOTOGRAPHIC, MEDICAL AND OPTICAL GOODS	38
MISCELLANEAOUS MANUFACTURING INDUSTRIES	MISCELLANEOUS MANUFACTURING INDUSTRIES	39
TRANSPORTATION	RAILROAD TRANSPORTATION; LOCAL AND SUBURBAN TRANSIT AND INTERURBAN HIGHWAY PASSENGER TRANSPORTATION; MOTOR FREIGHT TRANSPORTATION AND WAREHOUSING; UNITED STATES POSTAL SERVICE; WATER TRANSPORTATION; TRANSPORTATION BY AIR; PIPELINES, EXCEPT NATURAL GAS; TRANSPORTATION SERVICES	40, 41, 42, 43, 44, 45, 46, 47
ELECTRIC, GAS AND SANITARY SERVICES	ELECTRIC, GAS, AND SANITARY SERVICES	49
WHOLESALE TRADE DURABLE GOODS EXCPT HW	MOTOR VEHICLES AND MOTOR VEHICLE PARTS AND SUPPLIES; FURNITURE AND HOMEFURNISHINGS; LUMBER AND OTHER CONSTRUCTION MATERIALS; METALS AND MINERALS, EXCEPT PETROLEUM; HARDWARE, AND PLUMBING AND HEATING EQUIPMENT AND SUPPLIES; MACHINERY, EQUIPMENT, AND SUPPLIES; MISCELLANEOUS DURABLE GOODS	501, 502, 503, 505, 507, 508, 509, 5043, 5044, 5046, 5047, 5048, 5049
WHOLESALE TRADE NONDURABLE GOODS	WHOLESALE TRADE; NONDURABLE GOODS	51
OTHER RETAIL TRADE	BUILDING MATERIALS, HARDWARE, GARDEN SUPPLY, AND MOBILE HOME DEALERS; FOOD STORES, AUTOMOTIVE DEALERS AND GASOLINE SERVICE STATIONS; APPAREL AND ACCESSORY STORES; HOME FURNITURE AND FURNISHINGS STORES; HOUSEHOLD APPLIANCE STORES; EATING AND DRINKING PLACES; DRUG STORES AND PROPRIETARY STORES; LIQUOR STORES; USED MERCHANDISE STORES, FUEL DEALERS; RETAIL STORES, NOT ELSEWHERE CLASSIFIED	52, 54, 55, 56, 571, 572, 58, 591, 592, 593, 598, 599, 5941, 5942, 5943, 5944, 5947, 5948, 5949, 5962, 5963
BANKING, FINANCE AND INSURANCE	DEPOSITORY INSTITUTIONS; NONDEPOSITORY CREDIT INSTITUTIONS; SECURITY AND COMMODITY BROKERS, DEALERS, EXCHANGES, AND SERVICES; INSURANCE CARRIERS; INSURANCE AGENTS, BROKERS, AND SERVICE	60, 61, 62, 63, 64
REAL ESTATE	REAL ESTATE	65
HOLDING AND OTHER INVESTMENT OFFICES	HOLDING AND OTHER INVESTMENT OFFICES	67
MISCELLANOUS SERVICES	HOTELS, ROOMING HOUSES, CAMPS, AND OTHER LODGING PLACES; PERSONAL SERVICES; AUTOMOTIVE REPAIR, SERVICES, AND PARKING;MISCELLANEOUS REPAIR SERVICES; MOTION PICTURE THEATERS; VIDEO TAPE RENTAL; DANCE STUDIOS, SCHOOLS, AND HALLS; BOWLING CENTERS; MISCELLANEOUS AMUSEMENT AND RECREATION SERVICES	70, 72, 75, 76, 783, 784, 791, 793, 799

BUSINESS SERVICES	CONSUMER CREDIT REPORTING AGENCIES, MERCANTILE REPORTING AGENCIES; SERVICES TO DWELLINGS AND OTHER BUILDINGS; MISCELLANEOUS EQUIPMENT RENTAL AND LEASING; PERSONNEL SUPPLY SERVICES	732, 734, 735, 736, 7381, 7383, 7384, 7389
ENGINEERING AND RESEARCH	ENGINEERING, ARCHITECTURAL, AND SURVEYING SERVICES; RESEARCH, DEVELOPMENT, AND TESTING SERVICES	871, 873
MANAGEMENT, ACCOUNTING AND PUBLIC RELATIONS	ACCOUNTING, AUDITING, AND BOOKKEEPING SERVICES; MANAGEMENT AND PUBLIC RELATIONS SERVICES	872, 874
HEALTH, EDUCATION, SOCIETY AND PUBLIC ADMIN	HEALTH SERVICES; LEGAL SERVICES; EDUCATIONAL SERVICES; SOCIAL SERVICES; MUSEUMS, ART GALLERIES, AND BOTANICAL AND ZOOLOGICAL GARDENS; MEMBERSHIP ORGANIZATIONS; PRIVATE HOUSEHOLDS; SERVICES, NOT ELSEWHERE CLASSIFIED; EXECUTIVE, LEGISLATIVE, AND GENERAL GOVERNMENT, EXCEPT FINANCE; JUSTICE, PUBLIC ORDER, AND SAFETY;PUBLIC FINANCE, TAXATION, AND MONETARY POLICY, ADMINISTRATION OF HUMAN RESOURCE PROGRAMS; ADMINISTRATION OF ENVIRONMENTAL QUALITY AND HOUSING PROGRAMS; ADMINISTRATION OF ECONOMIC PROGRAMS; NATIONAL SECURITY AND INTERNATIONAL AFFAIRS	80, 81, 82, 83, 84, 86, 88, 89, 91, 92, 93, 94, 95, 96, 97
NON CLASSIFIABLE	NON CLASSIFIABLE	9999

Clustering coefficient

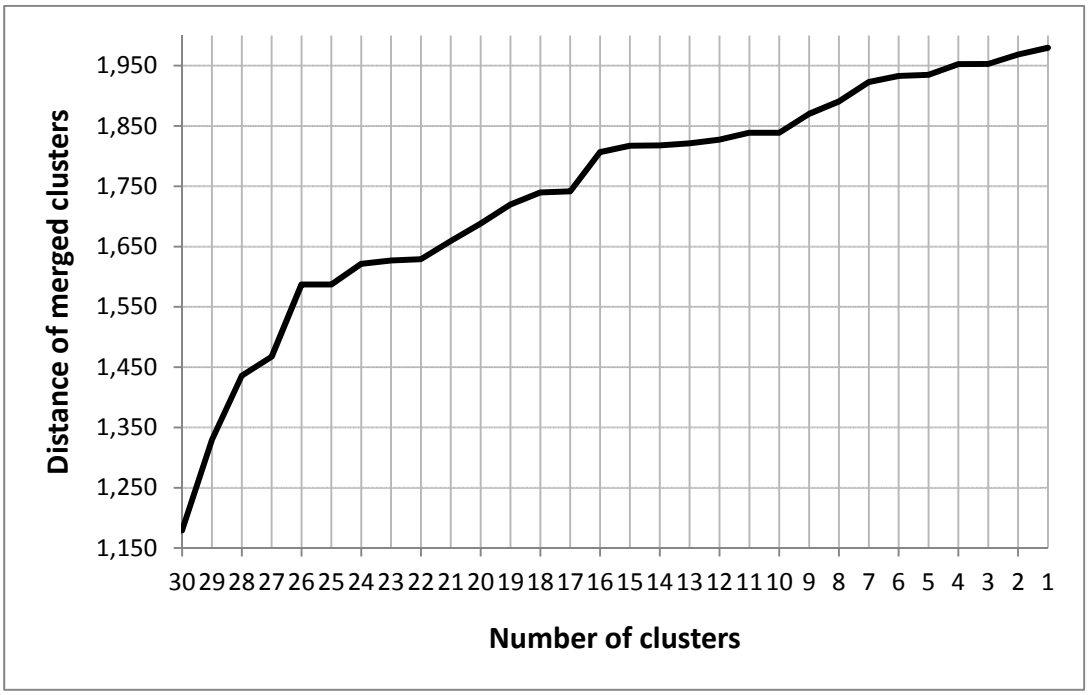

Figure 1: Clustering coefficient curve

Table 2: Clustering coefficient and difference to previous value

Number of clusters	Distance of merged clusters (clustering coefficient)	Difference to the previous value
30	1.179	
29	1.330	.151
28	1.436	.106
27	1.467	.031
26	1.587	.120
25	1.587	.000
24	1.621	.034
23	1.627	.005
22	1.629	.002
21	1.659	.030
20	1.688	.029
19	1.720	.032
18	1.740	.020
17	1.742	.002
16	1.807	.065
15	1.817	.011
14	1.818	.001
13	1.821	.003
12	1.827	.006
11	1.839	.011
10	1.839	.000
9	1.870	.031
8	1.891	.021
7	1.923	.032
6	1.933	.010
5	1.935	.002
4	1.953	.018
3	1.953	.000
2	1.968	.015
1	1.980	.011

Table 3: Degrees of sector assocation

SECTOR	CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Hardware Components	**1**																														
Hardware Equipment	**2**	19.4																													
Software	**3**	3.9	17.8																												
Telecommunications	**4**	2.3	6.4	8.2																											
Media	**5**	0.6	2.5	6.1	8.3																										
Electronics Retail	**6**	1.1	5.3	4.3	2.2	3.8																									
Agricultural Production-Crops	**7**	0.2	0.4	0.4	0.4	0.8	0.6																								
Mining	**8**	0.4	0.3	0.6	0.4	0.2	0.1	0.6																							
Construction	**9**	1.5	2.2	1.6	1.9	1.1	1.6	1.4	2.1																						
Manufacturing General Products	**10**	1.2	1.3	0.9	0.6	2.1	1.5	9.1	0.8	2.4																					
Manufacturing Chemicals and Petroleum	**11**	2.2	1.2	1.0	0.4	0.9	1.1	2.4	3.5	2.7	8.3																				
Manufacturing Materials and Metal Products	**12**	5.7	3.3	1.6	1.0	0.8	0.8	1.0	3.8	6.1	7.3	7.5																			
Industrial Machinery	**13**	7.2	3.7	1.8	0.5	0.9	0.8	0.7	1.6	4.2	2.6	3.0	10.4																		
Multipurpose Electrical Equipment	**14**	9.1	5.8	1.2	1.1	0.4	1.2	0.6	0.3	1.8	1.3	1.2	4.4	8.1																	
Transportation Equipment	**15**	3.1	2.0	0.8	0.4	0.6	0.7	0.8	0.7	1.9	1.7	1.1	5.6	10.0	4.6																
Instruments and Apparatur	**16**	7.3	4.7	2.7	1.0	0.7	1.0	0.2	0.2	1.2	1.1	4.1	3.3	5.0	4.7	3.0															
Miscellaneous Manufacturing Industries	**17**	1.1	1.3	0.7	0.3	1.7	1.5	0.6	0.5	0.5	2.2	1.5	3.1	2.1	1.5	1.7	1.5														
Transportation	**18**	0.8	1.2	1.9	1.2	2.3	4.3	3.0	2.8	4.9	3.7	2.8	3.0	2.1	0.7	4.1	0.8	0.5													
Electric, Gas and Sanitary Services	**19**	1.6	1.2	1.1	1.9	0.6	0.8	1.3	4.6	6.1	2.2	4.0	3.4	2.6	2.1	0.7	0.7	0.4	4.4												
Wholesale Trade Durable Goods except HW	**20**	3.2	5.2	1.8	0.6	1.6	3.3	1.4	2.4	6.2	5.2	4.3	11.2	9.9	3.3	7.6	5.6	3.8	4.2	2.9											
Wholesale Trade Non-Durable Goods	**21**	1.1	2.2	1.1	0.5	2.5	4.3	5.7	1.5	2.1	15.5	12.9	4.2	1.8	0.8	0.9	1.4	2.1	4.9	2.4	7.0										
Other Retail Trade	**22**	0.9	2.2	1.7	1.3	3.4	11.6	2.4	1.2	3.0	8.8	4.6	3.2	1.4	1.2	2.4	1.5	2.6	6.1	2.3	7.3	12.2									
Banking, Finance and Insurance	**23**	0.5	1.2	2.6	0.8	1.0	1.0	0.6	0.5	1.5	1.7	0.6	1.0	1.0	0.3	1.2	0.5	0.3	1.9	0.8	1.5	1.2	2.2								
Real Estate	**24**	1.9	3.1	2.6	1.7	3.0	5.2	2.6	1.6	15.2	5.9	3.6	5.2	2.7	1.3	1.8	1.5	1.3	8.4	3.4	5.8	5.7	8.8	6.7							
Holding and other Investment Offices	**25**	3.1	3.9	3.8	2.7	3.0	1.8	1.9	2.5	4.2	4.8	3.1	4.3	2.0	1.6	1.7	1.3	1.3	3.9	2.8	3.7	3.6	5.5	23.8	12.9						
Miscellaneous Services	**26**	1.6	2.4	2.7	1.8	5.3	5.2	1.7	0.9	5.9	2.9	2.1	2.7	2.9	1.8	3.1	1.3	2.0	8.3	2.0	5.2	2.6	10.1	2.5	13.2	5.5					
Business Services	**27**	1.9	4.1	6.8	3.1	5.2	3.0	0.9	0.9	4.5	2.8	1.6	2.6	3.3	0.8	1.8	1.9	1.3	4.7	2.2	4.8	2.6	4.4	4.3	5.3	3.6	5.7				
Engineering and Research	**28**	2.2	1.8	2.3	1.1	1.1	0.6	1.1	2.1	8.7	1.0	9.5	2.9	3.2	2.1	2.4	4.0	0.5	2.3	3.1	3.3	1.7	1.2	0.6	3.0	2.7	1.7	3.6			
Management, Accounting and Public Relations	**29**	1.3	2.2	5.0	2.0	3.9	1.7	2.1	1.0	6.4	1.7	1.5	1.6	1.6	0.6	1.2	0.7	0.5	4.0	2.8	2.4	2.1	2.7	2.7	6.0	6.0	4.0	6.9	5.6		
Health, Education, Society and Public Admin	**30**	0.8	2.5	5.6	2.1	4.4	2.0	1.1	0.4	2.2	1.1	2.9	1.1	1.3	0.5	1.0	2.5	0.6	2.1	2.5	2.2	1.8	2.6	1.4	2.7	2.5	3.4	4.0	4.6	5.7	
Non Classifiable	**31**	1.3	1.2	1.2	1.3	1.4	0.9	1.0	0.8	1.4	1.6	1.5	1.3	1.7	0.8	1.2	1.1	1.1	1.5	1.4	1.6	1.1	1.6	1.5	1.5	1.2	1.7	2.2	1.1	0.8	1.3