Attributes and Dynamic Development Phases of ICT Standards Consortia

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Abstract

Standards consortia are private industry alliances that serve a certain purpose and gather likeminded companies that share the same interest to sponsor and develop technologies for standardization. Compared to formal standard setting, participation in consortia is less bureaucratic, more efficient in reacting to market needs and allows, in respect to the tiered membership structures, a strategic influence of standard setting outcomes. Formal standardization is in contrast an often protracted process of development and negotiation. This paper tries to provide a broad and comprehensive picture of standards consortia and their dynamic development in the past ten years. Analyses show that consortia have distinct characteristics which help to explain and justify their presence in the standard setting context. The observation of consortia existence over time identifies relationships between the formation, termination and merger of consortia with respect to market and technology development. Furthermore the paper seeks to measure consortia performance with respect to organizational structures and market position. Therefore we test the likelihood of consortia termination. Results of a survival analysis reveal that the probability of consortia success is especially connected to structures that determine coordination among members. Additionally the scope and focus on technology and markets also influences if consortia remain in business over time.

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1. Introduction

In the past years the complexity and speed of technological development has constantly been increasing. Especially in the field of information and communication technologies (ICT), markets show evidence of a higher variety of products and solutions in a more frequent manner (David, 1996). The need for technological standardization is growing (Blind et al., 2010), but the complexity and speed challenge companies in their coordination activities. Standard setting is a complex process, which is dependent on consensus agreements between often competing organizations. These processes can take several years. Especially formal standard bodies are sometimes not able to keep up with the market pace (Cargill, 2002). Since fast changing markets required more flexible solutions to set standards, the standardization landscape has changed over the past twenty years (Updegrove, 2008). Today not only formal standard developing organizations (SDOs), but also informal industry driven standard setting organizations such as consortia, produce widely adopted and important standard solutions. Other than formal organizations, which produce so called "de jure standards", informal consortia create and promote mostly "de facto standards" (Jakobs, 2004). For the latter we can further distinguish between a "de facto standard" developed by a single firm and a "consortia standard", where the standard is set by a group of firms (Bunduchi et al., 2008).

Formal standardization is often time consuming and can take several years, whereas informal consortia are more flexible and able to anticipate technological development and thus set the standard right in time (Cargill, 2002). Even though informal standard specifications are agreed on without a formal accreditation, they can still be widely accepted and of great importance or even follow up a certain formal standard (Blind et al., 2010). Yet, there is no common definition for a standards consortia and the consortia landscape has developed to be very heterogeneous in characteristics such as technical issues, structure, members, transparency or IP policies (Hawkins, 1999). Updegrove (2008) defines consortia as being "anything from a loose, unincorporated affiliation of companies, to an incorporated entity with offices, marketing, technical and administrative staff and a multi-million dollar budget". He distinguishes between *specification groups* which agree to promote an industry standard, *research consortia* with the main intent of creating and developing a technologic solution and *strategic consortia* which focus on the adoption of a technology or the formulization of a yet informal common practice (Updegrove, 1995).

In this article we consider standards consortia which meet the criteria set by the ISSS CEN Survey:

- *The organization must be international in outlook and scope, not simply an instrument of single-nation policy,*
- *must have an active and international membership,*
- *must not be set-up specifically as a single vendor, government, or proprietary technology advocacy group,*
- *must be of importance to the areas of standardization or its processes* (CEN/ISSS, 2009).

In Europe (Council of the European Union, 2000) and in the US (Center for Regulatory Effectiveness, 2000) standards consortia are recognized as being organizations that influence standard setting processes, but which are not officially recognized (Egyedi, 2001). So far there has not been much empirical work on the role of consortia. Earlier work mostly focuses on theoretical explanations for the existence of consortia (Cargill, Weiss 1992: Updegrove 1995; Axelrod et al., 1995; Hawkins, 1999; Bunduchi et al., 2008). More current research uses a case study approach and characterizes and compares the processes of informal consortia such as Updegrove (1995): *X Consortium and Open GIS Consortia*, Egyedi (2001): *W3C and ECMA*, Coulon (2004): *Symbian Alliance*, Anderson (2008): *ECMA, IETF, OASIS, OMG and W3C*, Koenig (2008): *FlexRay, Autosar and Jaspar*, Grotnes (2009): *Open Mobile Alliance (OMA).* A first comprehensive analysis on the evolution of standards consortia was done by Blind & Gauch (2008). They accessed a dataset of more than 250 consortia to map the change of consortia between 2000 & 2004 and found evidence for a complimentary relationship of formal and informal standard setting activities. Other empirical contributions rather focus on the effects of consortia in terms of coordination outcomes and efficiency (Leiponen, 2008; Delcamp and Leiponen; 2012; Baron et. al., 2012).

This paper presents a unique dataset of over 400 standards consortia. Consortia are analyzed by characteristics, attributes, membership, active markets and industries as well as by the dynamics of consortia evolution over the last 10 years. The article uses 14 editions of the ISSS CEN survey on ICT standards consortia. Further information was added exploiting the consortia database of Andrew Updegrove (http://www.consortiuminfo.org/). To retrieve historical membership information on consortia activity as well as memberships, the paper further makes use of the internet archive waybackmachine (http://archive.org).

2. Theoretical Considerations

In many literature sources, standards consortia are described as explicit alliances or groups, which are especially formed when the fast evolution of technology requires coordination mechanisms (Axelrod et al., 1995). Such alliances are further defined as groups of companies where the benefits of the collective activity arise from a commonly produced public good (Olson, 1971; Cargill and Weiß, 1992). Irrespective of the costs of producing the public good, the good is equally available to all members. However, members' benefits and incentives to invest may differ (Kindleberger, 1983). Groups emerge when a single firm is incapable of producing a certain good itself. Firms thus join groups when the collective activity is beneficial and exceeds the costs of membership. Incentives to join or leave the group are simply related to a cost-benefit analysis, though groups may scale costs to counteract defection (McGuire, 1972). The size of the group matters as a factor of effective coordination. As to Olson (1971), coordination failures such as "cheating" or "free-riding" diminish when the group is held respectively small. Furthermore, the costs of coordination increase with the size of the group. Groups are characterized as "exclusive" groups when the collective good increases by excluding others. In comparison "inclusive" groups are these, where it is more beneficial to include as many market participants as possible.

Group formation in standard setting postulates a special case of coordination and collective benefits. Standards are subject to network externalities since users of a standard obtain benefits not only from the technology itself but furthermore depend on the share of users in the market. Thus, the success of a standard always depends on the installed base of users (David and Greenstein 1990). When network externalities are significant, firms have to coordinate in product development processes. This coordination can be reached by standard-writing committees such as standard consortia (Weiss, Sibru, 1990). Besen and Johnson (1986) list several conditions for successful coordination in standard setting. In this sense, the consortia should gather a certain market share of the industry, the group should not be subject to antitrust objections and members should reduce the number of technological alternatives to reach consensus while further eliminating subjective disputes.

In conclusion, standards consortia are subject to network externalities, while also inhibiting coordination failures of a group. Oslen (1971) argued that small groups benefit from coordination efficiencies. In comparison Axelrod (1995) states that consortia are especially successful when they gather most market players. The latter argument is further connected to the installed base of a standard, which increases with the number of participants

sponsoring the standard (David and Greenstein, (1990). To a certain extent standards consortia are inclusive, since a common standardization project is only reasonable when a sufficient number of market players participate. However, standards consortia pursue a particular approach to standardization compared to formal standard bodies. While formal standardization seeks consensus decisions and is open to all market participants, standards consortia are more closed in their membership rules. Membership fees, more regular meetings and a certain interest to influence technologies in early stages differentiate consortia from formal bodies. A consortium can thus be seen as an exclusive group of firms that are more committed to standardization or have a particular interest in a technology. However, consortia are inclusive to the limits of likeminded companies that share the same interests.

3. Methodology

This paper uses a broad approach to illustrate the dynamic landscape of ICT consortia over the past ten years. The research is based on the use of two data bases that have assembled more than 700 informal standards consortia since 1998. The CEN survey provides information on 435 informal ICT standardization consortia. These consortia have been selected based on transparent and objective selection criteria, which are stated above. The survey by Andrew Updegrove[2] provides information on 555 consortia, 276 of which are not covered by the CEN survey. Both data sources indicate the tiering of membership, the consortium scope, technical categories, industry sectors, IP policies and years of existence. The number and identification of consortium members (including 20,000 independent entities in more than 35,000 consortium memberships), was retrieved by an internet search using data from historic homepages from the internet archive waybackmachine (http://archive.org). To get a complete picture of the informal standard setting landscape, information from all databases were matched. However, to guarantee database compliance, time series analysis only uses information from fifteen editions of the ISSS CEN survey from 1998 until 2009. Furthermore, not all consortia could be classified in their respective attributes, since some consortia do not provide distinct information. Attributes such as industry sector, technical category, business spectrum and IP policy were only assessed from the CEN survey data. Finally, we build up a data panel over the time span of 1998-2009 to better assess organizational effects on consortia survival. We apply one year periods and use consortia termination as our event of failure.

[2] http://www.consortiuminfo.org/

4. Empirical Analysis

4.1 Consortia Characteristics and Attributes

In contrast to formal standard bodies where structures are fixed and default, the formation process of informal consortia allows a variety of organizational choices. The four charts in figure 1 give a vivid picture of informal ICT consortia characterized by member quantity, membership levels, business spectrum and industry sector. The two former attributes reveal information on specific member information such as quantity and member levels. The latter two charts illustrate the sector and the scope of involvement.

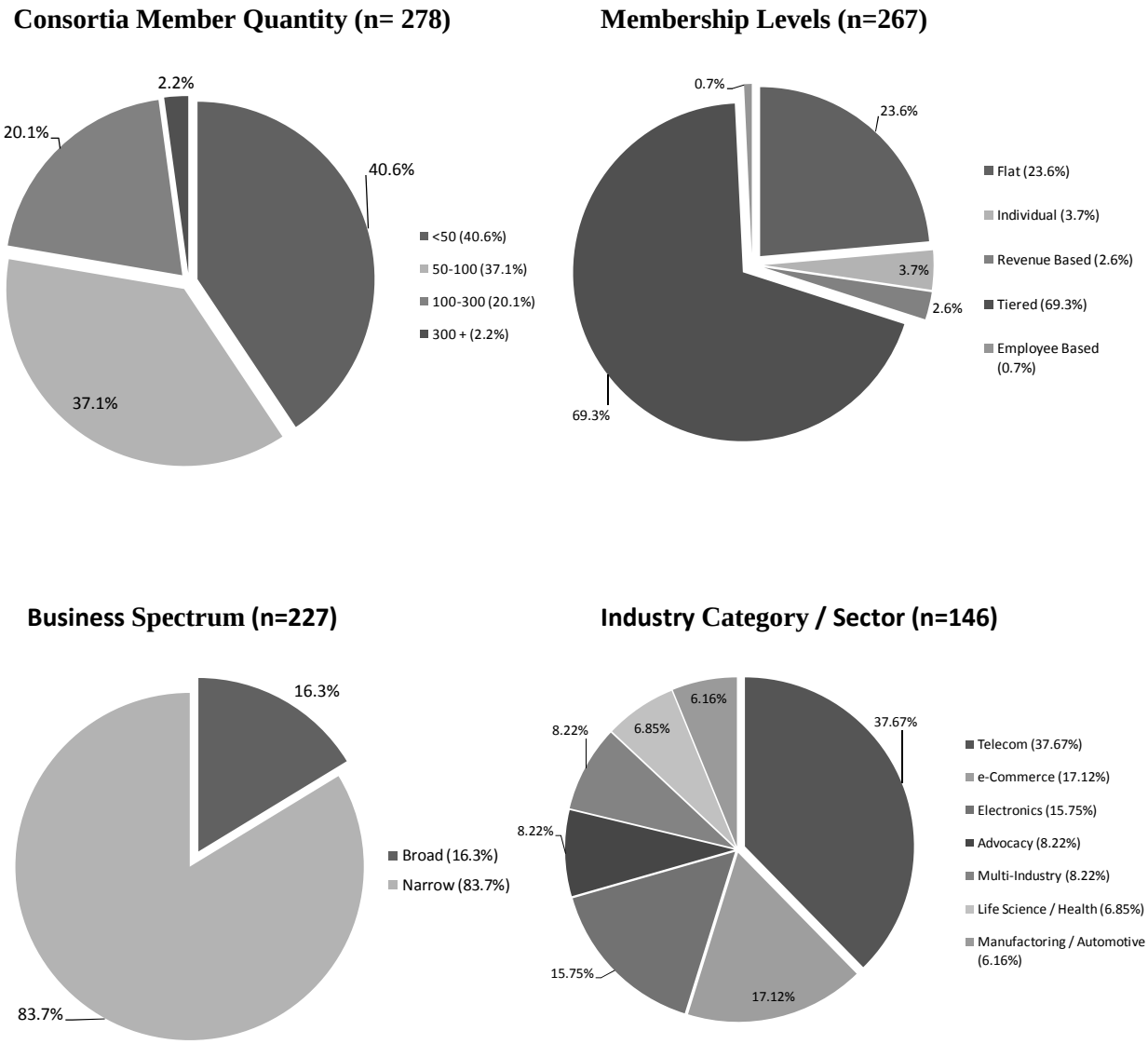

Figure 1 Characteristics and attributes of informal ICT standards consortia

Most consortia have a considerably low amount of members, since 77.7% have less than 100 participants, 20.1% have 100-300 members and only 2.2% list more than 300 members. To illustrate the scope of involvement in standard setting among consortia, the business spectrum was classified into broad and narrow. Only 16.3% of the consortia follow a broad spectrum of standardization, which is comparable to structures in formal standard bodies. The so called "one purpose consortia" usually pursue only one standard or specification and their business can therefore be classified as narrow (83.7%). These findings can be related to the quantity of memberships. The data shows that most narrow consortia tend to have a lower amount of members. A possible assumption is that this leads to more effective and flexible decision making processes within consortia. Both attributes are distinct characteristics to differentiate consortia from formal standard bodies, since the latter mostly follow a broad business spectrum and tend to have a higher number of members. The evaluation of the CEN survey further provides information on the primary and secondary industry sector where a particular consortium is active in. These findings indicate a very heterogeneous picture of the consortia landscape. In order to better frame these results, data was aggregated into seven categories. Over a third of the consortia produce standards for the telecommunication industry (37.67%). E-Commerce (17.2%) and electronics (15.75%) also make up one third of the consortia target industry. Less ICT related industries such as advocacy, life-science, manufacturing and multi-industry summarize the last third of consortia target industries. These results are in line with most researchers' assumptions that especially ICT industries rely on more flexible and quick standard solutions developed by informal consortia.

The chart of membership levels illustrates the hierarchical structures of consortia. A flat membership structure can only be found in 23.6% of the regarded consortia. The findings indicate that informal standard setting is in many cases strategically dominated by market power and revenue of commercial entities and vendors. Organization types and shares per member level can be consulted in figure 2. The graph shows that 93.56% of the members are vendors and other commercial entities, whereas universities and colleges account for only 2.52%, governmental entities for 0.17% and consumer groups for a stake of 3.75%.

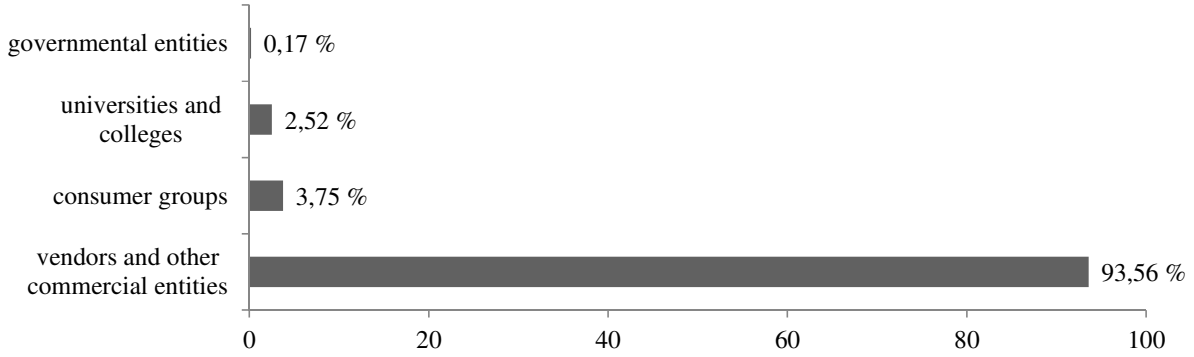

Figure 2 Consortia membership structure

As to the results of the survey, 69.3% of the standards consortia have tiered membership structures, where the member levels can in general be differentiated into *Leaders*, *Followers* and *Spectators*.

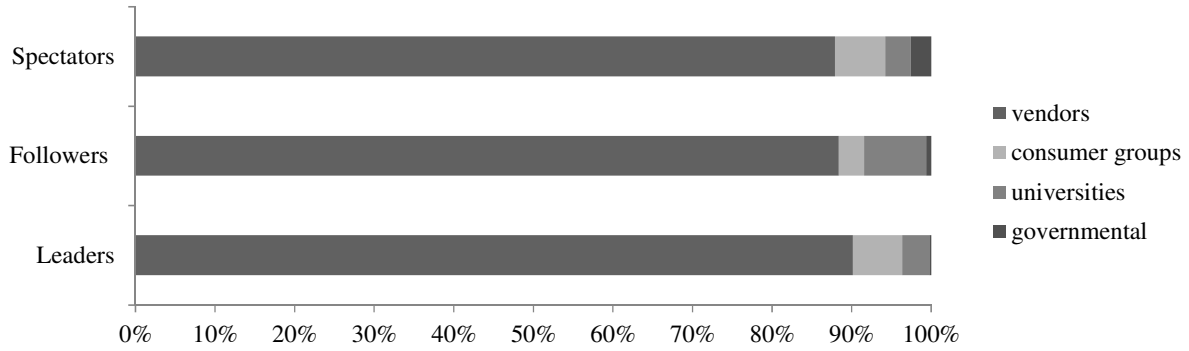

Figure 3 Consortia membership structure as to shares in tiered levels

Using this classification by Updegrove (2008) data analyses indicate that the *Leader* level is dominated by commercial entities, most universities can be found in the *Follower* and *Leader* level and governmental entities and consumer groups mostly choose the *Spectator* level (figure 3). However, all member levels are strongly dominated by vendors. In most cases membership fees are scaled, since *Leaders* usually pay higher dues. Thus they have more voting or veto power and are able to strategically influence the standard setting process. In consequence membership levels often reflect the balance of member power (Updegrove, 2008).

A very political and lately often discussed topic is the interplay of IPR and standards. In comparison to formal standard bodies, the IP policies of consortia are not always transparent and distinct. Thus only 95 consortia could be classified appropriately.

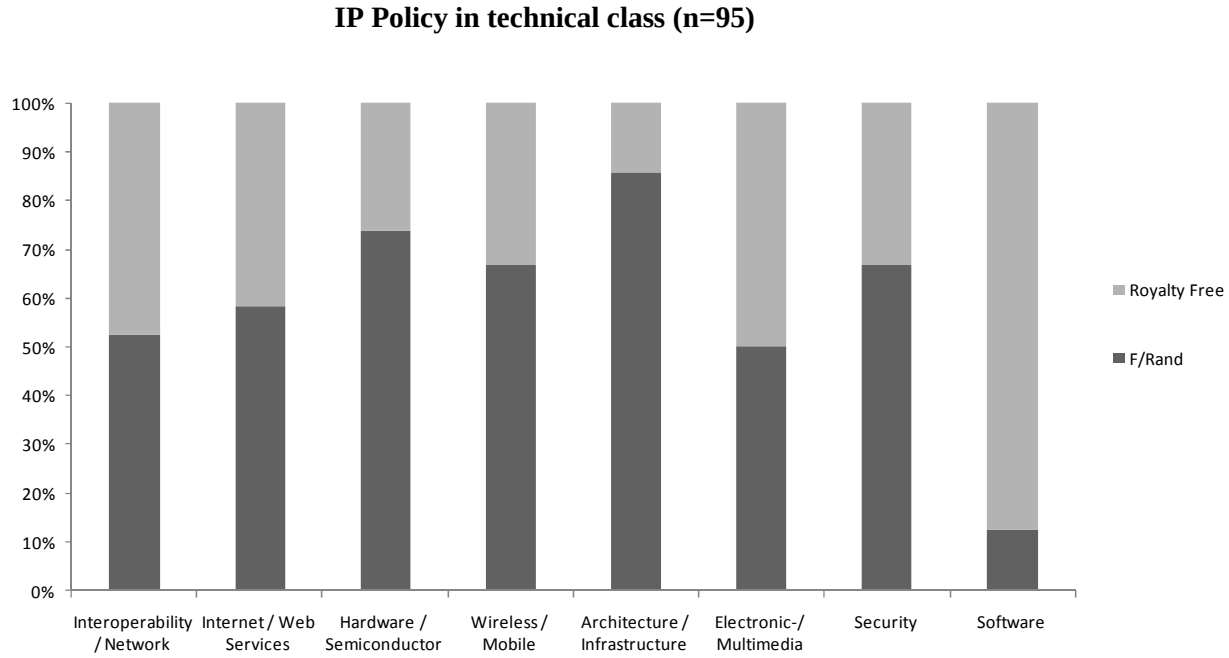

Figure 4 IP policy statements of consortia per technical class

The survey differentiates between royalty free and FRAND (Fair Reasonable and Non-Discriminatory) IP policies. Standard setting organizations often mandatorily require firms participating in standard setting to disclose any patent that might turn out to be essential for the standard in question. Furthermore holders of such patents have to submit a declaration on whether they accept to commit on fair, reasonable and non-discriminatory terms for licensing these patents (FRAND commitments). If a firm discloses a patent and refuses to commit on such licensing terms, the standard organization will usually set the standard excluding the protected technology. Even though standardization may be accompanied by complex licensing agreements, the rules for licensing of complementary patents essential for a common standard are often unclear and can be subject to complex discussions. Nevertheless, FRAND commitments are commonly seen as an important instrument to curb anticompetitive and abusive strategies. In situations of royalty free commitments firms may include patents into standards but commit upfront to not charge royalties (Layne-Farrar et al. 2007; Farrell et al. 2007).

As to the CEN survey 54.7% of the consortia follow a FRAND policy, whereas 43.3% of the consortia use royalty free IPR regulations. To better assess these results, consortia were also classified in their technical classes. Figure 4 illustrates the IP Rules of consortia per technology. The graph shows that IP policies differ between technologies and it thus seems presumable that the technical topic determines the pursued IPR rules. The high number of royalty free consortia in software is on the one hand due to several open source

consortia which can be found within this class and can on the other hand be explained by the fact that IPR on software is restricted in several countries. Explanations of other technological classes are not always obvious and have to be assessed on a lower level of aggregation, since IPR rules differ between specific products and companies involved. However, one has to consider that F/RAND policies may also allow to license essential patents royalty free.

4.2 Consortia Development Phases

There are several articles that describe the development of standardization with respect to the formation and evolution of informal consortia (Hawkins, 1999; Cargill 2002; Jakobs, 2003; Updegrove 2008). However, there is yet no comprehensive quantitative approach to examine the survival of standards consortia over time. Using the CEN survey editions between 1998 and 2009 the data assembles a current list of ICT consortia for every year and even twice a year in 2001 and 2006. Figure 5 shows the quantity of consortia at the respective point of time, also indicating the fluctuation rate, which is the sum of new and terminating consortia. To consider consortia evolution with respect to the standardized technologies, figure 6 illustrates the consortia development assigned to the respective technology class.

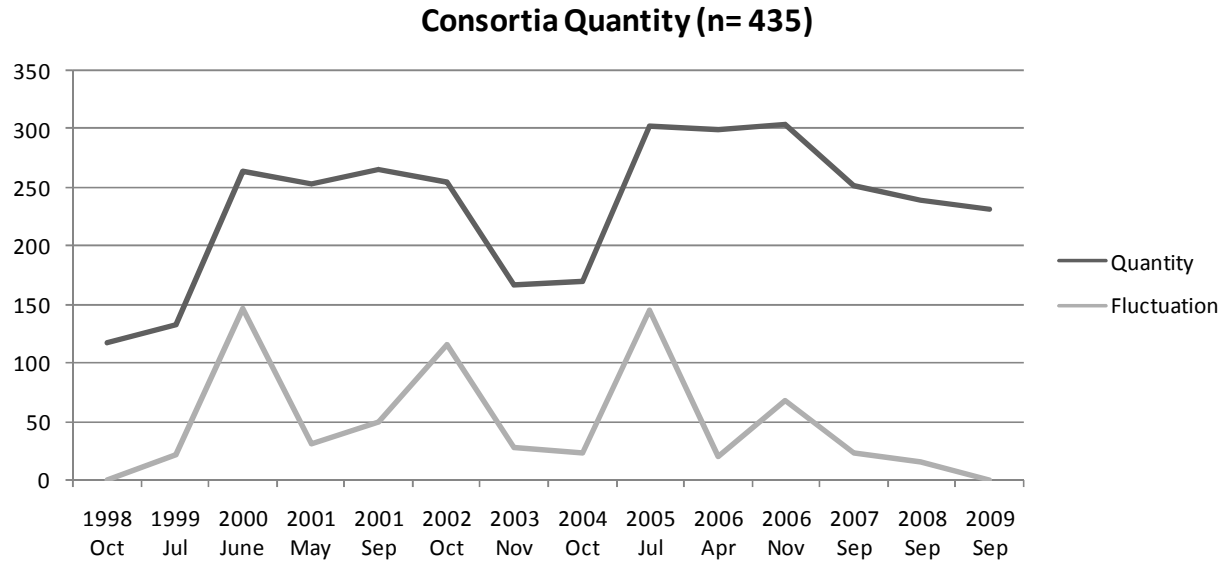

Figure 5 Evolution of ICT standards consortia 1998-2009

Since the mid-1990ies the increasing formation of consortia can be explained by the rise of the internet market, where the first peak of development is in June 2000, counting 123 new consortia compared to July 1999. This period is characterized by strong standard battles (Microsoft Explorer vs. Netscape Navigator) and the rise of future influential consortia in the

internet infrastructure such as the Internet Engineering Task Force (IETF) or the World Wide Web Consortium (W3C) (Cargill, 2002; Updegrove, 2008). Figure 6 shows that the class Internet / Web Services increased from a share of 14.47% in July 1999 to 20.16% in May 2001.

The next fluctuation peak can be found in 2002, where 107 consortia were terminated compared to May 2001. Taking a closer look at the technology class development, especially the percentage of Internet / Web Service consortia decreased from 20.44% in October 2002 to 16.67% in November 2003. Also Security and Wireless / Mobile decreased in their shares between 2-3%. A deeper look at the data also shows a consolidation process. Several consortia were not dissolved but merged with other consortia. The consortia amount remained stable in other technology classes and thus gained an increase of share.

Taking into account the burst of the "dot-com bubble" between 2000 and 2001 where the NASDAQ Composite had a historical decrease, these economic developments also led the consortia formation into a recession. The results are evidence for the close relation of market development and consortia formation. Thus the findings show how quickly consortia standard setting activities are able to react to economic developments and changing market needs.

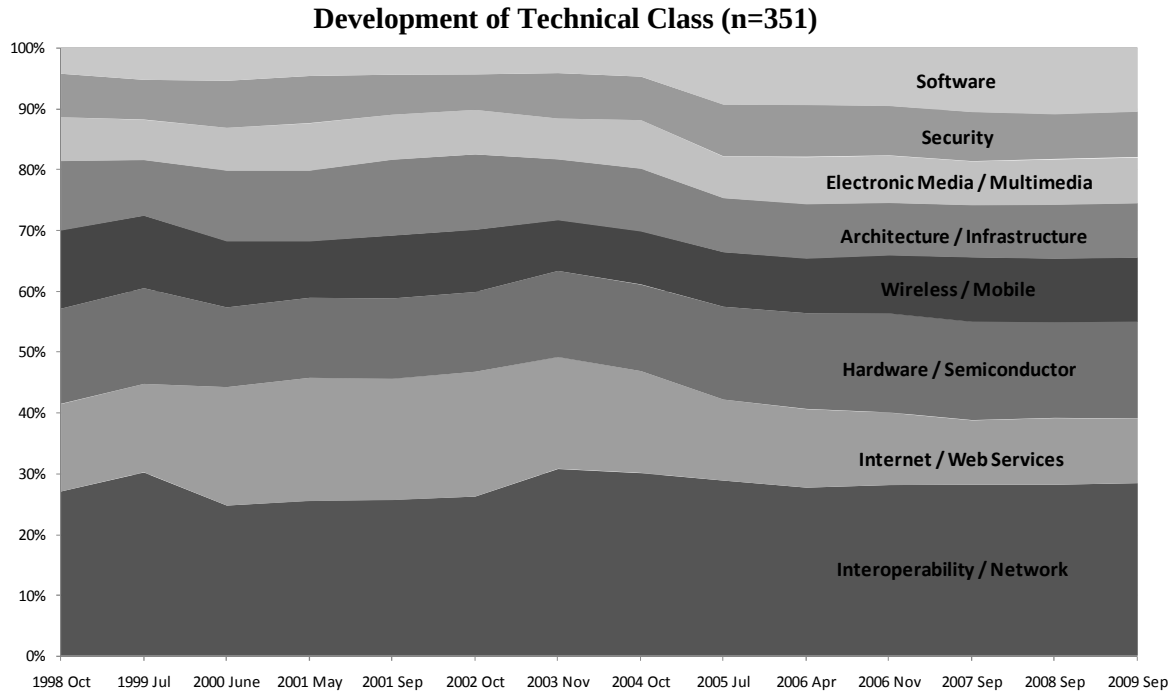

Figure 6 Consortia technology development 1998-2009

A significant period of consortia formation started in 2005. Between October 2004 and July 2005 the CEN Survey data identifies an amount of 133 new consortia. The technical class development shows that the share of software orientated consortia tripled within one year.

This development was especially due to a new awareness of open standards in general and the rise of the open source consortia in particular. One third of the software consortia can be distinctly identified as open source projects. Except for Internet / Web Services a new formation of consortia in all technical classes has taken place. This gives evidence for an increasing broader appreciation of standard setting consortia.

Since the highest peak level in 2006, counting a quantity of 304 consortia, the formation of new consortia remained on a constantly low level in the years to come. In contrast between September 2006 and 2007 the second highest peak of consortia termination took place, as 50 consortia ended their business or merged with others. Again these findings can be linked to economic events, as the US subprime mortgage crises took place in 2007, which later triggered the worldwide financial crises starting in 2008. The findings are able to reflect the close connection of consortia development and industry performance. The timing of consortia formation and termination again indicates that consortia formation is more flexible and dynamic and thus able to react immediately to ups and downs of market development.

4.3 Consortia Performance

In order to measure the performance of standards consortia we apply a survival analysis over the whole sample of our survey. The survival or termination of consortia may be subject to multiple occurrences. In our preceding section we have discussed consortia termination as a result of technology or market shocks. Consortia termination may consequently be the implication of technology obsolescence or economic recession. However, reasons for dissolving a consortium may also be connected to organizational structures or performance.

In some cases the purpose to form a consortium is to standardize a specific technology without the intention to continue development once the project is finalized. Consortia termination would thus be the consequence of previous decisions. Furthermore, consortia often operate similar to commercial corporations with permanent employees, a budget, income streams and customers. If business goals cannot be achieved anymore consortia may dissolve and go bankrupt. Since the purpose of standardization is always connected to coordination of firms, disputes and discrepancies may be another reason why a consortium is dissolved. We have discussed that consortia are special interest groups that pursue a common goal. If these interests and goals diverge, collective activities may be ended.

In the following we seek to measure which consortia structures would survive longer in technology and market conjunctures. We therefore calculate the Kaplan-Meier estimates of

the probability that a consortium terminates. Survival estimates are the likelihood that an observation will "survive" for a specific time. At each time in our analysis, only consortia that have been observed are taken into account. The following statistics are therefore not subject to truncation problems. Downward steps of the survival function represent failures. The y axis denotes the percentage of consortia that survive over time as to years on the x axis.

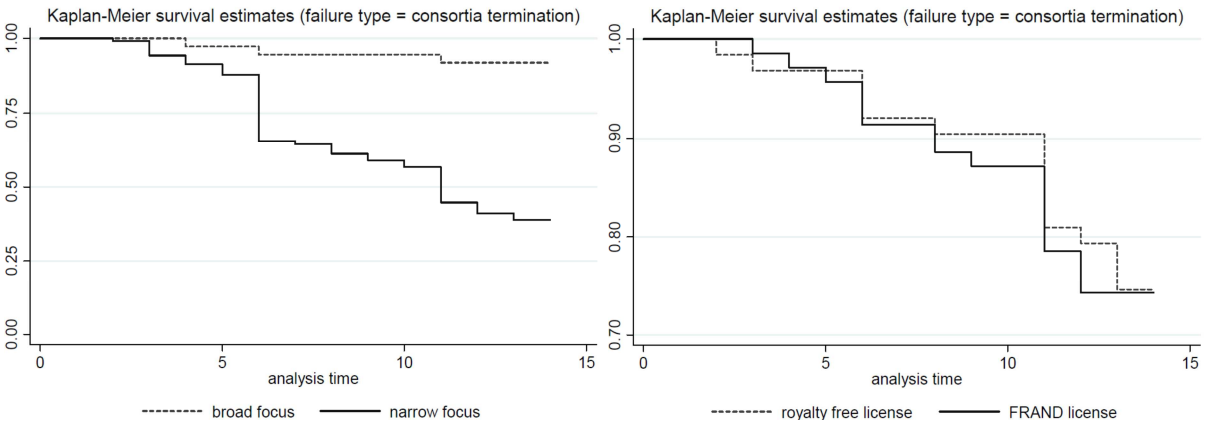

Figure 7 Kaplan-Meier survival estimates of consortia termination by consortia focus and IP policy

Results from figure 7 represent the survival functions of consortia as to consortia focus and IP policy. The left graph shows that standards consortia which pursue a broad focus in their standards projects survive respectively longer compared to narrow purpose consortia. Results indicate that after 10 years almost 50% of narrow focused consortia are terminated. This finding may confirm the notion that consortia are in some cases formed to solve a very specific problem over a limited period of time. Survival of these so called "one purpose consortia" would thus be subject to planned termination. However one could also argue that consortia which are able to extend their business focus to additional standards projects are more successful and thus survive respectively longer.

In the right graph in figure 7, we estimate whether the differences of IP polices have an influence on consortia survival. To make results of the Kaplan-Meier survival test visible we changed the scale of our y axis. However, survival developments seem to show no significant differences between the two licensing schemes. Only in periods after seven years consortia with a royalty free policy seem to survive longer, while the survival rate decreases after ten years to the same level as FRAND policy consortia. These developments may furthermore be connected to the technology that is developed (figure 4). We argued earlier that FRAND commitments also include royalty free agreements. Yet analysis is far from conclusive to explain the effects of IP policies on the survival of consortia.

Consortia size is a crucial factor that influences both; consortia coordination among members and market power. The costs of coordination increase with the number of members. Large groups may inhibit coordination failures such as “free riding” or “war of attrition” (Olson, 1971; Farrell and Simcoe, 2012). This may result in disputes and in cases of hardship lead to consortia termination. In comparison, we argued that the success of a standard is connected to a large group of companies that sponsor the standardized technology (David and Greenstein, 1990; Axelrod et al., 1995). Figure 8 compares five categories of consortia membership quantity and observes the survival curve over time. Again we adjusted the scale of survival rates in our y axis to make results visible. Large consortia with 200-300 and 300-1000 members survive the longest over the years. Rather small consortia in comparison <50 and 100-200 terminate in earlier periods. These results support the argument that consortia which gather a larger number of industry players are more successful and seem to operate significantly longer than small consortia. However, we have to keep in mind that narrow “one purpose consortia” with a planned termination are considerably smaller than others.

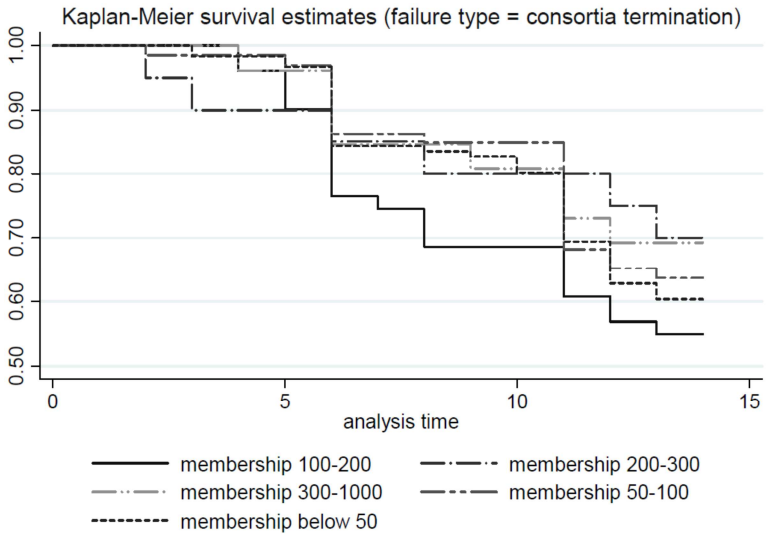

Figure 8 Kaplan-Meier survival estimates of consortia termination by membership size

Consortia membership may influence termination not only by size but also by membership structures. We conduct another survival analysis and estimate if different membership arrangements influence survival rates. Figure 9 illustrates that for consortia with individual membership structures termination is more likely compared to others. Individual members participate not as a corporation but as individual persons. Members may still serve the interest of a group or company but participate in meetings and conferences individually. These consortia are often very technical and seek to solve specific problems which may not be

subject to corporate strategies. Again we assume these consortia to be limited in time and scope which would result in earlier termination.

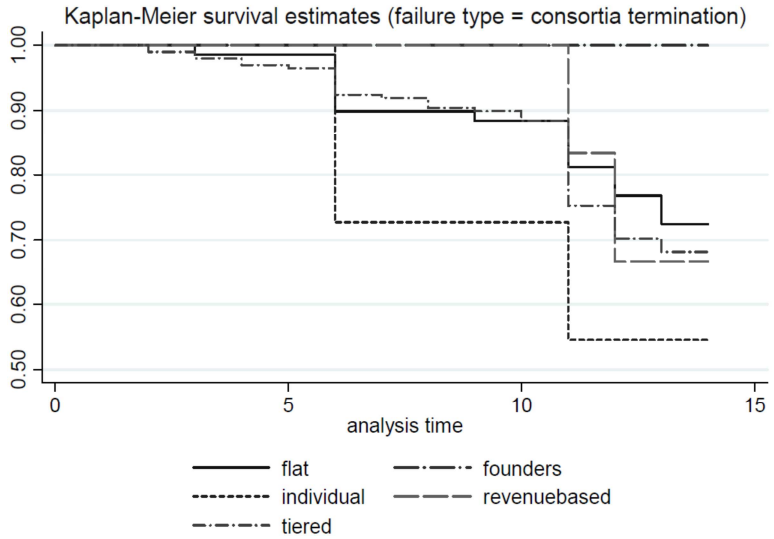

Figure 9 Kaplan-Meier survival estimates of consortia termination by membership tiers

In consortia where membership fees are revenue based or tiered, members which pay higher dues obtain more rights than others. As to the categorization of member levels in figure 3, *leader* firms may get full and early access to information, may participate in all meetings, may have certain veto or voting rights and may be part of the organizational management of the consortia (Updegrove, 2008). Tiered member levels thus ensure that strong market players can better influence standardization outcomes and bypass smaller entities which only participate as spectators or followers. Compared to flat membership and founder based membership, consortia with tiered structures more likely terminate over time (figure 9). However, we would expect that coordination failures would be solved by hieratical tiered structures. In comparison, in flat membership structures all members have the same rights, which may lead to discrepancies. Even though theoretical considerations are opposed to our finding, we could argue that tiered member structures are subject to a selection effect. Companies that pursue certain interests or seek to sponsor technologies that are not shared by other market participants may rather choose to join consortia where they can suppress others. Thus consortia with tiered structures would experience participation of companies that would generate more coordination problems compared to consortia with flat structures.

5. Conclusion and Discussion

This paper intends to give a broad overview of standards consortia, its characteristics, organizational structures, policies and developments in the past ten years. Even though empirical analysis is rather descriptive, results already introduce coherences in terms of the consortia features and survival. Several characteristics differentiate the consortia phenomenon from other standard setting activities. By combining the assessed consortia information, relationships are revealed to deliver a more transparent picture of the consortia landscape. The stereotypical consortium could hence be described as having usually less than 100 members, following only one purpose of business, being hierarchical in its decision making structures and due to tiered membership fees, is often dominated by vendors and commercial entities. The stated IP policy is strongly connected to the produced technology. In contrast to formal standard bodies, consortia are very flexible and react to market developments. This either results in a formation as well as termination of businesses or mergers with other consortia. Involvement in consortia standard setting enables members to gain quick and flexible participation to influence the standardization process. Especially solvent vendors and commercial entities can use their strong membership positions to strategically direct a certain standard or specification.

This article further estimates survival rates to assess which consortia are successful and stable and how consortia features correlate with termination and continuity of business. In consideration of theoretical implications we show that especially structures of member coordination as well as focus and positioning on markets determines consortia survival over time. While termination may be planned for some consortia, others may close their business due to problems that can be connected to a consortium's organizational approach. We show that larger consortia survive significantly longer compared to smaller consortia. However, when membership levels are tiered termination is more likely. Furthermore a narrow focus on certain technologies also leads to earlier termination, while the adopted IP policy seems to have no effect.

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