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DOI

[10.1080/09537325.2013.785511](https://doi.org/10.1080/09537325.2013.785511)

Publication date

2013

Document Version

Final published version

Published in

Technology Analysis & Strategic Management

Citation (APA)

van de Kaa, G., Greeven, M., & van Puijenbroek, G. (2013). Standards battles in China : Opening up the black box of the Chinese government. *Technology Analysis & Strategic Management*, 25(5), 567-581. <https://doi.org/10.1080/09537325.2013.785511>

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To cite this article: Geerten van de Kaa , Mark Greeven & Gido van Puijenbroek (2013) Standards battles in China: opening up the black box of the Chinese government, *Technology Analysis & Strategic Management*, 25:5, 567-581, DOI: [10.1080/09537325.2013.785511](https://doi.org/10.1080/09537325.2013.785511)

To link to this article: <https://doi.org/10.1080/09537325.2013.785511>



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Standards battles in China: opening up the black box of the Chinese government

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Research on standards battles primarily focus on battles that occur in developed economies. In this research we focus on standards battles in China. In particular, we analyse two cases in which, in China, two competing domestic standards were developed in response to international standards but where the domestic standards do not get diffused in the international and domestic arena. Although the government plays a significant role in developing China's economy, we show that her strong hand does not easily promote a chosen standard into market dominance. By studying these cases of standards battles we open up the black box of the government and identify inconsistencies and competition within the government that lower overall commitment to enforce a strong standardisation policy of the Chinese government.

Keywords: standards battles; China; government; institutions

1. Introduction

In response to the global dominant digital versatile disc (DVD) and wireless fidelity (WIFI) standards, in China, two local standards were developed: a standard for a new generation of high definition digital laser video disc system (enhanced versatile disc or EVD) and a standard for a wireless authentication and privacy infrastructure (WAPI). These present two cases in which Chinese stakeholders have tried to circumvent Western technologies and their intellectual property rights (IPR) by successfully developing competing standards but fail to get the standards widely diffused not only in the international arena but also domestically.

Much research on standards battles has focused on developed market economies such as Japan, the EU and the USA (Shapiro and Varian 1999; Grindley 2002). However, the fast developing and emerging economy of China is often overlooked even though it has a mixed economy (Krug and Hendrischke 2008) in which both a socialist legacy and newly introduced market mechanisms influence the institutional framework for standardisation. A standards battle refers to a situation in which different incompatible standards contest for market dominance (Shapiro and Varian 1999).

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Previous research suggests that, in standards battles, the role of the government is generally particularly important in that it can enforce a standard in a market as well as provide the standard with a certain degree of legitimacy (Greenstein 1992; Backhouse, Hsu, and Silva 2006). China's examples indicate a different role for the government. The role of the government in reforming and developing the economy, including the institutional infrastructure for standardisation is considerable (Zhan and Tan 2010). Thus, our research question is:

RQ: What is the role of the Chinese government in setting the conditions for standards battles that involve the introduction of an endogenous domestic standard that competes with a global dominant standard?

Although one may expect a dominant role for the central government, considering China's one-party non-democratic state, previous literature suggests the opposite. Qian (2000) suggests that because of a gradual reform approach, China's economy has both state socialist and market-oriented institutions coexisting, resulting in overlapping and conflicting rules to govern the economy. Roth and Kostova (2003) suggest that transition economies in general suffer from institutional baggage which makes the Chinese government's role (at central, provincial and local levels) both ambiguous and complex. Therefore, the uncertainty of all stakeholders in standardisation in China is expected to be higher than and different from the EU. This not only sets China apart from the EU but also the countries within Europe. Second, whereas China's non-democratically chosen central government provides an overall policy framework with national ministries and a State Council (SC) for 'managing the country', the EU provides rules only in certain sectors and parts of society (such as border regulations and tariffs), and each EU state has its own national government with significant sovereignty in making economic and political decisions.

In this paper we focus on a situation in which endogenous standards are introduced while there are already global standards. We use Zheng's (2007) conceptualisation of China's government as a *de facto* federalist institution to open up the black box of China's governmental institutions for standardisation in order to understand why the EVD and WAPI standards did not make it after being developed and selected. As we will explain in what follows, the hybrid nature of China's government with uncertain and ambiguous institutional layers is among the factors for explaining why China's government cannot push the market acceptance of the standard. By identifying the different stakeholders in standardisation, we further detail the complexities of China's institutional infrastructure for standardisation. With our study we contribute to the standardisation literature by incorporating an institutional perspective and extending into China's economy, as an example of a transition economy. On the basis of two case studies we will allude to the institutional tensions derived from the co-existence of a socialist state and market institutions.

We find that the government can initiate standards, but has much difficulty in steering the outcome of standards battles, since it does not operate as a single agent. Not only is the power of the central government quite low, also China's national, regional and local governments are vying for influence (Kambil and Lee 2004; Keller and Samuels 2001). In what follows we will develop our conceptual argument and we will analyse two standards battles in China. The purpose is to identify the stakeholders and their activities, at each step in the standardisation process: from standards development, acceptance, to diffusion. Also, we want to assess to what extent the government has played a role in the standardisation process from initial development to market dominance. Thus, we will further open the black box of the government in China and illustrate the consequences of China's transforming economy.

2. China's government-led standardisation

Phases in the standardisation process comprise of (1) standards development/design; (2) acceptance/enforcement; (3) choice/diffusion; and (4) impact (Lyytinen and King 2006). In this paper we consider the role of the *government* during standards development, acceptance and diffusion. Several authors in the area of technology management and standardisation in particular have proposed frameworks for standard dominance (Schilling 1998; Suarez 2004; Van de Kaa et al. 2011). These authors also mention the influence of certain stakeholders such as standards committees and governmental agencies (which may consist of multiple institutions operating in a complex infrastructure). King et al. (1994) identify a set of formal institutions that influence the adoption of information technology (IT) such as government authorities, international agencies, research oriented higher education institutions and industry associations. While the model of King et al. (1994) focuses on institutions specifically, Andersen, Bjørn-Andersen and Dedrick (2003) consider more environmental factors such as industry structure, information infrastructure, financial and human resources, and social and cultural factors. Some scholars argue that government involvement in standardisation may provide standards with a certain degree of authority or legitimacy and is beneficial for their diffusion (Backhouse, Hsu, and Silva 2006). Also, governmental agencies may use their power to prescribe a standard (Greenstein 1992). An example is the Federal Communications Commission which has exercised its power in different standards battles including the battle for a colour television standard (Shapiro and Varian 1999) and the battle for a high definition television (HDTV) standard (Farrell et al. 1992). The government can also mass procure products implementing the standard in order to enlarge its installed base. Then, the government attempts to positively influence standard dominance by acting as a large buyer (Greenstein 1992). One of the reasons why a governmental agency might want to play a part in standards battles is when the results of standards battles affect national goals. A governmental agency might also want to intervene when it believes that the result of a standards battle is improperly affecting market competition (David and Greenstein 1990). Yet, it is difficult for a governmental agency to effectively play a role in a standards battle as it must intervene before a market is 'locked in' to a standard or the switching costs become too high. At that juncture, governmental agencies have the least amount of information about which actions should be taken; they are 'blind giants' (David 1986, as cited by David and Greenstein 1990).

Previous literature has not adequately dealt with standardisation and the role of the government in China. However, China is posing a qualitatively different environment for standards battles with a substantially different role of the government. According to Millar, Choi, and Chu (2005), the role of the government as a whole is larger, especially during stage 2 (acceptance) than in capitalist systems. Considering the mixed economy nature of China, in particular its planned economy legacy, it is likely that the public sector in China is able to exert a relatively larger strategic control over the economy's development than in capitalist systems. Also, China's government continues to exercise influence on enterprise activity and actively designs industrial policy and development (Krug 2004; Krug and Hendrischke 2007). Furthermore, private players are not yet constituting a strong enough social class to counterbalance central government decisions. Empirical evidence suggests that it is also unlikely that private players will compete for such powers at the expense of losing the status quo that allowed them to prosper (Dickson 2008). Technological forecasting, foresight and technology selection is used by policy makers to plan and organise technologies and industries in China (Mu et al. 2008). Zhan and Tan (2010) find that the Chinese government has played a crucial role in the establishment of the time division, synchronous code division multiple access (TD-SCDMA) standard. TD-SCDMA is an indigenous standard for third generation

wireless telecommunications that was successfully developed as a result of China's ambitious policy for indigenous technological development and implementation. Therefore one could argue that governmental institutions have a significant influence on standardisation.

This is not to say that China's central government has unlimited reach and leverage of power; in particular, we propose that China's government is so diverse and complex that it no longer can be seen as a monolithic socialist state that can push a standard into success. On the contrary, the reforms since 1978 have resulted in heterogeneity of business environments (Krug and Hendrischke 2008). Such distinct patterns can only exist if there is considerable autonomy at the local level with respect to political and economic decisions. China's business environment has considerable vertical intergovernmental inconsistencies and horizontal government competition which increases the uncertainty of governance of critical resources (Dougherty and McGuckin 2008).

The complexity and diversity of China's standardisation infrastructure is a consequence of China's decentralised government with the provincial level as the most relevant 'local' government agent (Zheng 2007). Inter-governmental decentralisation has become institutionalised, i.e. difficult to change, and provinces have responsibility over local economy and politics. Therefore, local governments have strong incentives to push forward initiatives that benefit local economic development. In this context, local market forces gained importance in influencing and setting local political agendas, in particular since public-private business partnerships have emerged in the 1990s and 2000s (Krug and Hendrischke 2008). The alliance of economic – and government actors in networks has the clear purpose of pursuing and developing economic interest. In sum, China's government is characterised by decentralisation to the local level and co-existence of local political and economic initiatives. Consequently, China's institutional infrastructure for standardisation has become complex and diverse. Therefore, we need to understand the key stakeholders and their motivation at different levels of government.

Since the entry to the World Trade Organization (WTO) in 2001, China has made clear and distinct steps towards standardisation and acceptance of international standards. With the further marketisation of the economy and the key role played by private enterprises, the sense of urgency to develop domestic standards increased significantly. Furthermore, the efforts to build a strong institutional infrastructure for standardisation were strengthened. Interestingly, China's standardisation strategy is by no means centralised and coherent across the sectors of the economy. To better understand the standardisation process in China, it is useful to identify the key institutions within China's government which have a stake in standardisation. In 1989 China made a law in which Chinese standards were categorised into four types at different levels of analysis; national standards (requiring nationwide consistency), trade standards (requiring consistency for certain industries), local standards (requiring consistency for certain products), and enterprise standards (for specific firms requiring standardisation of, e.g. production processes). Local standards can become industry standards and industry standards can become national standards. At each of these levels, different institutions exist (see Table 1).

Taking into account China's heterogeneous economic environment, we will explore the stakeholders at the national, sector and local level. A national standardisation strategy is supported by the National 11th 5-year Scientific and Technical Development Programme and the Standards Administration of China's (SAC's) Outline of the 11th 5-year plan on the development of standardisation (the 11th 5-year plan is from 2006 to 2011). These two documents jointly put forward eight key areas for standardisation which was adapted after the start of the global financial crisis (2008) to 10 key industries by the SAC, National Development and Reform Commission (NDRC) and Ministry of Information Industry (MII). The SAC tries to mobilise government financial support

Table 1. China's governmental infrastructure for standardisation.

National level

State Council (SC)

Administration for Quality Supervision Inspection & Quarantine(AQSIQ)

Administration of Certification & Accreditation of China (CNCA)

*China National Accreditation Board for Certifiers (CNAB)**China National Accreditation Board for Laboratories (CNAL)**China National Auditor and Training Accreditation Board (CNAT)**China Quality Certification Centre (CQC)**China Certification & Inspection Group (CCIC)*

Standards Administration of China (SAC)

*China Association for Standardization (CAS)**China National Institute of Standardization (CNIS)**Standards Press of China (SPC)*

Ministries and their standardisation workgroups (in particular Ministry of Science and Technology(MOST), Ministry of Information Industry (MII), Ministry of Trade (MT), Ministry of Defence (MD), Ministry of State Security (MSS), and Ministry of Commerce (MC))

National Development and Reform Commission (NDRC)

WTO TBT National Inquiry Center

International Inspection and Quarantine Standards and Technical Regulations Research Center

People's Liberation Army (PLA)

State Security Agencies (SSAs)

National Radio Monitoring Center (NRMC)

Sector level

Sector government departments within SC (such as State Encryption Management Commission (SEMC), State Economic and Trade Commission (SETC), and State Bureau of Quality and Technical Supervision (SBQTS))

Science and Technology Office (STO)

National standardisation technical committees

Sector specific testing and inspection centres

26 Trade standardisation research institutes including China Electronic Standardization Institute (CESI)

12 Trade standardisation organisations including CECS, CESA and CCSA

Local level

158 Local level standards research institutes including Shanghai Institute of Standardisation (SIS) and Shenzhen Institute of Standards and Technology (SIST)

257 local standardisation organisations including Shanghai Information Electronics Association (SIEA)

Local governmental agencies at city and province–municipality level

Quality and technology supervision bureaus of provinces, municipalities and autonomous regions

Source: Authors' compilation of American National Standards Institute, CAS(www.china-cas.org), SAC (<http://www.sac.gov.cn/templet/english/>), *China Business Review* (<http://www.chinabusinessreview.com/public/0305/weeks.html>).

to fund the formulation of national standards and support the participation of Chinese domestic experts (Wang, Wang, and Hill 2010).

Besides a national strategy, a variety of sector government departments that manage and monitor different industries have developed strategies for standardisation within industries in cooperation with the SAC and NDRC. The standardisation strategies in the different industries emphasise the importance of independently developed technologies that should integrate international or sector standards (Wang, Wang, and Hill 2010). Sector government departments have made every effort to mobilise funding for standardisation in both government and business. These sector government departments have especially close relations with state-owned enterprises.

Next to the national and sectorial level, local standards are an integral part of China's standardisation strategy. These local authorities push forward local economic and technological development and hence the formulation and implementation of local standard strategies. The first local governments that implemented a municipal standardisation strategy were those of Shenzhen and Shanghai in 2007, later followed by Beijing, Jiangsu, Zhejiang, Shandong, Henan and Shaanxi (Wang, Wang, and Hill 2010). The policy extended standardisation into urban construction, community and administrative services. Many of these initiatives paid close attention to local industries, economic conditions and people's needs and were often more feasible and attractive than national initiatives. In line with studies on fiscal federalism (Qian 2000) and local variety (Krug and Hendrischke 2008; Jing and Tylecote 2005), local governments, especially at the provincial level, have incentives to promote local economic development by making their localities attractive for investments. This has resulted in widely diverse economic and political conditions across regions in China (World Bank 2006).

China's strategy for standardisation must accommodate a considerable heterogeneity of interests and objectives (Suttmeier 2005). Moreover, the various stakeholders involved in standardisation sometimes operate according to their own interest and within ministries, different officials operate according to their own agenda (Suttmeier, Yao, and Tan 2006). With different national and local interests and goals we cannot assume that there is a consistent objective about standardisation in China. Whereas some motivations reflect national information security considerations, others are about motivating technological capabilities and market power. Furthermore, while the government ministries (with often competing interests and goals) are still the dominant players in setting initiatives for new standards, Chinese companies, industry associations and also universities have become increasingly active in initiating standards.

In sum, the reforms of China's state socialist economy are accompanied by an increase in economic and political actors with a variety of interests (Krug and Hendrischke 2007). Although the motivations and initiatives to develop standards are strong, they originate at different national, sectoral and local levels. Such heterogeneity of initiatives obscures the widespread diffusion of standards beyond local or sectoral arenas. In summary, China's government is expected to be relatively weak in pushing the standard into widespread diffusion across China, let alone, internationally.

3. Research design

We apply the case study method (Yin 2009). We conducted two exploratory case studies of standards battles in China. The battles concern the battle for a DVD standard and the battle for a wireless data encryption standard. We chose these battles since they both have a dominant global standard and China has developed a native standard to try to compete with the dominant global standard. We performed a historical case study of each standard from its initial development until its eventual demise. In particular, we determined the 'route' that the standard travelled going from institution to institution. We attempted to identify the role that different government stakeholders have played at the various stages of the standardisation process. To determine the stakeholders that constitute the institutional environment for standardisation in China we applied the method of De Vries, Verheul, and Willemse (2003). Prior studies (Markus 2006) have effectively applied this method for the same purpose. The application of this method has resulted in a list of stakeholders for each standard. In our analysis we focus on the governmental stakeholders. To determine the level of participation, the position of each stakeholder was assessed. Finally, to arrive at a shorter list of relevant stakeholders we chose the stakeholders that have the power to affect the

standardisation process (definitive stakeholders – see De Vries, Verheul, and Willemse (2003)). By using the method proposed by De Vries, Verheul, and Willemse (2003) we are confident that we have arrived at a comprehensive overview of the different stakeholders involved in each battle. We assessed the level at which they operate in the government (local, sector, national) and the standard(s) that they support.

Evidence to support our analysis comes from interviews and news archives reports on the standards battles: *EE Times Asia*, ChinaTechNews.com, *The Asian Times China section* and the *Financial Times*. Our interviews were conducted with a group of experts on standardisation in China. Experts have been identified through literature search and via recommendations made by other experts; they have either published at least one paper/report about standardisation in China, and/or are occupied with the subject matter on a daily basis for their professional occupation. These interviews were part of a larger project on factors that influence standardisation in China. For the analysis of this paper we relied on the information and insights from a subgroup of (7) experts (Chinese and non-Chinese) in academics (USA), government (European Commission delegate in China, China National Institute of Standardization (CNIS)) and consultants (international and located in China).

4. Case studies

4.1. EVD

In 1990 Toshiba and Time Warner proposed a new generation of compact discs (CDs); the Super Disc standard which had a capacity of 5 gigabytes. In 1994 Philips and Sony developed the MultiMedia CD, which had a capacity of 3.6 gigabytes. A standards battle ensued. However, in 1995, Intel proposed a unitary DVD standard that incorporated elements from both competing standards (De Laat 1999). Soon, DVD overshadowed the video home system (VHS) and became dominant in its product category. Nowadays, the biggest DVD player producing country is China. In 2002 China produced 30 million players, more than 70% of the world output for that year. On the surface this looks like a money spinning position. However, DVD is a standard for which DVD-player producers have to pay high license fees that can amount approximately to US\$20 per DVD player, which only leaves razor thin margins for the DVD-player producers. Because of these high fees China initiated its own standard; EVD.

In May 1999 the Science and Technology Office (STO) of the MII established an alliance with a group of Chinese research institutes active in the area of digital optical disks. Five months later, the group successfully applied for State Economic and Trade Commission (SETC) research funding (10 million Yuan). The SETC approved the formation of the China Digital Optical Disk Technology (CDODT) Consortium, which started work on a project to develop EVD. In April 2000, the New Generation Digital Optical Disk Standardization Working Group (NGDODSWG) was established which, in September 2000, developed a first draft EVD specification (NGDODSWG was approved by China's National Audio Video and Multimedia Systems and Devices Standardization Committee (which operates under the State Bureau of Quality and Technical Supervision (SBQTS) and MII). The working group was led by Being E-World Technology, an organisation formed by members of the CDODT consortium.) In July 2001 NGDODSWG approved EVD as a draft standard and at the end of December 2001 EVD received a positive evaluation from the MII. Meanwhile, local competing standards were developed including the High-definition Versatile Disc (HVD) and the High Definition Video (HDV) standard. In response, the MII decided that EVD should be re-evaluated against these (locally developed) standards. This was done by the National Testing

and Inspection Center for Radio and TV Products. The fact that the MII deemed it necessary to re-evaluate EVD decreased the popularity of EVD somewhat, as indicated by our interviews.

Eventually, in 2005, the MII accepted EVD which provided a considerably degree of legitimacy and in turn attracted other stakeholders to EVD. So, standard diffusion is often a highly politicised process on which a country's government can indeed have an impact. Furthermore, lead champions in specific industries with strong ties to the MII supported EVD. As our interviews suggested, 'Since Zhang Baoquan (on Forbes China Rich list, Antaeus Group in real estate and EVD) managed to get a license to run EVD movie theatres throughout China and the presence of several government related entities in the EVD working group, it can be safely assumed that EVD uses its relations for strategic interaction with the government.' Yet, local standards continued to be supported by local institutions decreasing the dominance of EVD. HVD was supported by local governmental agencies and standardisation organisations. For instance, in 2005, the Shanghai Information Electronics Association (SIEA) adopted HVD.

The question arises why local authorities such as the SIEA (Shanghai) can support local standards instead of national standards. The Shanghai government is different from other areas in that Shanghai is a province-level municipality that reports directly to Beijing. Four of these special cities exist (Shanghai, Chongqing, Tianjin and Beijing). This gives Shanghai considerable political power. Furthermore, it is likely that Shanghai as an economic stronghold in China having considerable ties to the international business world has additional weight.

In Figure 1 we present a graphical overview of the route EVD has traveled and the institutions which had an influence on EVD. In Table 2 we present an overview of the main governmental stakeholders, the level at which they play a role and the standards that they supported.

Thus, EVD was faced with a fractioned government on two levels. Local authorities favoured other local standards whereas the MII, operating at the national level, supported EVD as a national standard. This resulted in a situation in which the national standard did not achieve widespread diffusion but actors mostly support locally developed standards.

Our interviews suggested that the international market plays a large role: 'I think that the ration between domestic market and the international market (or three largest international markets outside of China) plays a role, because all manufacturers in China want and must export, but the bigger the domestic market and the more self-confident China becomes, it will set its own standards, unless it loses business with large foreign markets.' However, at the international level, EVD did not have a comparative advantage. The main advantage of EVD was that the price of the complementary goods (EVD discs) was significantly lower compared with DVD discs. Price of the complementary goods in which the standard is implemented is one important factor determining the success of the standard. However, this advantage is largely dissolved, since pirated DVD's could be bought on almost every street corner in China. Pirated DVDs are regular DVDs on which illegally obtained content, free of price, is placed. These pirated discs are only slightly more expensive than EVD discs. Therefore, the advantage of a low price for EVDs largely dissolved. A lower price could have resulted in an increased installed base in China and thus towards dominance locally. Under the influence of network effects, the high installed base could grow even further possibly leading to global acceptance of the standard. China has a large potential installed base and therefore if a local standard gains widespread adoption in China it may become a global dominant standard.

In sum, in this case, a lack of acceptance of EVD in the domestic market owing to inconsistent government interests at the central and local level resulted in a weak position in international markets. In turn, Chinese manufacturers' incentives to accept and facilitate EVD diminished and market forces overthrew EVD.

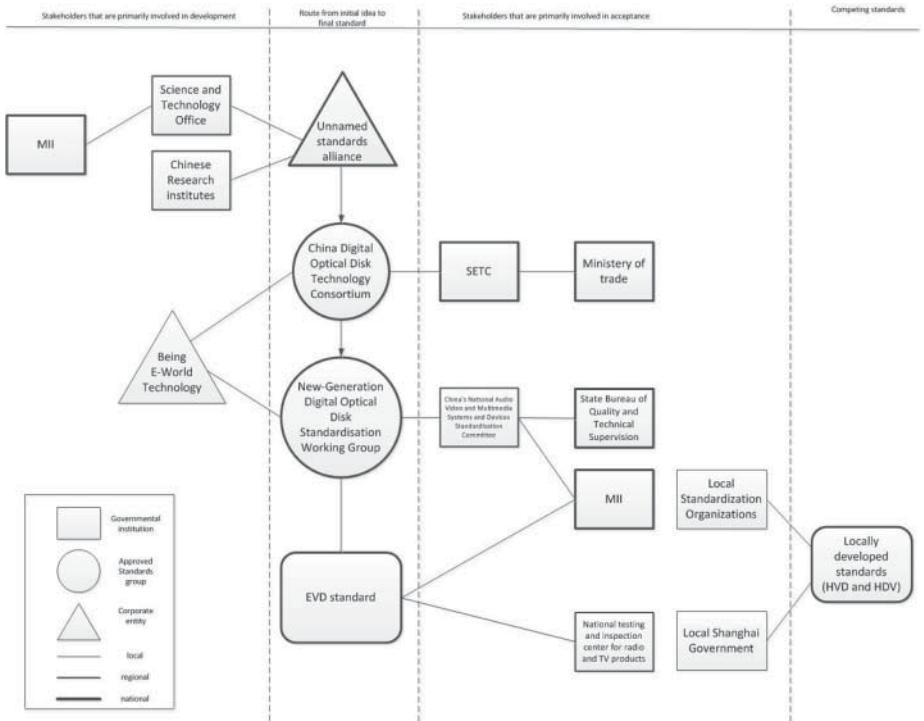


Figure 1. Standardisation route: EVD.

Table 2. Governmental stakeholders in EVD standardisation.

Governmental stakeholder	Governmental level	Standards supported
MII	National	EVD
STO	Sector	EVD
Chinese Research Institutes	Sector	EVD
SETC	Sector	EVD
MT	National	EVD
China's National Audio Video and Multimedia Systems and Devices Standardization Committee	Sector	EVD
SBQTS	Sector	EVD
National Testing and Inspection Center for Radio and TV products	Sector	EVD
Local government agencies	Local	HVD
Local standardisation organisations	Local	HVD

4.2. WAPI

In 1990, the Institute of Electrical and Electronics Engineers (IEEE) started to work on the development of standards for wireless data communication. In 1997, the first version of WIFI (IEEE 802.11) was introduced. In the years that followed, IEEE 802.11 became the dominant global standard for wireless data communication. In 2001 the encryption mechanism used to secure IEEE 802.11 networks was cracked by cryptanalysts. IEEE responded by forming the 802.11i

task group, which developed the 802.11i amendment, which provides improved encryption and security for networks. In June 2004, 802.11i was ratified by the IEEE. In 2006 the 802.11i standard was submitted to the International Organization for Standardization (ISO) for recognition as an international standard.

In 2000, the National Key Lab of Integrated Service Network Theory and Key Technology at Xidian University established the IWNCOMM Corporation, which aimed to establish a new wireless data encryption standard in China. IWNCOMM had strong ties with the Chinese military and state security agencies (SSAs). These institutions hoped that WAPI would become an international standard and that they could, by providing the security protocol, join foreign companies in the development of products that implemented the standard. By collaborating, Chinese institutions could learn from the foreign companies. One of the other important actor behind WAPI was the State Encryption Management Commission (SEMC), which had access to the encryption codes (In 1999 the SC imposed a rule that every firm (including IWNCOMM) should hand over their encryption codes to the SEMC). In 2001, IWNCOMM established the Broadband Wireless Internet Protocol Standards group (BWIPS) to start work on WAPI. BWIPS had 10 members among which were five universities, the China Electronic Standardization Institute (CESI) and National Radio Monitoring Center (NRMC) under MII, and a research centre affiliated to SAC. In 2002, the two crucial parts of WAPI were finished: WAI (WLAN Authentication Infrastructure) and WPI (WLAN Privacy Infrastructure), which encode the user identity and transmitted data respectively. After a positive assessment by the SEMC, the SAC ratified WAPI in 2003. Confirmed by our interviews, politics matter and the government influenced the standardisation process in several phases. As a result of the restrictions set up by the SC, WAPI was closed because specifications were not released. Furthermore, the SEMC enforced foreign companies to cooperate with Chinese companies that licensed WAPI. Thus, WAPI was strongly enforced by SEMC.

Meanwhile, foreign companies believed China was using WAPI as a form of protectionism which is in direct violation with the WTO regulatory framework (Suttmeyer, Yao, and Tan 2006). According to one interviewee, 'the WTO was not a stakeholder but a tool for foreign companies'. Eventually the US government interfered by setting up negotiations with China. From the negotiations that followed it appeared that BWIPS did have close ties with the Ministry of Defence (MD), but not with the ministries with economic power (the Ministry of Commerce (MC) and the Ministry of Science and Technology (MOST)). This unbalanced connection prevented WAPI from gaining buy-in from the ministries with economic power, ultimately leading to a strong disagreement and a lack of support within the Chinese government itself. In their division the Chinese government was very much at odds and the most influential ministries refused to give full support. Our interviews confirmed that Chinese stakeholders in the standardisation of WAPI did not form a strong alliance. Aside from the lack of involvement from foreign stakeholders and domestic customers, operations and competitors, the central government was not overly supportive of this standard. The latter is exemplified by the lack of senior official support at the official announcement of WAPI by eight authorities. BWIPS failed to get support from both industries and central government leadership.

In 2006 the SAC submitted WAPI to ISO. However, during an ISO fast track ballot, the WAPI standard received eight votes and the IEEE 802.11i standard received 24 votes resulting in IEEE 802.11i becoming a global standard. Yet, the Chinese government actively continued to promote WAPI through other channels. For instance, in 2007, the MII asked Intel to support WAPI. Again, without strong domestic support for the standard, China has a weak international position. In Figure 2 we present a graphical overview of the route that WAPI has travelled. In Table 3 we present an overview of the main governmental stakeholders.

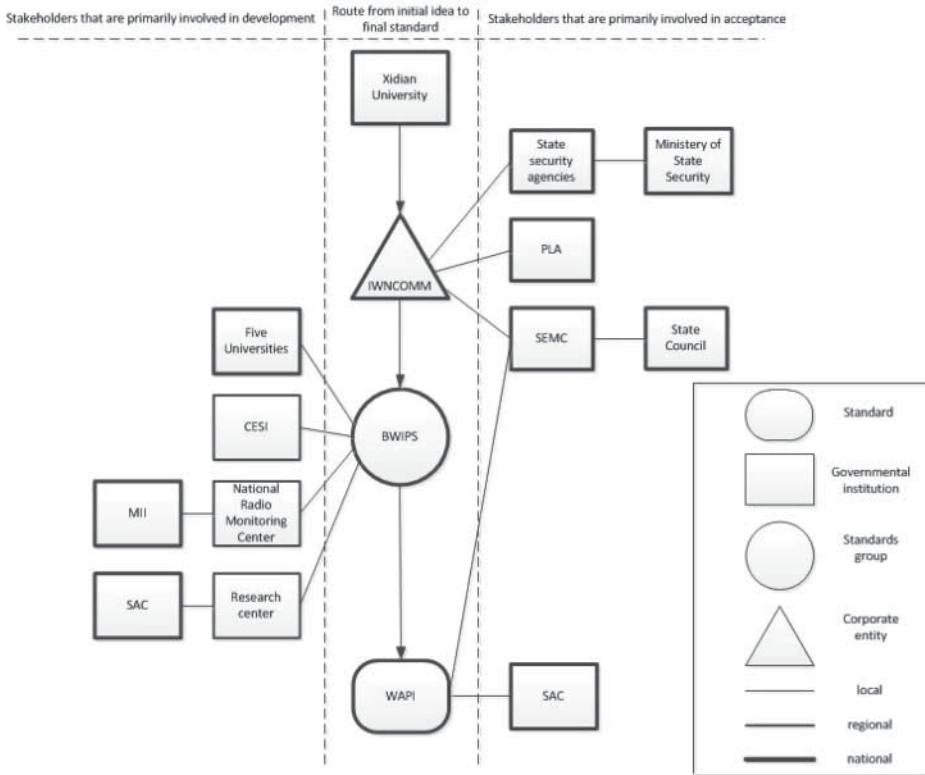


Figure 2. Standardisation route: WAPI.

Table 3. Governmental stakeholders in WAPI standardisation.

Governmental stakeholder	Governmental level	Standards supported
Five universities	National	WAPI
CESI	Sector	WAPI
NRMC	Sector	WAPI
Research centre	Sector	WAPI
SAC	National	WAPI
SSAs	National	WAPI
PLA	National	WAPI
SC	National	WAPI
SEMC	National	WAPI
MSS	National	WAPI
MD	National	WAPI
MII	National	WAPI
MC	National	WIFI
MOST	National	WIFI

So, it can be concluded that WAPI lost the battle, because stakeholder interests within the government were not aligned. The SEMC, MD and the MII were strong adherents to WAPI, but the MC and the MOST were not. If the government had concertedly made efforts to push WAPI

(keeping within the WTO regulatory framework), WAPI might have had a higher chance of being accepted in China's industries. Similar to the EVD case, market forces now have pushed out WAPI in favour of the international IEEE standard for wireless data encryption. Also, certainly, the fact that the SEMC had access to the encryption codes of WAPI made firms reluctant to adopt WAPI. This is a typical example of a China specific aspect that negatively influences the chances that indigenous standards achieve dominance.

5. Cross-case analysis

Summarising, whereas the initiative and technical development of a new standard in China was managed and coordinated by the government up until the official selection of EVD and WAPI, strategic manoeuvring and market forces come into play during the diffusion phase in which the control of the government is low. Several interesting insights emerge when comparing the two cases.

First, the role of the local government in the EVD case was substantial and clearly illustrates the limited reach of the central government. This finding is in line with other studies on governmental decentralisation, such as Zheng (2007), and provides a new insight in the standardisation literature: the government does not act as one but in order to understand the involvement we need to identify at national, sector and local level the key stakeholders and their influence. In particular, the local government's interest is often aligned with local economic actors. Thus, *vertical government inconsistencies* exist as a result of competing interests. Second, the WAPI case suggests the inconsistencies within the national government institutions. Not so much as a result of local government efforts but the lack of aligned interests in competing ministries resulted in lower chances of being diffused in large industries. Here we can speak of *horizontal government inconsistencies* as a result of competing sector interests. Third, in both cases, market forces played an important role in influencing the acceptance of the standards; going beyond the reach of the government.

Lastly, note from Figures 1 and 2 that in certain phases of the standardisation process certain government stakeholders play a key role. For instance, the SETC only plays a role in the acceptance of EVD. However, in the EVD case, one institution (MII) is involved in both standard development and acceptance. This institution appears to be especially involved in the standardisation process as it is the only institution that is involved in both EVD and WAPI. Furthermore, the two cases suggest that not all stakeholders that we identified play a role in all standardisation processes. For instance, in the WAPI case we see a role for the SAC in the development and acceptance of the WAPI standard but we see no such role for the SAC in the EVD case.

6. Conclusion

An endogenous standard was developed in China to compete with an already existing global standard. Reasons for this are the ambition to be decreasingly dependent on foreign technology, the presence of a largely untapped domestic market and other strategic reasons. A strong government hand can and did push the development and acceptance of a domestic standard. However, the government was not able to push the standard into widespread diffusion.

From the cases we find evidence for the conditions that the government has difficulties in pushing a standard because there are competing levels of government (vertical inconsistencies and misaligned interests) and sectoral competition between different national institutions (horizontal

inconsistencies and misaligned interests). The first condition – decentralisation of government – found support in the EVD case. Local authorities supported another standard than EVD further weakening the position of EVD. The second condition finds support in the WAPI case. In this case it appeared that the ministries were not aligned, as the SEMC, MD and the MII strongly supported WAPI whereas the MC and the MST did not. So, although in the literature the government is seen as one large monolithic entity, in fact we show that it comprises various levels of government which play diverging roles in different stages of the standardisation process.

That leaves us with the interesting conclusion that China's relatively controlled socialist market economy is suffering from an inconsistent and fragmented government system, which is referred to in the literature as *fragmented authoritarianism* (Lieberthal and Oksenberg 1988), which obscures the standardisation process. We propose that *China's government is strong in initiating, developing and accepting endogenous standards but relatively weak in pushing the standard into widespread diffusion because of conflicting interests within and between different layers of the institutional framework.*

As most other studies this study is subject to limitations. We studied two battles that have already finished and considering the fact that the conditions in China – institutional, economic and industrial – are quickly changing, we cannot predict how the role of the government in the future will be or change. Nevertheless, we have opened-up the discussion of the government in China and how the government is composed of decentralised and fragmented players. The latter is unlikely to change radically because institutional mechanisms – such as the governance and behaviour of the government – are path dependent and only change incrementally. Empirical evidence suggests that the economic and social conditions in China are changing quickly but that it is unlikely that the government system will be significantly different in the near future (Tsai 2007; Dickson 2008). Second, we only looked at two cases and the generalisability of findings from a small sample is debatable. Nevertheless, the purpose of the paper is theory building rather than testing hypothesis and we believe our chosen approach makes our study more valid but at the same time less reliable. Future research should study more recent standards battles in China, such as 4G, to verify our ideas. In these studies attention should be paid to the possible positive effects of the 12th Five Year Plan, which emphasises the development of indigenous innovation and the MLP ('National medium- and long-term plan for the development of science and technology (2006–2020)'), which is a detailed plan focusing on innovation and creating framework conditions for technological development, including standardisation. These policy initiatives are focused on enhancing the situation for Chinese standards setting and therefore we expect that standards battles in later periods (i.e. after our two cases) will show a more favourable position for Chinese indigenous standards.

Practical implications of this study are that companies with a presence in China should be on guard and ready to thoroughly examine the world behind Chinese standards. 'On guard' because chances are high that in industries in which China either wants to develop itself, or has captured a strong position there will be a scrimmage for dominance. 'Ready to examine' because China is at least a different arena which makes it a different battle and at most since China might be more complex because of its developmental nature.

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