

The recently chosen digital video standard : playing the game within the game

Citation for published version (APA):

Lint, L. J. O., & Pennings, H. P. G. (2000). The recently chosen digital video standard : playing the game within the game. (ECIS working paper series; Vol. 200002). Eindhoven: Eindhoven Centre for Innovation Studies.

Document status and date:

Published: 01/01/2000

Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
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- The final published version features the final layout of the paper including the volume, issue and page numbers.

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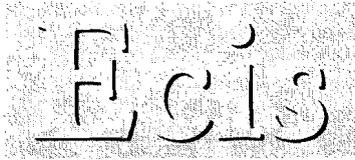
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Eindhoven Centre for Innovation Studies, The Netherlands

Working Paper 00.02

**THE RECENTLY CHOSEN DIGITAL VIDEO STANDARD: PLAYING THE
GAME WITHIN THE GAME ***

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February 2000

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[Acknowledgement]

*This research is supported by the Netherlands Technology Foundation (STW) in the Netherlands.

Abstract

In the recent process leading to the agreement on the digital versatile disc two product standards have been developed: one by Philips and Sony, and the other by Toshiba and Time Warner. Three actions in the process of standardization have startled business analysts. First, Matsushita's choice to support the Toshiba-Time Warner standard. Second, Sony's statement to unconditionally market the standard developed with Philips. Third, the unexpected agreement between parties on a uniform standard. We show that these moves in the game concerning the digital video standard should be viewed as a game within a larger game. The larger game encompasses the players' interest beyond the digital technology. We develop and apply a straightforward managerial framework for product standardization games that supports managers looking beyond the small game.

Problem identification

Academics and practitioners alike have studied the phenomenon of first-mover or pioneer advantages. Academics in terms of abnormal economic returns, practitioners in terms of managerial tactics and time-to-market performance. The so-called PIMS-studies (Profit-Impact-of-Market-Strategy) are often cited as empirical evidence that advantages from first-movership exist. In spite of this rich database, the commonly acclaimed first-mover advantages and superior market share performance must be interpreted with care. There is still a lack of strong evidence that pioneering advantages are explicit and result from order of entry solely (Tellis and Golder, 1996). Unless firms have the required competencies to exploit first-mover opportunities offered by a pioneering position, being first to market will not bring about a sustainable competitive advantage.

Firms with superior R&D competencies may pioneer. If successful, they may be able to set a generally accepted technology or dominant product standard and license the results of R&D efforts. On the contrary, firms with excellent marketing and manufacturing skills may prefer to keep options open. These firms will benefit from executing keen marketing and low-cost manufacturing plans in conjunction with investments in advertising and high-volume production. As fast followers, they take a

wait-and-see position and may exploit marketing mistakes from the pioneer (Carpenter and Nakamoto, 1990, and Schnaars, 1986).

The notion of postponing market introductions and the perception that entry strategies are dynamic and interrelated to competitive actions, draw attention to the productive field of game theory. Although this theory in the form of applied mathematics has well developed, it has just recently been introduced to change the game of business. Brandenburger and Nalebuff [1995] present a practical setting for changing game situations in business, based upon a systematic analysis of the crucial elements in a business game: players, added values, rules, tactics, and scope. Ghemawat [1997] applies game theory to understanding management strategy based upon business cases.

The purpose of our contribution is twofold. We present a game theoretic perspective to a significant strategic issue, the conduct of a standardization battle. The issue in question is the pioneering of digital video, a recent topical concern for the consumer electronics industry. We aim at an accurate description of the battle and a demonstration of the practical use of game theory in business. The key insight of this paper is the notion that the current standardization game is a game within a game. The counterintuitive actions of the players within this game can be rationalized by considering the interest of the players beyond the immediate payoff from the new digital standard. In particular Matsushita's interest in the larger game (i.e. enduring its leadership in the video market) explains why it took so long before a general agreement was reached.

This paper is organized as follows. We start with a recapitulation of the lessons learned from the battle over the analog video standard, where Matsushita reaped the benefits of the emerging mass-market. Meanwhile, initiators such as Sony and Philips were left behind with technologically superior systems. Furthermore, we describe characteristic events preceding the agreement on a final standard for digital video, with a clear identification of actions that appear to be counter-intuitive. Consequently, we analyze these steps ex-post by means of original proprietary research utilizing a straightforward application of a game-based perspective. Since the public data we use

were known prior to the final agreement, the framework can also support managers in making ex ante predictions of standardization outcomes.

The analog video standard

The battle over the analog video standard that started at the end of the seventies shows that a technological superior product does not automatically become the final product standard. Though Philips' V2000 was technologically superior to Sony's Betamax, and this system in turn dominated JVC's¹ Video Home System (VHS) from a technological perspective, the latter has become the final product standard. In spite of being the first with a system for the mass-market, Sony could not fully benefit from its first mover advantages, such as technological leadership and the definition of product standards. The successful lobby of Matsushita, parent of JVC, at other electronic giants, like AKAI and Hitachi, for the VHS-system by supporting them with production and marketing resulted in the backing of film industries and a globally accepted standard. As soon as software industry uniformly chooses between the available standards, the battle is ended. Subsequently, negotiations about royalties will be milked out by the developer of the uniformly backed standard with companies willing to take licences on the standard. These royalties will be rather insignificant at the early stages of the product-life cycle, but significantly contribute to company profits at later stages. The exact amount of royalties that Matsushita yearly earns for the VHS-standard is unknown, but will be important for Matsushita since the annual turnover in the total video market exceeds 50 billion Dollars².

The total benefits of Matsushita's keen follower strategy are substantial. In their well-documented contribution, Rosenbloom and Cusumano [1987] estimate that already in the early eighties revenues for Sony and JVC in the videomarket duplicated within five years, but for Matsushita revenues quadruplicated from \$800m (1980) to \$3,000m (1985). Matsushita waited for the optimal exercise moment of its strategic option and when it took its chance, it benefited from two decades of substantial technical progress, largely achieved by major competitive pioneers.

This raises the question how well the experience gained from the contest for the analog video standard has been internalized by Matsushita's competitors. We will answer this question by taking a look at public events that preceded the agreement on a uniform standard for digital video. A chronology of events will be presented, highlighting counter-intuitive actions from the contestants.

The competition for the digital video standard

The battle over the digital video standard matured with the following steps³. In September 1994, Philips Interactive Media Systems, announces that Philips, Sony and Matsushita -at that time still a partner in the consortium- will soon proclaim specifications of the newly developed digital video disc. In December a worldwide standard will be announced and in 1996 the first players will be ready for the consumer market. Philips also states that former time-tables, suggesting market introduction in 1995, are beyond reality.

At the end of 1994 Philips and Sony announce the Multimedia Compact Disc (MMCD) in order to meet the demand for increasing information density of future multimedia applications. The new CD can be seen as an amalgamation between the current CD for PC-applications (CD-ROM), the audio-CD and the CD for video and interactive functions (CD-I). The current CD capacity is only 650 Mb and inapt for next generations of digital video. The proposed MMCD with a single layer is able to contain 3.7 Gb information, which, using today's compression techniques, is equivalent to 135 minutes of digital video.

At the same time, however, Toshiba and Time Warner are jointly developing an alternative standard, the Super Density Disc (SD). The SD uses both sides of the disc and has a total information capacity of 9 Gb. Despite its incompatibility with existing CDs the SD gains growing interest of competing consumer electronics companies and film industries. The increased density enables longer films (e.g. 'Gone with the Wind'), different languages and interactive endings. The increased density offers also the opportunity to combine two films on one disc, for instance an A-movie in combination

with a B-movie. With these arguments Hollywood is successfully approached by a high level ad-hoc advisory group. Toshiba and Time Warner also get consumer electronics companies on their side with a so-called open licensing approach. Pioneer, Thomson Consumer Electronics and Hitachi subsequently back the SD standard.

An adequate response to the criticism with regard to MMCD capacity is Philips' and Sony's cooperation with 3M in developing a technique which enables reading multiple layers on one side of the disc. Each layer can be read by laser beams with different amplitudes. This way, the total information capacity can be increased to 7.4GB without changing discs. Now that the last disadvantage of MMCD with respect to SD is eliminated, the way is open to leapfrog the Toshiba-Time Warner position.

In January 1995 however, Matsushita surprisingly announces to back the standard by Toshiba and Time Warner. On the opposite, a number of CD-ROM producers, like TEAC and ACER, subsequently choose to back the Philips-Sony standard. This choice is not surprising since Philips has already at the outset chosen for CD-ROM applications of MMCD. However, the support of these companies does not tilt the balance in favor of Philips and Sony as there are still important indecisive companies like Disney. One month later Sony announces to proceed unconditionally with preparing the market launch of MMCD.

Subsequently, MMCD with a double layer is successfully presented at the CD world conference in San Francisco. The transition from the upper layer to the lower layer occurs seamlessly and the picture quality is excellent. At the same time, however, Matsushita announces to develop its own standard while still backing the SD. Moreover, JVC, an independent subsidiary of Matsushita, decides to back the Philips-Sony standard.

Finally in Fall 1995 Philips announces at the time of the Funkausstellung at Berlin, that after negotiations a uniform standard has been settled with Toshiba. As a result of this agreement, "digital video products will still be launched in 1996". Details on the agreement are not published, but Toshiba states in the press that Philips has made substantial concessions and claims victory.

A deja-vu

In accordance with this brief history, a few general observations can be made. The longer playing time of the SD and the role of the film industry provide interesting parallels with the battle over the analog video standard. There was one hour playing time on the Betamax system while VHS a little later created the possibility of two hours playing time and hence won a lot of confidence from parties involved. After all, the standard length of a movie requires at least one and a half hour playing time. Matsushita's seminal approach of software industry created a jumping board for its successful market launch of analog video. One might speculate that Toshiba, not a key player in consumer electronics and easily overlooked by a sketchy competitive analysis, copied Matsushita's successful strategy to influence software industry in order to create momentum for its own product standard. Since SD is a substitute product, Toshiba has the disadvantage that the time to cover the extensive R&D costs is much longer compared to a complementary product like MMCD. Therefore, Toshiba is expected to have a major interest in a rapid commercialization.

Like Toshiba, Philips has a disproportionate interest in a fast market introduction of MMCD in order to cover development costs as soon as possible. MMCD fits well in a tradition of breakthrough inventions from its renowned research laboratories, starting with the compact audio cassette tape in 1967. Since there were no rival formats, the compact audio cassette became a major market success. Subsequently, the battle over the standardization of video tape, another classic innovation, ended unsuccessfully for Philips in the eighties with its V2000 system. However, the timely cooperation on CD with Sony offered again a unique thriving format and a prosperous market introduction. Given the R&D-driven background of Philips and the marketing merits from co-developing CD, a fortunate successor of CD will therefore be of utmost importance. Moreover, and opposite to Matsushita, introducing MMCD has minor cannibalizing effects on existing product-market combinations of Philips, since it holds a relatively small stake in analog video.

The Games

We perceive Matsushita and Sony as expressing irrational behavior in the digital video contest (the 'small' game), but rationally focussing on their total interests in the consumer electronics market (the 'large' game). One would expect Matsushita in the small game to support the MMCD since a uniform standard creates a new mass market. As a major player in consumer electronics Matsushita could enforce a favorable license upon Philips and Sony. Moreover, Matsushita could benefit from its strong marketing and manufacturing skills, just like the company did when adopting VHS. After all, even in the current CD market Matsushita holds a profitable stake without an important patent position.

However, Matsushita decides to back the smaller player. This apparently irrational strategy can only be understood from a large game perspective. Though supporting MMCD would certainly maximize the net *present* value in the digital video game, it is not the value maximizing strategy in the large game. Matsushita maximizes its *total* value in the consumer electronics market by playing three smart cards in the small game. First, by backing Toshiba it postpones a uniform digital standard and sustains its leading role in analog video, a cash cow for Matsushita. Second, delay provides Matsushita with time to develop an own standard independent of MMCD and SD. Third, JVC, an independent subsidiary of Matsushita, decides to back the Philips-Sony standard. Despite the autonomy of decentralized subsidiaries, it is reasonable to assume an intensive communication with Matsushita because of the impact of such a decision. The backing of MMCD by JVC induces a wait-and-see strategy for Matsushita. Matsushita keeps both standardization options open and protects its dominant position in VHS, regardless of the outcome of the small game.

Contrary to Matsushita, Philips and Toshiba have a relatively small interest in the analog video market. For both companies playing the small game coincides with playing the large game. Maximizing the net present value in the digital video contest induces a value maximizing strategy in the consumer electronics market. If a uniform standard is agreed upon, a new mass market in consumer electronics emerges. However, if delay

occurs, both Philips and Toshiba forego cash flows from the emerging digital video market on the short run. In the spirit of "better having a market than a mill", we demonstrate in the analytical section that it would therefore be beneficial for Philips to give up the MMCD standard when Matsushita would persist in backing SD.

Since Matsushita supports SD and Philips could give up MMCD, one would not expect that Sony unconditionally persists in market launching MMCD. Again, this seemingly irrational behavior in the small game can only be understood by considering the large game. Though giving up MMCD would maximize the net present value in the digital video game, it is not the value maximizing strategy in the large game. Sony maximizes its total value in the consumer electronics market by prolonging their position in the analog video market, in particular the Camcorder, a cash cow for Sony.

In the next section, we create a game-based perspective by introducing game theory as a managerial tool for the analysis of the behavior of the involved companies. Consequently, we amalgamate the qualitative observations so far with a quantitative analysis by means of calculating pay-offs.

Game theory

Before discussing the relevant setting, we will first give a background of game theory that helps to understand the concepts that will be used. Game theory can play an important role in strategy formulation by management, since strategies of competitors are viewed from a dynamic perspective. As yet, managers often do not regard the strategy of competitors as flexible, dynamic and contingent on their own strategy.

Game theory is based on the idea that acting rationally by all involved parties may lead to a suboptimal outcome. A *game* is a formal representation of a situation in which a number of players interact in a setting of strategic interdependence. To describe a situation of strategic interaction, we need to know the players involved, the rules of the game, the outcomes for each possible set of actions and the pay-offs. The rules of the game capture who moves when, what actions each player can take and what players

know when they move. The most famous game in this context is the prisoner's dilemma. In this game two suspects have the choice between confessing a crime or remaining silent. When both confess, they will get a mild punishment. When both remain silent, they will get a severe punishment. When one suspect remains silent while the other confesses, the latter will get capital punishment, while the first will be acquitted of the offence. A dominant strategy for the individual suspects is to remain silent, but this leads to a severe punishment for both. The joint dominant strategy, when communication between the suspects is allowed, is to confess, as this leads to a better result for each suspect in terms of a mild punishment.

When a certain strategy provides an improved result compared to another strategy for at least one player, while it does not worsen the position of other players, the strategy is Pareto-superior to the other strategy. When there is no strategy Pareto-superior to other strategies, the strategy is called Pareto-efficient. In the case of the prisoner's dilemma, a Pareto-efficient strategy can only be achieved by communication between the suspects.

The key issue in game theory is of course the prediction of optimal strategies in any specific game situation. An important contribution to solving this issue has been made by Nash [1951] by defining the so-called Nash-equilibrium. In a Nash equilibrium, no player has an incentive to deviate from his strategy given that the other players do not deviate.

Setting up an appropriate game perspective is complex, but essential for a solid analysis. Throughout this article, we will consider the competition for a global multimedia standard as a static game, which means that there is just one round to play. This assumption may hold, since the issue for the players is whether to persist in development of the own standard or to abandon the own standard and switch to the competing standard. The pay-offs that are required for a game theoretic analysis of the standardization game will be elucidated with estimates of cash flows. Under conditions of perfect information the player is able to observe all his rival's previous moves, while

under imperfect information the player does not know what has previously transpired in the game. In the standardization game we assume that players have all relevant information about each other, including the pay-offs that each receives from the various outcomes of the game. Such games are known as games of complete information.

A game-theoretic framework for product standardization

The purpose of this section is to propose a straightforward framework that specifies a minimum set of principal drivers and elements that construct a game-based setting and related optimal actions. The framework helps managers to (1) identify key players, (2) assess the money at stake, (3) determine the optimal strategy and (4) get the most out of the game. The framework is depicted in figure 1.

----- Please insert figure 1 about here -----

The principal drivers are the *competitive position* and *market opportunities*, establishing the over-all specific *game assumptions*. These three factors denote the *game-based perspective* from which *optimal strategies* can be derived. The envisaged optimal strategy may be elaborated quantitatively by means of a *sensitivity analysis and simulation* and qualitatively by a complementary analysis on *competition and cooperation*. The optimal strategy results in the *execution of optimal actions*, and its consequences are used as a *feedback* mechanism to assess and adjust the overall game assumptions as well as to capture learning effects for new game-based situations. Thus the framework can be used for ex-post evaluation as well as ex-ante predictions of competitive game-based strategies.

(1) Identify key players

In order to identify key players, an analysis of the *competitive position* and *market opportunities* of each player is essential. Of special interest are smart players that are not immediately observed as direct contestants, but have a major influential role in the outcome of the game. We list as essential elements for an assessment of the competitive position: the number of competitors, the market shares of the major competitors (industry concentration), core competencies and patent positions. As important elements for evaluating market opportunities we enumerate: the potential, growth and profitability of the anticipated market, expected entry barriers, substitution effects and the estimated diffusion rate of the new standard. We will not discuss all these elements in-depth but refer to general textbooks on marketing and strategy for expository matters.

(2) Assess the money at stake

As represented in figure 1, the *game-based perspective* is the composite effect of the principal drivers: Market Opportunities, Competitive Position and Game Assumptions. Based on an in-depth analysis and assessment of qualitative and quantitative aspects the compound effect on the cash flows can be determined and quantified. A high level of consistency can be accomplished by accurately defined questions and scoring methods to “objectify” and quantify subjective judgements. By discounting the cash flows at the *weighted average cost of capital* the calculation of the *pay-offs* is the final step in constituting the game-based perspective. The pay-offs represent the Net Present Value (NPV) of future earnings.

The money at stake is the maximum improvement when one consortium jumps to a better position. As we will show in our study, when Philips and Sony get out of the prisoners’ dilemma, they improve their payoffs with \$13bn. in total. Of course, the other consortium must be compensated for their worsened payoffs as to harmonize positions. Clearly, in situations where positions cannot be improved, the money at stake is zero.

(3) Determine the optimal strategy

With the pay-offs, the *optimal strategy* is determined. In the case of a Pareto-efficient outcome communication and negotiations will not enhance the players' positions. On the contrary, in the case of a Prisoner's dilemma, the money at stake is used to neutralize impaired payoffs of other players involved. Otherwise, there is no way out. If there is cash left after neutralizing the payoffs in the Prisoner's dilemma, all players' positions can improve. Cooperative and competitive ways to change the game can be considered, looking for win-win opportunities. Sensitivity analysis and simulation, such as Monte Carlo simulation, may be used to gain complementary insights on the quantitative side. The *tactics envisaged* must detail the steps how to win the standardization contest.

(4) Get the most out of the game

The implementation of the optimal strategy will take place by the *execution of optimal actions*. This means changing the game when communication leads to improved payoffs. Essential elements are the timing and sequence of those actions, the plans in relation to the several marketing, financial and R&D aspects and a commitment to financial and human resources. Finally, the outcome of the game serves by means of a *feedback* loop as input for new game situations or, with multiple rounds within the game, as information to adjust the overall game assumptions. The feedback consists of a post-entry evaluation describing the outcomes and recommendations for future game situations. This way, learning and dynamics in the organization sustain growth.

Analysis of the standardization contest

In this section we consider the large game on which each company bases its strategy. We determine the total money at stake for each player and apply the proposed framework. The starting points can be captured by a (2x2) pay-off matrix with four possible scenarios. The players in the consortia can choose between continuing the development

of their own standard or abandoning their preferred standard. Each pay-off shows the NPV in billion Dollars. Three sources contribute to the NPV. First, the cash flows and patent royalties from the VCR market without a new standard. Second, the cash flows and patent royalties from digital video when parties agree on a uniform standard. Third, the expected value of postponement. Examples of calculated pay-offs are summarized in table 1⁴. Pay-offs across all scenarios are represented in tables 2 and 3.

It is beyond our scope to discuss all pay-offs of the matrices in depth. We will limit the discussion to the major lines of thought. Table 2 can be interpreted as follows. Scenario I in which Philips and Sony carry on pushing the MMCD and Matsushita keeps on backing the SD, means a high probability of on-going competition. This scenario is characterized by the ambiguity about the new digital video standard. Software industries will wait and market introduction of digital video is substantially delayed. This is profitable for Matsushita. A direct consequence is that sales of analog video, a cash cow of Matsushita, and royalty incomes prolong. Moreover, Matsushita can utilize the delay of market introduction for the development of an own standard. Thus, by backing the Toshiba standard, Matsushita creates a 'wait-and-see' option to switch to the standard that will eventually succeed. By developing its own standard in the meantime, it can execute an even smarter strategy. Hence, waiting is extremely advantageous for Matsushita and this flexibility value is substantial.

The pay-off for Matsushita in scenario I can be explained as follows. When Matsushita does not establish a delay, a dominating Philips-Sony standard and rapid diffusion are likely. This will be at the expense of analog video sales. Hence, Matsushita's market share dilutes in the total -digital and analog- video market. When Matsushita backs Toshiba, Matsushita's market share does not dilute. Royalty profits of analog video will also continue.

To summarize, Matsushita's payoff from the VCR market without a new standard is \$2.2bn. Second, the cash flows and patent royalties from digital video when parties

agree on a uniform standard are \$0.66bn. Third, the expected value of postponement is \$1.94bn. Therefore, total NPV for Matsushita is \$4.8bn. in scenario I.

Matsushita's pay-off under scenario II consists of the net cash flow that can be earned without supporting SD. This payoff will be considerably smaller than in scenario I. The flexibility value is negligible when Matsushita withdraws backing of the Toshiba-Time Warner standard and thus gives up postponement. The pay-off in this case consists of a cash flow from digital video of only \$4.2bn.

Next, we take a glance at Philips' positions in scenario I and II. In scenario I, an agreement on a worldwide standard is substantially delayed. Therefore, sales of analog video continue. However, Philips holds a minor position in the VHS-market. Moreover, the present value of future income from digital video will be small. The pay-off for Philips in scenario I is \$2.4bn, consisting of \$1.08bn. cash flows from the VCR market without a new standard plus \$1.32bn. cash flows and patent royalties from digital video when parties agree on a uniform standard.

In scenario II where SD loses all ground Philips and Sony will determine the worldwide multimedia standard. Once MMCD is chosen as the final standard, the aggregate turnover in the multimedia market will grow rapidly. Philips is expected to reach a substantial market share as it can benefit from first mover advantages after a rapid withdrawal of Matsushita's support to SD. Hence, the pay-off for Philips in scenario II mounts up to \$9.6bn. of cash flows from digital video.

With the backing of Matsushita and the abandonment of Philips and Sony, Toshiba and Time Warner will determine in scenario III the worldwide multimedia standard. Estimates of pay-offs in this case are based on expected large market shares and royalty earnings in case they win the competition. Scenario IV in which both parties abandon their own standard allows the possibility of jointly developing an alternative new system. The chance of this scenario is negligible because of excess inertia: even when it is rational from an economic point of view to change, the involved players will

be reluctant to change. They will pursue the acceptance of their own standard as discussed previously. The pay-off matrices derived enable us to discuss the counter-intuitive actions by the players in more detail.

Matsushita's choice to back SD

When we consider the different pay-offs in table 2, Matsushita has a dominant strategy to continue the support for SD, since Matsushita's pay-off is highest in the case of persistence, irrespective of Philips' strategy. This directly follows from table 2 as Matsushita has a \$5bn. pay-off in scenario I (persistence) versus a \$4bn. pay-off in scenario II (abandoning). Also, the pay-off when persisting in scenario III exceeds the pay-off when abandoning in scenario IV (\$8bn. against \$6bn.). On the opposite, Philips attains the largest pay-off when the company persists and Matsushita abandons. This happens in scenario II with a \$10bn. pay-off for Philips. Matsushita, however, will not abandon but will keep on supporting SD. Therefore Philips is forced to choose between scenario I (continuing) or scenario III (abandoning). As the pay-off for Philips, when it chooses to withdraw support for MMCD, doubles the pay-off under on-going competition (\$4bn. against \$2bn.), Philips will be inclined to abandon the own standard. So, there is a unique Nash equilibrium in this game.

Sony's sustainment to unconditionally market MMCD

Sony's starting point considerably differs from Philips' as Sony is a market leader in the field of Camcorders. Since MMCD will be read-only in the initial stage of 3 years of the product-life cycle, Sony will in the short term maintain a dominant position in the mature Camcorder market. Also, an important competitive advantage for Sony is its independence of software industries in the Camcorder market. Therefore, Sony has no interest in making concessions and will always choose to continue MMCD. Sony's pay-off under an on-going competition is estimated at \$6bn. This pay-off considerably differs

from Philips' pay-off under scenario I since Sony has a large postponement value. In this scenario, consumers will continue to buy Camcorders, since they are the only available systems for both recording and playing. Sony's pay-offs in all other scenarios, as illustrated in table 3, are also higher than the pay-offs for Philips. Nevertheless, they are only about one billion Dollars higher due to fact that consumers will anticipate recordable digital Camcorders once a uniform digital standard is set. This will rapidly lead to a decline of analog Camcorder sales.

According to table 3, this game has a dominant strategy for Matsushita to continue support for SD and for Sony to persist in MMCD. Although Sony as well as Matsushita will continue to back each preferred standard, the pay-off for both is larger when both abandon and work jointly on a new standard. Table 3 indicates that the strategies in scenario IV are Pareto-superior to the strategies in scenario I since the pay-off for Sony amounts to \$9bn. when abandoning MMCD, compared to a \$6bn. pay-off when continuing MMCD. Equivalently, Matsushita will get a \$6bn. pay-off when abandoning SD while it gets a \$5bn. pay-off when it continues support for SD. This is a typical case of the prisoner's dilemma. Both players will persist in their choice to support the preferred standard though their pay-offs could be improved with communication and cooperation.

Game-over tactics: a sudden agreement between the two consortia

Opposite to Matsushita, introducing MMCD has no cannibalizing effects on existing product-market combinations of Philips. Unlike Matsushita and Sony, Philips has no dominant strategy. Given an on-going competition on which Sony and Matsushita bear down, the only opportunity is negotiating with Toshiba as quickly as possible⁵. From an economic point of view, Philips will start discussing the duration of the competition on standardization, given the pay-offs in table 2. On the contrary, the pay-offs in table 3 indicate that Sony will always persist in setting the MMCD as the ultimate standard. Therefore, Philips is more or less obliged to keep on supporting MMCD, as this standard has been developed in conjunction with Sony and both companies share a history of

successful cooperation in CD technology. Matsushita will, based upon the equilibria of the games in tables 2 and 3, always carry on the support for SD. Therefore, competition will endure and Philips puts at stake substantial future cash flows and Matsushita maintains an important postponement value.

Since Philips has -like Toshiba- a major interest in a fast market launch of MMCD, speed is essential. The only way-out for Philips is to achieve an agreement on a joint standard with Toshiba on a short term in the small game, by means of which Matsushita's possibility to profit from its postponement value is cut off. As presented in table 1, postponement is valued at about \$2bn. for Matsushita. Acting accordingly by Philips, Matsushita's pay-offs in scenario I and III will be eliminated. The result for Philips is that scenario II becomes relevant instead of scenario I and that the pay-off substantially improves from \$2bn. to \$10bn.; see table 2. It implies for Sony that scenario II becomes relevant instead of scenario I and that its pay-off increases from \$6bn. to \$11bn. Though Matsushita is forced in an offside position, the company may, by means of its subsidiary JVC and negotiations, soften the impaired pay-off of \$4bn. (scenario II) instead of \$5bn. (scenario I).

Players' results

Summarizing, the total money at stake is \$13bn. It consists of the improvement for Philips and Sony from the Prisoners' Dilemma to a cooperative situation. However, positions of Matsushita and Toshiba worsen. As previously analyzed in our framework, all players' positions can improve in a Prisoner's dilemma if there is cash left after neutralizing the payoffs. To neutralize positions of all players, Matsushita and Toshiba must be compensated. After compensation, the pie is still big enough to achieve an agreement in which each player gains. The piece of the pie for each player depends on negotiation strengths. Market shares and patent positions are decisive for cutting the pie.

----- Please insert figure 2 about here -----

Figure 2 symbolizes the outset with relatively minor market shares in the analog video market for Philips and Toshiba and major market shares for Sony and Matsushita. Philips, Sony and Toshiba have major stakes in the emerging digital video market resulting from essential patent positions. Matsushita lacks a patent position in digital video, but is market leader in the analog video market. However, the future gains of analog video are conditional on the outcome of the small game. If Philips, Sony and Toshiba agree upon a uniform digital standard in the small game, future earnings of analog video for Matsushita will evaporate. By successfully playing the smart cards in the small game, Matsushita maximizes its total value in the consumer electronics market and creates an optimal starting position for the negotiations. The potential value of analog video for Matsushita in the large game is characterized by dashed lines. Likewise, Sony's potential value of analog video in the large game is illustrated by dashed lines. The bottom part of the figure illustrates the additional values that each player gains *after* negotiations. The negotiations solve the prisoners' dilemma and distribute the money at stake. Matsushita and Sony materialize a large part of the virtual postponement value.

As a final event in the digital video game, Philips announces by Henk Bodt, CEO of the Product Division Consumer Electronics and Executive Vice-President, on September 15, 1995 that after negotiations a uniform standard is agreed upon with Toshiba. The standard will still be launched in 1996, but with a three months delay. Toshiba states in the press that Philips has made substantial concessions and claims victory. These announcements surprise many analysts. We conclude, however, that these statements are consistent with the previous game-based analysis.

Conclusion

Management is confronted with a game within a game when (1) there is minimal one major innovation that creates a new market or substantially affects a current market, (2) at least one innovation involves more than one player, and (3) players have different interests in positioning and timing of each innovation. When confronted, management should not

only clearly identify the current market position of each player in the direct contest (small game), but also study the impact of the outcome of the small game on the total interests of each firm (large game). We observe that using discounted cash flow techniques for calculating payoff in the small game solely leads to suboptimal outcomes in the essential game. When management cannot empathize with the role of players in the large game, strategy analysis is restricted to the small game. As demonstrated in this article, game theory offers management tools able to predict apparently less rational strategies and order-of-entry moves from strong competitors.

Though details about the arrangement that have led to the final digital video standard will probably never become publicly known, all involved players seem to have reached an excellent result by playing the game within the game. Matsushita did well by creating flexibility. Although the competitors' actions deter further postponement, Matsushita has already benefited from establishing an initial delay. Sales of analog video continued to the advantage of Matsushita. Also, the company is indirectly a strong negotiator via its subsidiary JVC and holds a strong position in the Toshiba-Time Warner consortium as a reward for backing their standard. Sony is rewarded for the strategy of being resolute in pursuing global acceptance of MMCD, invented and developed by the company in conjunction with Philips. Its Camcorder market share will endure in the short term, since the recording function of the new standard is expected to be introduced after at least three years.

For Philips, it seems that the fast entrance into negotiations has successfully changed the standardization game. The evaporation of Matsushita's considerable postponement value by agreeing on a uniform standard enables Philips to benefit from the rapidly evolving multimedia market. Also, its position as a major inventor of breakthrough technologies is confirmed. Considering the outcome for Toshiba, we observe that the company has stretched its position in the consumer electronics market by executing a smart strategy. After all, Toshiba was better known for its semiconductors, portable PCs, air conditioners, and power-generating equipment than for consumer electronics. Its successful lobby in Hollywood provided Toshiba with the support of

Matsushita and later on of other major consumer electronics companies. This made the company a player to be reckoned with in the Digital Age.

Finally, we consider consumers as beneficiaries of the standardization contest. Consumers are kept uncertain when a timely worldwide acceptance is postponed due to strong competitors who are stuck in a prisoners' dilemma.

Figure 1: A game-theoretic framework for product standardization

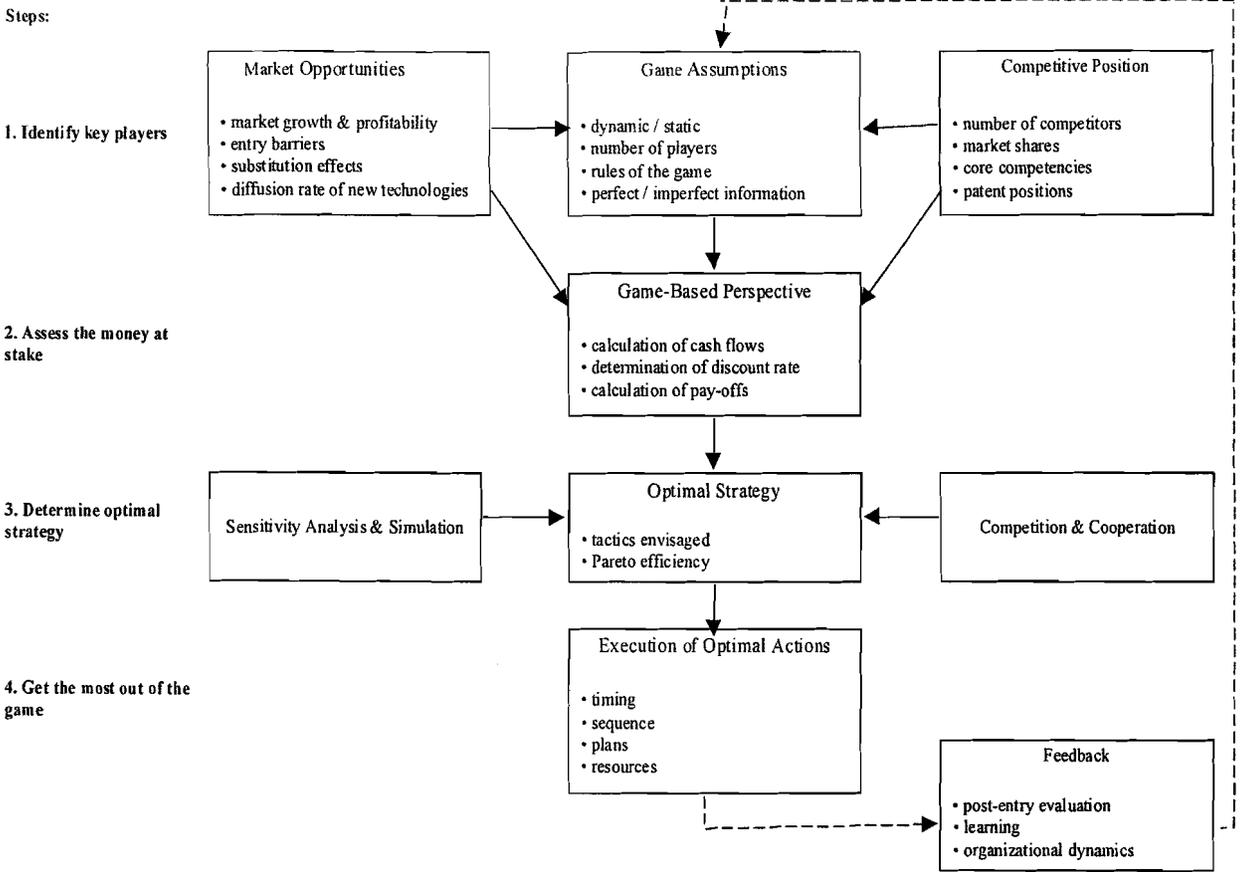


Figure 2: Illustration of pre- and post-negotiation positions of companies.

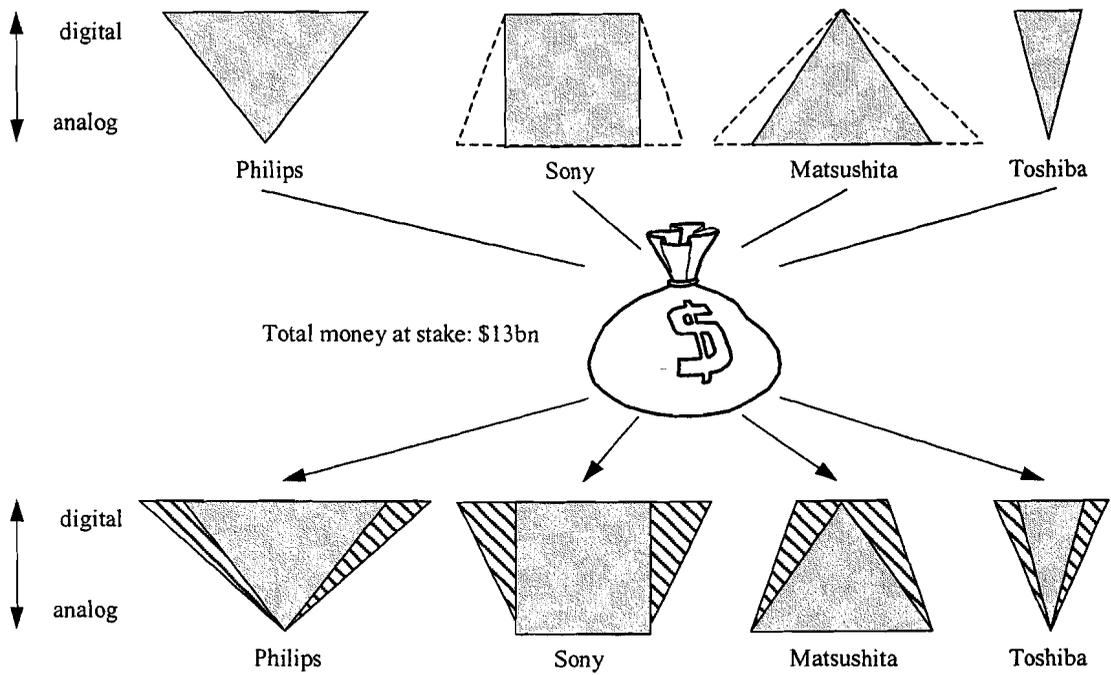


Table 1: Composition of pay-offs for Matsushita and Philips in scenario I en II (amounts are expected values in billion Dollars)

	Scenario I		Scenario II	
	Philips	Matsh.	Philips	Matsh.
NPV of cash flows from VCR market	1.08	1.88	0	0
NPV of patent royalties from VCR-market	0	0.32	0	0
NPV of postponement	0	1.94	0	0
NPV of cash flow from new standard	1.20	0.66	9.00	4.20
NPV of patent royalties from new standard	0.12	0	0.60	0
	-----+	-----+	-----+	-----+
	2.40	4.80	9.60	4.20

Table 2: Pay-offs in billion Dollars (rounded figures).

		Matsushita	
		continue	abandon
Philips	continue	I: 2, 5	II: 10, 4
	abandon	III: 4, 8	IV: 8, 6

Table 3: Pay-offs in billion Dollars (rounded figures).

		Matsushita	
		continue	abandon
Sony	continue	I: 6, 5	II: 11, 4
	abandon	III: 5, 8	IV: 9, 6

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¹Matsushita, parent of JVC, early adopted the VHS system at the beginning of 1977 after JVC successfully developed the two-hour VHS.

² VCR-market is still larger than total CD-market (\$30 bn). Source: Industry estimates, International Federation of Phonographic Industries, 1994.

³ Sources (in alphabetical order): Business Week, CD-ROM Professional, Electronics Engineering Times, Electronics Weekly, Financial Times, Nikkei Weekly, Video Week.

⁴ These numbers originate in our proprietary research utilizing the framework presented and are based on assumptions and analysis that are further detailed in Lint and Pennings (1997).

⁵An independent organization could mediate between the involved players in the competition. During the analog video battle, for example, the Japanese Ministry of Trade and Industry mediated, without success, between Sony and Matsushita.