Education on standardization as an input to research on standardization: a success story

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Abstract
At the faculty of Technology, Policy and Management, Delft University of Technology, The Netherlands, education about standardization focuses on market based standardization and particularly on factors for standards battles. We have developed a general (award winning) course on technology and strategy in the first year of the M.Sc. Management of Technology and we have developed a specific course on standards battles in the specialization stage of the master program that builds upon and extends the knowledge taught in the general course. We provide students with a detailed understanding of the specifics of market based standardization.

An important part of the course on technology and strategy focuses on identifying the reasons why most industries adopt a dominant standard and why a particular firms’ technology is adopted as the dominant standard. Furthermore, different factors that affect the outcome of technology battles are examined. At the end of the first year of the M.Sc. Management of Technology, students will choose a specialization. Students that choose to specialize in innovation management will follow the basic course on standards battles, technology patterns and business ecosystems. In this course, students study how the network of stakeholders supporting the competing standards changes over time during the technology life cycle and how this impacts dominance of the competing standards.

What makes education on standardization at Delft University of Technology so innovative? First, in our courses we apply state of the art research on standardization and we constantly update the teaching material. So our education is strongly research driven. Second, our education results in novel input for research through empirical material gathered in the courses and in the master theses.

In this paper we will explain each course in detail providing information on course objectives, format, organization, and grading. We will provide students evaluations where possible. We will conclude with a discussion on how education on standardization provides valuable input to our research.

Introduction
Table 1 provides an overview of the basic characteristics of each course.

<table>
<thead>
<tr>
<th>MOT1433: Technology and Strategy</th>
<th>MOT9592: Standards battles, Technology Patterns, Business ecosystems</th>
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</thead>
<tbody>
<tr>
<td>Coordinating teacher</td>
<td>Geerten van de Kaa</td>
</tr>
<tr>
<td>Other involved teachers</td>
<td>Cees van Beers, Erik den Hartigh, Roland Ortt</td>
</tr>
<tr>
<td>Program</td>
<td>M.Sc. Management of Technology</td>
</tr>
<tr>
<td>Stage</td>
<td>1st year</td>
</tr>
<tr>
<td>Study load</td>
<td>6 ECTS</td>
</tr>
<tr>
<td># students</td>
<td>+/- 75</td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
</tr>
</tbody>
</table>

Table 1: general characteristics of the courses on standardization

In the remainder of this paper we will explain each course in detail providing information on course objectives, format, organization, and grading. We will provide students evaluations where possible. We will conclude with a discussion on how education on standardization provides valuable input to our research.

Education on standardization

Technology and Strategy
Course objectives relating to the standardization part of the course ‘technology and strategy’ include:

- Identify differences in the types of innovation and the general patterns that characterize technology improvement trajectories and technology diffusion rates (including s-curves and technological discontinuities).
- To increase students’ understanding of why a dominant standard emerges and why it is not always the most technological superior standard that becomes dominant.
- To identify the primary sources of increasing returns and network externalities.
- Familiarize students with the key factors affecting standard dominance including timing, licensing and compatibility, pricing, distribution, and marketing.

The course is organized into 6 regular sessions, 6 teaching case sessions and 1 game session. Each regular session consists of interactive lectures. In the teaching case sessions students present and discuss posed questions. The course sessions are based on empirical material gathered in the courses and in the master theses.

In this paper we will explain each course in detail providing information on course objectives, format, organization, and grading. We will provide students evaluations where possible. We will conclude with a discussion on how education on standardization provides valuable input to our research on standardization.

1 The European Credit Transfer and accumulation System (ECTS) is a standard for comparing study load for courses across the European Union. 1 ECTS equals 28 hours.
battle between bluray and HD-DVD and the battles fought in different generations of the gaming console industry. Students are expected to analyze these battles and discuss questions posed in the teaching cases. As such they apply the theory to different practical situations.

For the regular sessions students study the literature and for the teaching case sessions students prepare the teaching cases in an assignment. When a teaching case is presented all groups participate in a class-wide discussion. For each teaching case, one group is assigned as a discussant group and prepares several discussion topics and initiates these topics in class. In class, the teacher introduces additional questions about the case. Other students are also invited to introduce their additional questions. Through class discussion students further deepen their understanding of the topics and themes of the regular session.

In one session, we play the “Back bay battery” game. This simulation is designed to bridge theories in innovation and the impact of an emerging, disruptive technology (standard) to the real-world context in which managers must make decisions about investing in innovative technologies (standards) under conditions of uncertainty. The simulation presents the student with the challenges associated with making investment choices in both mature and emerging technologies under uncertain—and highly constraining—real-world conditions. After the session the game is open to students until the exam takes place and for 5 additional runs. The 10 students with the highest score at the end of this period will earn one extra point for the exam. This provides the students with an extra incentive to play the game and apply the theories covered in the course.

We distinguish between two grading components: (1) The unweighted average of the grades for the teaching case, presentation, plus discussion in class, which counts for 20% of the end grade, and (2) Written individual exam: a closed book exam with open questions, which counts for 80% of the end grade, and (2) Open questions, which counts for 20% of the end grade, and (2) Written individual exam: a closed book exam with open questions, which counts for 80% of the end grade.

In total, 168 hours are spend on the course. This includes 4 hours/week lectures = total 28 hours (1 ECTS), 8 hours/week preparing lectures = total 53 hours (2ECTS), 28 hours preparing teaching cases (1ECTS), and finally, 53 hours preparing exam, teaching game, plus 3 hours exam (2ECTS)

Standards Battles, Technology Patterns and Business Ecosystems

The main course objective that we have specified for the course ‘Standards Battles, Technology Patterns and Business Ecosystems’ is:

- After the course students are able to understand the theoretical background of standards battles, technology patterns, and business ecosystems and the relations between these topics.

The course is organized into 6 regular session of 4 hours and one closing session. Each of the regular sessions consists of a mixture of lecturing and discussions. For each session students study the literature. Through class discussions students further deepen their understanding of the topics and themes of the class.

The course starts with presenting a framework of different factors for standard dominance which is a result of research carried out by the author (Van de Kaa et al., 2011). To increase understanding of the factors for standard dominance, students apply the framework to different standards battles in class (e.g. Gallagher et al., 2002; Schilling, 2003; Shapiro et al., 1999). In subsequent lectures the technology life cycle is presented and different papers are discussed that focus on how factors for standard dominance may change in different stages of the technology life cycle (e.g. Suarez, 2004). Finally, in the last two lectures, students get acquainted with the literature on inter-organizational networks. Students analyze different papers that study the impact of inter-organizational networks on standard dominance (e.g. Leiponen, 2008).

Every student has to complete an assignment. In the assignment the students are asked to analyze a standards battle in depth. In the first session they can choose for a standards battle. The assignment consists of three parts: (1) Standards battles, (2) Business Ecosystems, and (3) Technology Patterns. For the first part students have to analyze a standards battle. The end result is a document in which student present a case description and a case analysis. The case description consists of a historical overview of the standards battle. The case analysis consists of a text in which the student analyzes the battle and determine why the (dominant) standard has achieved dominance. To arrive at a case description and analysis students begin with analyzing the existing literature that reports on the standards battle (some standards battles such as the battle for a VCR standard have been studied numerous times). From this initial analysis students will arrive at a table in which for every factor and for every publication, they will indicate whether the factor was mentioned in the publication. Maybe the literature on the standards
battle does not mention all factors found in the literature. This can mean that these factors did not apply to the case or that addition of one or more of these factors could provide a better explanation of the case. Therefore, additional research should show to what extent these factors actually have played a role in the battle. Hence, the student conducts a secondary data analysis in the form of reports, practitioners literature, external databases, etc. and the write a preliminary version of the case description and analysis. At this stage the student has to carry out additional interviews with practitioners to fully reconstruct the case. A pre-defined questionnaire is used when carrying out interviews. The interviews are transcribed and attached as an appendix. Quotes can be used to back up claims made in the report. In the analysis of the standards battle students are asked to link all of their observations back to the literature (so a particular event that leads to dominance of one particular standard should not just be mentioned but also be explained by making use of the appropriate literature).

In the second part of the assignment students should give an answer to the primary question: “What is the pattern of development and diffusion for the product in which the standard is implemented?” First, the student should begin with providing a clear definition of the product / technology. Second, students should provide a historical overview of the main events in the life cycle of the product. This results in a technology life cycle for the product in which the standard is implemented.

In the final part of the assignment, students should analyse the interorganizational network of actors developing and promoting each standard in every stage of the technology life cycle. Finally, students should give an answer to the primary question: how the network of stakeholders supporting the competing standards changes over time during the technology life cycle and how this impacts dominance of the competing standards.

We ask students to be particularly critical towards theory (theory can be right, but can also be not applicable to their problem) and towards data (data can be more or less reliable, depending on the source). Students make the assignment in the form of a paper. There is an up-front limitation in numbers of words. Students are encouraged to make the paper as short, compact and clear as possible. It is graded on the quality or the argumentation, the structuring of the document and the arguments, theory based reasoning, fact (data) based reasoning, compactness (too long stories will be graded lower), clarity of argumentation, and general understanding of the topic.

Discussion: how education on standardization may lead to research on standardization

The assignment which is part of the course ‘Standards Battles, Technology Patterns and Business Ecosystems’ results in a report that follows a pre-defined template set up by the teachers. This makes it possible to analyze and compare the empirical data that the students have gathered. Eventually, good reports have been used as empirical data in our research. For example, two students have gathered data on the case of HD DVD versus Blu-ray and Windows versus Mac PC operating systems. We have used that data as empirical data in a paper in which we track the changes in structure and composition of business networks supporting these technologies in the different phases of the technology life cycle. In the paper we suggest that strategic decisions of firms were key to winning and losing these battles and should therefore not be overlooked. The paper has been presented at several conferences and published as a book chapter (den Hartigh et al., 2011). The paper is a typical example of how education about standardization can lead to insights for research on standardization.

Students that have written excellent reports and that want to deepen their knowledge of standards battles can choose to write a master’s thesis on the topic of the course applying the empirical data gathered in the course. To date, three students that have participated in the course ‘Standards Battles, Technology Patterns and Business Ecosystems’ have chosen to write a master thesis on the topic of standards battles. For example, one student is currently finishing his master thesis on the topic of ‘re-evaluating the class video standards battle’. The classical battle between VHS (as supported by JVC), Betamax (supported by Sony) and V2000 (Philips and others) is a well documented battle (Bartlett et al., 1988; Cottrell et al., 2001; Cusumano et al., 1992; Dai, 1996; Economides, 1996; Grundley, 1995; Johne, 1994; Klopfenstein, 1989; Ohashi, 2002; Puffert, 1999; Roome, 2006) about the emergence of a dominant standard in the VCR market in the 1970s and 1980s. Although at that time Betamax was widely recognized as superior compared to VHS, the latter standard eventually won the standards battle. In this research project the objective is to re-evaluate this battle using a framework for standard dominance (Van de Kaa et al., 2011) that is more complete compared to existing frameworks suggested in the literature (Lee et al., 1995; Schilling, 1998; Suarez, 2004). Second objective is to test the framework: does it provide a better ‘toolbox’ to analyze standards battles than other models / literature do? The project started with an extensive literature search.
study in which the different papers that have studied the standards battle were analysed. It was investigated whether the factors mentioned in the framework played a role in this battle and if so how they affected the outcome of the battle. Maybe the literature on the VCR battle did not mention all factors found by Van de Kaa et al. (2011). This can mean that these factors did not apply to the case or that addition of one or more of these factors could provide a better explanation of the case. Therefore, additional research should show to what extent these factors actually have played a role in the battle. This has been done by interviewing both academics who studied the case and practitioners who were involved in the case. In interviews with key authors about the case, the factors mentioned in the framework have been discussed and it was assessed whether the author came to new insights in the case after applying the model. The research carried out by the student will result in a paper or material for a paper.

Other examples include a student that has graduated in 2011 on the topic of ‘Interrelation of Factors for Standard Dominance in Standard Battles in the consumer electronics and IT industries’ and a student that has graduated in 2011 (with an 8) on the topic of ‘Factors influencing photovoltaic adoption and selection’. The latter thesis has been written in the form of a paper and is currently under preparation for an ISI rated journal.

Conclusion

So what makes education on standardization at Delft University of Technology so distinctive? First, in our courses we apply state of the art research on standardization (Cusumano, 2011; Gallagher, 2012; Millar et al., 2010; Soh, 2010; Van de Kaa et al., 2011) and we constantly update our teaching material. So our education is very much research driven. Second, our education results in novel input for research through empirical material gathered in the courses and in the master theses. Finally, the fact that we use a diverse amount of teaching methods including interactive lectures, teaching cases, and a teaching game results in the fact that students apply the knowledge in different ways greatly contributing to their understanding of the specifics of market based standardization.

The course ‘Technology and Strategy’ is evaluated good by students (see table 2).

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Student evaluation</th>
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<tbody>
<tr>
<td>Usefulness</td>
<td>Good</td>
</tr>
<tr>
<td>Connection to prior knowledge</td>
<td>Good</td>
</tr>
<tr>
<td>Level</td>
<td>Excellent</td>
</tr>
<tr>
<td>Teaching method</td>
<td>Good</td>
</tr>
<tr>
<td>Teaching</td>
<td>Good</td>
</tr>
<tr>
<td>Study material</td>
<td>Satisfactory/good</td>
</tr>
<tr>
<td>Organization</td>
<td>Good</td>
</tr>
</tbody>
</table>

Table 2: student evaluations Technology and Strategy 2010-2011, 78 students enrolled of which 58 participated in the evaluation.

The course ‘Technology and Strategy’ also received a teaching award. This award is based upon the student evaluations for the course during the period of 2010-2011. 78 students enrolled of which 58 participated in the evaluation. Due to the small amount of students involved quantitative evidence is not available for the course ‘Standards Battles, Technology Patterns and Business Ecosystems’

The overriding intent of the courses that we provide at Delft University of Technology is to help students, as engineers, become savvier players and better prepare them for a successful business career in the area of standardization. Students can become standardization strategists in large companies such as Philips or they can apply their knowledge at consulting agencies or standard development organizations.

References


