

# **Factors for winning Format Battles: a modelling approach**

## **Abstract**

There is considerable literature on format competition with several review articles establishing lists of factors that are thought to apply broadly in such contexts. However, the literature is not unequivocal regarding some factors that apparently can have a reinforcing or balancing effect on format adoption and dominance. This paper attempts to transfer a recent theoretical framework proposed in the literature to a system dynamics generic model. It is intended to validate the hypothesis that the factors listed in the literature actually result in format dominance. Furthermore, it will allow an exploration into whether there are other intermediary factors underlying those listed as important, and look at what the ambiguity of some of them implies for the dynamics of format competition.

## **1. Introduction**

Firms involved in an interface competition face considerable risks. If they lose they may end up leaving the market. A format war is characterized by inherent uncertainty and switching costs (Burnham et al., 2003). At the same time, the temporal frame in which such battles are fought and won or lost, is getting smaller. For example competition over the width of railroad tracks took decades to settle while battles over standards in communication nowadays take considerably less time (Van de Kaa, 2009).

In every case distinct factors mentioned in the literature are integral to the way the endogenous dynamics in such settings play out (Schilling, 1998; Christensen et al., 1998; Shapiro and Varian, 1999). A recent comprehensive review of the literature and previously proposed frameworks was made by Van de Kaa et al. (2011). It discusses factors that have a positive or negative effect on platform dominance. There is a need to explore the effect of factors for platform dominance in time because the concept of format dominance is meaningful only with respect to a time frame. The same need is explicitly identified in the case of switching costs (Burnham et al., 2003).

In order to do this, first, the list of factors in van de Kaa et al. (2011) is transferred into a qualitative causal loop diagram so that the full complexity and the potential feedback loops can be appreciated. Then a system dynamics model is developed. In order to include switching costs between formats in some detail, the typology of Burnham et al., (2003) is used. It draws

on a breadth of literature spanning several industries, however the hypotheses in their work are statistically tested by data from the credit card sector. The synergy with format competition framework of van de Kaa et al. (2011) lies in that it has been applied to three cases (van de Kaa et al., 2013) one of them being the development of e-purse technology in the Netherlands, a substitute product for credit cards. Thus we can safely assume a level of compatibility and overlap between the two frameworks that allow their combined use in our model.

According to the theory, the influence of some factors on format dominance is ambiguous. For example, some authors argue that it is good to enter early while propose an inverted U-shaped relation of timing of entry with platform dominance. Given that this is a relatively new area it where theory is still developing, it is fertile ground for exploration and theoretical extension with simulation (Davis et al. 2007). The multiplicity of factors and the complexity of their interactions, leads to considering modelling and simulation of their interactions as a way of providing a better understanding of the factors for platform dominance. The present paper is intended to be the stepping stone for the development of such a model and will allow for the exploration of these factors.

The remainder of the paper is structured as follows. Section 2 discusses the factors of format competition and the nature of their interactions. Section 3 states additional assumptions that are required to meaningfully integrate them in a causal loop diagram that shows how they fit together. Then, Section 4 presents in some detail parts of the model we developed, taking into consideration the need to study particular factors for whose influence the literature is not unequivocal. Some preliminary results are presented in section 5 and the paper concludes in section 6 with discussion and thoughts on further work.

## **2. Factors in Format Battles**

The study of van de Kaa et al. (2011) classifies factors relevant to format dominance under five categories: (i) characteristics of the format supporter, (ii) characteristics of the format, (iii) format support strategy, (iv) other stakeholders, and (v) market characteristics. These are briefly summarised here in order to provide the context for the development of the causal loop diagram. While in the original study the factors were explicitly and directly linked to format dominance, the assumption made in this paper is that these are linked and interact. Inevitably there may be more than one steps between each factor and format dominance or more than one

ways in which each one can influence format dominance. In this paper we briefly describe the factors underlying these categories by drawing upon Van de Kaa et al. (2011).

Characteristics of the format supporter include complementary assets that are deemed essential in winning a format war. These include (1) financial resources that are needed to e.g. pursue a strong marketing campaign, (2) reputation and credibility, (3) operational resources such as sufficient production capacity to meet demand for the products in which the formats are incorporated, and (4) learning orientation, or the extent to which an actor can learn from earlier platform wars.

Characteristics of the format are these elements of the platform that make it technically superior compared to competing platforms. These include (1) technological characteristics such as aesthetic qualities, (2) (backwards) compatibility with another generation, (3) the extent to which complementary goods are available, and (4) flexibility or the extent to which the platform is changed to changing requirements.

Strategies that may be pursued in platform wars include (1) (penetration) pricing strategy whereby the price of a platform may be set at or below cost to quickly increase installed base, (2) appropriability strategy which refers to the extent to which the platform is open, (3) timing of entry (the point in time that the platform is introduced in the market), (4) marketing communications in the form of e.g. pre-announcements, (5) pre-emption of scarce assets (the extent to which through entering early certain key resources can be pre-empted from competitors), (6) distribution strategy; the extent to which sufficient distribution channels are available with which the product in which the platform is implemented gets distributed, and (7) commitment among stakeholder involved in the development and promotion of the platform. Recent research has shown that commitment towards the success of platforms may not always be high which can be detrimental for its market acceptance (van de Kaa and de Vries forthcoming).

A fourth category of factor for format dominance offered by Van de Kaa et al. is ‘other stakeholders’ which includes the actual adopters of the format (installed base) and the actors that have adopted the previous generation of the format (previous installed base). Also, a large and powerful stakeholder (‘big fish’) may adopt the format and by so doing increase its installed base considerably. The regulator and judiciary may set certain boundary conditions

which may affect the end result of the platform war. Van de Kaa et al. also mention the number of suppliers of complementary goods and the effectiveness of the (formal) standard development process as important factors underlying the category other stakeholders. Finally, certain aspects of the actual network of format supporter may be affecting the success of the format. For example, when a network of actors supporting a platform is more diverse, the platform will have higher chances of achieving dominance (Gomes-Casseras, B., 1994).

The fifth category includes the factors that indirectly affect format dominance and that are more or less given in markets such network effects (the phenomenon whereby technologies increase in value the more they are used), bandwagon effects (if one actor chooses a format, other actors will follow), the number of competing formats and the speed of change in a market which both affect the uncertainty in the market, and the switching costs (costs to switch from one technology to a competing technology).

The factors, their effect and the number of studies found in the literature found to support it are listed in Table 1 below.

Factor	Effect	Studies
Financial strength	positive	16
Brand reputation and credibility	positive	39
Operational Supremacy	positive	23
Learning orientation	positive/negative	47/1
Technological superiority	positive	39
Compatibility	positive	30
Complementary goods	positive	54
Flexibility	positive	10
Pricing Strategy	positive	39
Appropriability strategy	positive	23
Timing of entry	positive/negative	1/32
Marketing communications	positive	40
Pre-emption of scarce assets	positive	10
Distribution strategy	positive	24
Commitment	positive	9
Current installed base	positive	42
Previous installed base	positive	7
Big fish	positive	20
Regulator	positive	30
Antitrust laws	negative	13
Suppliers	positive	23
Effectiveness of format development	positive	11
Network of stakeholders	positive	13
Bandwagon effect	positive	32
Network externalities	positive/negative	65/2
Number of options available	negative	4
Uncertainty in the market	negative	9
Rate of change	negative	5
Switching costs	negative	20

Table 1 Factors influencing format competition (adopted from van de Kaa et al., 2011)

### 3. The Dynamics of Format Battles

In order to build a coherent overarching picture of how all of the factors discussed in section 2 are implicated in one format becoming dominant, a literature review was conducted of frameworks for format dominance as reported in the literature (Gallagher and Park, 2002; Hill, 1997; Schilling, 2002). The relations mentioned in these papers were identified. These fragmented causal relationships identified were then overlaid in one coherent causal loop diagram (CLD). This is what is presented in this section following standard system dynamics methodology (Sterman, 2000). Additional assumptions had to be made at several steps as on some occasions there are intervening causal links between a factor and its effect on the outcome of the format battle. Care was taken to identify the assumptions-causal steps required (dotted lines) in addition to those identified in the literature cited in van de Kaa (2011) (shown in solid lines) in order to built a coherent CLD. In addition the factors for which the literature is not unequivocal, network externalities and the timing of entry into the market, are identified on the CLD (bold) with the aim to explore their impact with a system dynamics model.

Starting at the bottom of the diagram, format selection leads to an increase in the Current Installed Base and with a certain delay it becomes the Previous Installed Base. This leads to an indication of how well the format supporters are doing in setting formats, and it creates network externalities in correspondence with the size of the installed base. Finally, it creates a stock of experience upon which the firms and the users involved can rely in the future. Network Externalities depend on format Compatibility, the Appropriability Strategy followed, i.e. whether the format is protected from imitation or it comes with an open license to increase its installed base. The range of Complementary Goods available is also an influence and is related to the regulatory framework that might prescribe certain formats or complementary products (Axelrod et al., 1995) and the diversity of the stakeholder network that support the format. The Switching Costs also depend on Appropriability and Compatibility variables and in addition Marketing Communication by format supporters can alter the perception of customers about switching costs by raising their expectations. These can eventually become a self-fulfilling prophecy so that the format that is expected to become dominant will actually become the dominant format (David and Greenstein, 1990). Format selection is also contingent on bandwagon effects – word of mouth effects which is the ubiquitous reinforcing mechanism in business diffusion processes (Sternan, 2000).

The outcome of platform competition in the literature review in van de Kaa (2011) was the format dominance. This has been disaggregated to two steps involving Format Performance Dominance and Format Selection. This allows a distinction between market related (bottom part of the CLD) and technology related (top part) factors. Several factors, technology and market related, affect Format Performance Dominance: the Effectiveness of the Format Development Process, the Financial Strength of format supporters, the operational competence and the Distribution Strategy.

Financial Strength is a given for new formats that enter into competition but for those already existing in the market is assumed to be built up based on revenue coming from current and past format installed bases and influences expense related variables: Marketing Spending and Low Pricing Strategy which can potentially include some start up losses and low earnings early in the diffusion process. It also plays a role in the Commitment that format supporters exhibit. This acts in a reinforcing way with other stakeholders and suppliers that might commit to a certain format and counteracts the uncertainty surrounding the early stages of format

competition when a number of formats are available (Adner, 2006). Firms often hedge against market uncertainty and risk by supporting more than one format.

The Effectiveness of Format Development Process is contingent on the past successes and network externalities that are reflected on Core Capabilities, the Technical & Market Know How that the format support group has at its disposal and the commitment with which it engages in competition. Finally, the Operational Competence is driven by the Format Supporters Resources, the technological and production capabilities involved in producing the format.

A note is required on Figure 1, this qualitative model, when checked against previous studies (Gallagher and Park, 2002; Hill, 1997; Schilling, 2002; Suarez, 2004; Lee et al., 1995) represents the current state of knowledge on factors influencing format dominance. It is foreseeable that with more on format battles this will be corroborated and/or updated as other relations may be found.

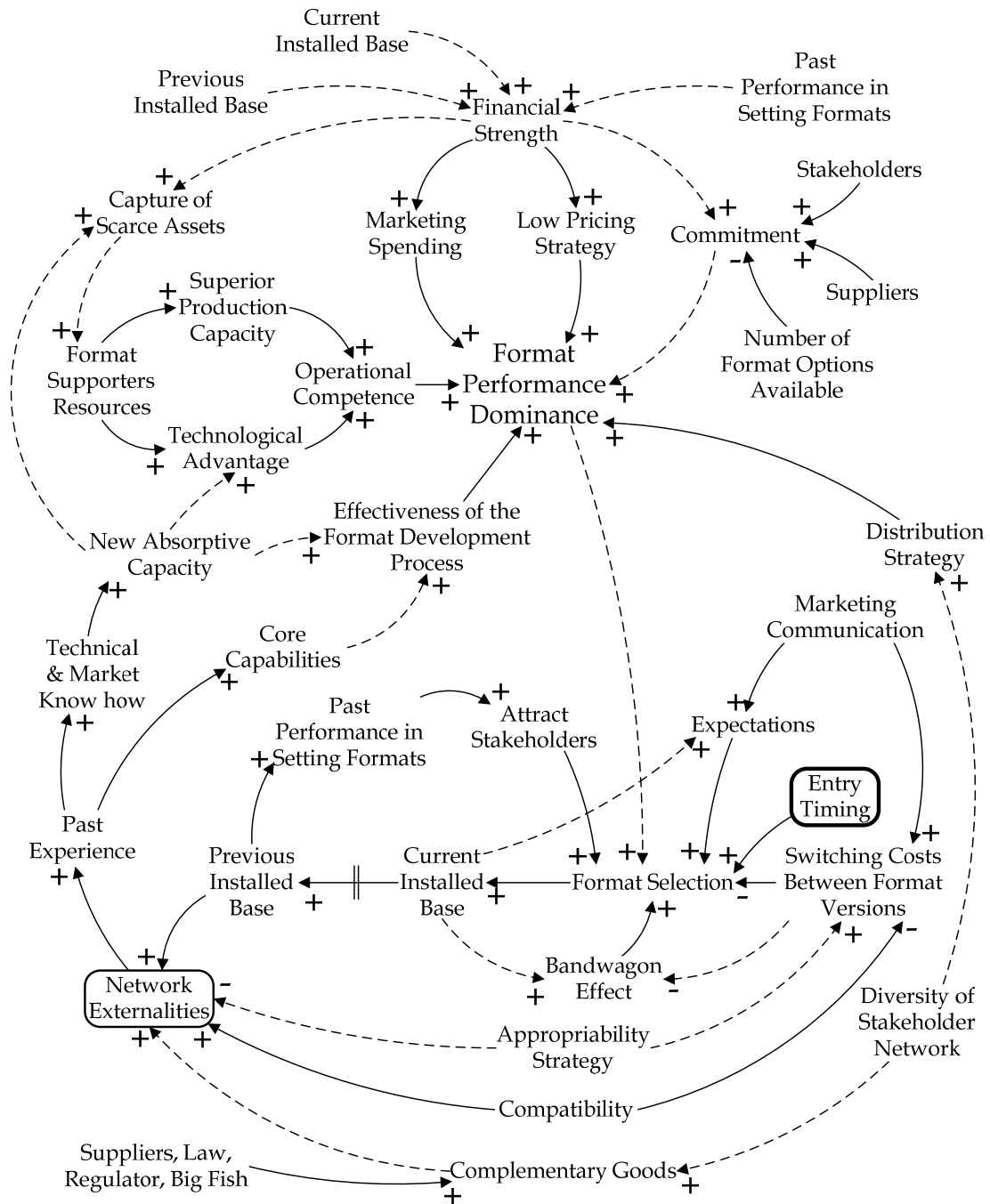


Figure 1 Causal loop diagram of the format competition dynamics

#### 4. A Model of Format Competition

Competition consists in one format winning a considerable market share at the expense of other candidate formats. This inevitably implies that users at some point have to switch from one format to another and thus switching costs is a factor that has to be taken up explicitly in the model. In order to model switching costs between formats, the typology of Burnham et al., (2003) was applied. Their typology draws on a breadth of literature across industries, however the hypotheses in their work are tested by data from the credit card sector. The framework of

van de Kaa et al. (2011) has been applied to three cases in van de Kaa and De Vries (forthcoming) where one of them is the development of e-purse technology in the Netherlands, a substitute product for credit cards. Thus we assume a level of compatibility and overlap between the two frameworks that allow their combined use in our model. The research of Burnham et al., (2003) confirmed a number of hypotheses on factors that directly influence switching costs and the intention of customers to stay with a particular product supplier. These are directly relevant to format competition and are discussed next.

Breadth of use: is the extent to which the consumer employs a variety of product types, features and functions offered by a supplier (In this paper this is taken to include products that are complementary to the core product that is in use). This was found to increase procedural costs i.e. the economic risk, the effort in evaluating, learning and setting up involved in switching to a new product. It also increases the financial costs for customers that consist of the benefits that the customer has to forego and the financial resources that have to be expended for the new product (Hypothesis 3 in the article). The effect of these switching cost factors is assumed to be reinforced by the appropriability strategy that format suppliers follow i.e. the actions taken to protect the format from competitor imitation. The level of compatibility between formats works in the opposite direction (van de Kaa, et al., 2011).

Product complexity: is also assumed to influence customer behaviour. Product complexity results in customers having difficulties in compiling relevant information and evaluating a product. Thus greater complexity is seen as a factor that drives switching costs (Hypothesis 1). Nevertheless, the results of Burnham et al., (2003) are not statistically significant. At the opposite end of the spectrum greater customer experience and knowledge about the various products, features and functions offered in the market reduces the uncertainty associated with switching to a new supplier as customers are able to accurately evaluate products and understand related information. Results in Burnham et al., (2003) confirm that it reduces the uncertainty associated with using a new format provider and results in lower procedural and relational costs (Hypothesis 5).

Thus we choose to aggregate the two hypotheses under uncertainty in evaluating and choosing a particular product. It is not assumed to influence switching costs directly because uncertainty in evaluating a product may lead the customer to perceive one as superior when in fact this is not the case. This effect has been modelled following the formulation of Loch and Huberman,

(1999) for assessing the level of performance of the new technology. A random component  $f_\xi$  is involved that has a symmetric exponential distribution with parameter  $\beta$  and density given by:

$$f_\xi(x) = \frac{1}{2}\beta e^{-\beta x} \text{ for } x \geq 0 \quad (1)$$

$$f_\xi(x) = \frac{1}{2}\beta e^{\beta x} \text{ for } x < 0 \quad (2)$$

$f_\xi$  has zero mean and variance  $1/\beta^2$ . Each customer evaluates the format separately and independently, so the random components across customers are independent and identically distributed random variables. Hence the same uniform distribution is used for  $x$ . The uncertainty diminishes as the technology becomes well understood and advances toward its performance limit. An additional influence to system evolution is the incremental performance improvement of technologies over time. Hence, the perceived technology performance changes between evaluations not only due to positive externalities, but also because of S shaped incremental technology improvements.

Prior customer switching experience: the greater the number of suppliers a customer has had in the past, the smaller the switching costs he will face, for two reasons. First, it increases customer experience about the switching process itself and using new products. Second, frequent switching inevitably implies that the customer interacts with each supplier for less time, thus the benefits accruing through this relationship are smaller and therefore easier to forego (Hypothesis 6). The switching experience of customers has been modelled as the cumulative stock of past switching events. A switching event takes place when the customer installed base for a format increases or decreases. Thus total switching events increase by the rate at which the market base for each format changes i.e. the 1<sup>st</sup> order derivative of market base.

Customer satisfaction: greater customer satisfaction keeps them from switching products (Hypothesis 7). Satisfaction with a particular format is assumed to depend on the product of two factors identified in van de Kaa et al., (2011): operational competence and the range of complementary goods. The logic is that a technically superior product with a wide range of complementary goods has an advantage over competition. Following Burnham et al., (2003)

there is no direct relationship in the model between customer satisfaction with product and switching costs.

Marketing campaigns and communications: Following van de Kaa et al., (2011) this was considered as an additional factor. It influences customer expectations about choosing a product and thus may play an important role in format battles. For example, in the early phase of a battle, pre-announcements about format characteristics or about its imminent adoption by firms can discourage users from adopting a rival format and thus deny market share to competitors (Farrell and Saloner, 1986). In the model it is assumed that customers are discouraged from adopting other formats when marketing communications raise expectations about a particular format and thus the perceived switching costs to another format as well. Communications reinforce the customer's perception of those format features that differentiate it from its competitors, thus increasing customer switching costs and reducing their search for alternatives (Heide and Weiss, 1995; Weiss and Heide, 1993).

The intention of customer to persist with a particular choice of format has been formulated in the model as:

$$\frac{(\text{Satisfaction with Format} + \text{Switching Costs} + \text{Perceived Switching Costs})}{\text{Switching Experience}}$$

The effect of network externalities has been modelled as:

$$\text{Previous Installed Base} * \text{Compatibility} * \text{Complementary Goods/Appropriability Strategy}$$

The logic this equation embodies is that network externalities depend on the previous format installed base to the extent that format compatibility is high and there are many products on offer that are complementary to the core product. The effect of network externalities and complementary products in particular, is moderated by the appropriability strategy that format supporter firms adopt i.e. all the actions that firms undertake in order to protect a format from competitor imitation (Lee et al., 1995). If the licensing policy is strict then this inevitably restricts the development of complementary products as well.

## 5. Simulation results

Drawing on the preceding discussion of factors influencing format competition, the current paper sets out to explore four concomitant questions in a hypothetical setting where two

formats compete starting out with a similar endowment of resources (financial, technological and other).

1. How does the probability of dominance for format 1 vary with the entry timing of format 2 for various initial market sizes?
2. How does the probability of dominance for format 1 vary with the compatibility level of format 2?
3. How does the probability of format 1 dominance vary with the rate of learning achieved by the supporters of format 2?
4. How does the probability of dominance for format 1 vary with compatibility and learning levels for format 2? is the one a sufficient substitute for another in vying for market share?

The model is simulated for 15 years with two competing formats. The list of input variables to the model is given in Table 2. Each experimental set up consisted in changing one parameter by one step and running the model 100 times. Results for the questions stated at the end of section 2 are presented in the rest of the section. While no particular case study has been used with which to calibrate, the model when used to answer these questions, should in principle exhibit some logical behaviour.

Variable	Starting Value	End Value	Step
Learning Rate	0.04	0.44	0.1
Compatibility	0.2	1	0.2
Competitor Entry Timing	1 yr	1.4 yr	0.1 yr
Initial Current Share	1%	20%	5%

Table 2 Variables and testing range

Figure 2 shows the probability of format 1 gaining a dominant market position given varying entry timing for format 2 and initial market sizes applied to both formats. For example, when both formats start out with 1-2% in market then an entry delay for format 2 can harm its chances for dominance. However, the odds are considerably worse if initial market shares for both formats are set at 10-20%. In this case the scale economy dynamics that develop in the model determine the outcome of the battle to a greater extent.

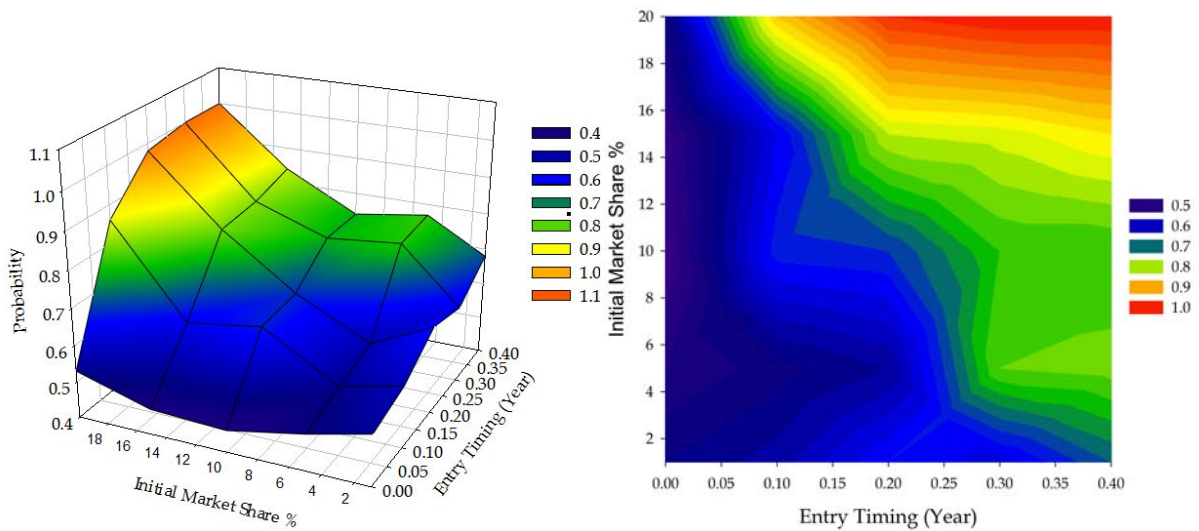


Figure 2 Probability of format 1 dominance with entry timing of format 2 and market size

Figure 3 shows the effect of compatibility with previous format generations. Thus setting format 1 compatibility to 1, the probability of gaining a dominant position is significantly increased at low levels of format 2 compatibility, irrespective of initial market size. At the same compatibility level the outcome of the competition is down to the uncertainty of customers in evaluate format performance.

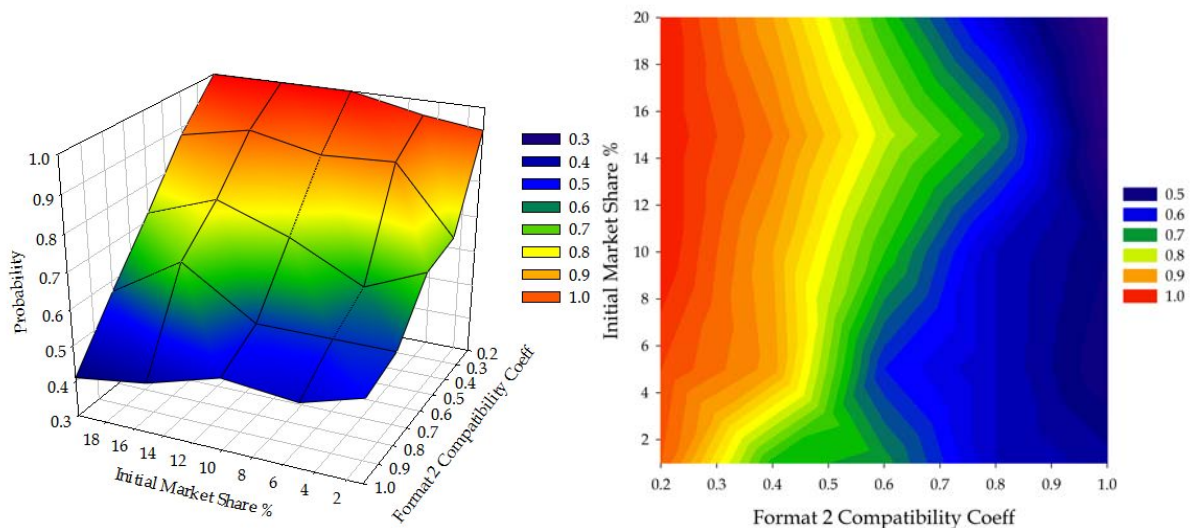


Figure 3 Probability of format 1 dominance with format 2 compatibility and market size

Figure 4 illustrates the effect of learning pace on the outcome of format competition. The probability of format 1 becoming dominant is approximately 50% when both formats start with the same learning coefficient (0.04). As the learning pace of format 2 is increased the chances

for format 1 decrease markedly. However, there seems to be a small area of the output space where format 1 still has good chances. This is when both formats start out with small initial market size. In this case a series of favourable customer choices may tilt the balance in favour of format 1 despite the greater learning capabilities of format 2 supporters and therefore the potentially superior performance levels it can achieve.

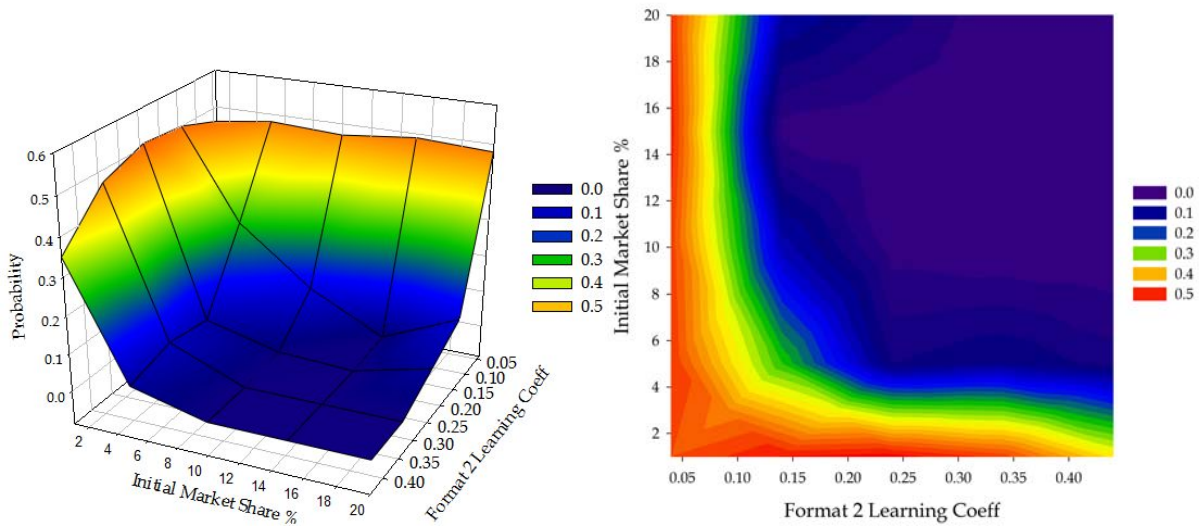


Figure 4 Probability of format 1 dominance with format 2 learning coeff and market size

Figure 5 shows the combined effect of learning pace and compatibility level for format 2. It reveals that there is a considerable margin where format 2 support actors can opt either for high compatibility and some learning or increased learning and low compatibility with approximately the same chances of success. This seems to be in line with the notion that major software upgrades for example usually present a break with previous versions i.e. low levels of compatibility, but at the same time offer a considerable array of new features and functionality stemming from the learning that group supporters are able to draw upon.

There are several implications that follow from this result. Firms are aware of the dilemma that low compatibility represents for users. They usually provide such products with higher functionality and performance in order to justify the switching costs involved. Customers more likely to make the switch are lead users that strive to have the latest and best technology available. At the same time given their knowledge about products on the market they are the most likely to switch to rival products if they think they get a better offer. Thus it is important for firms to maintain a customer base, mainstream consumers to ensure sustainable growth. Nevertheless, in keeping up with competition the introduction of a radically different new product with potentially low backward compatibility is inevitable. This is where lead users can

form an initial critical mass until sufficient compatible, complementary products are developed and solutions that work around incompatibility issues with previous product generations. The timing of this cyclical process is important in sustaining firm growth.

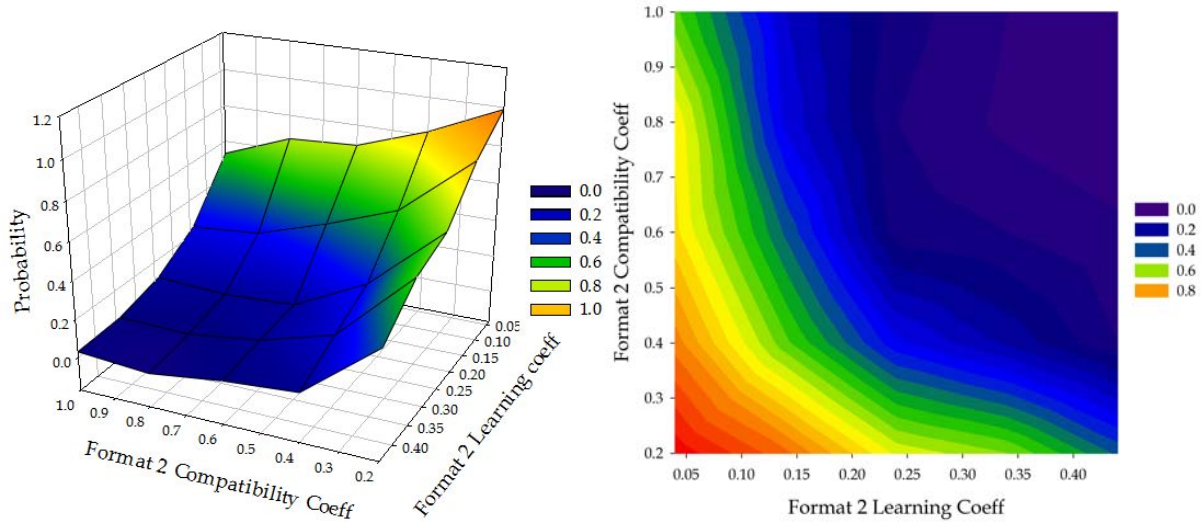


Figure 5 Probability of format 1 dominance with format 2 compatibility and learning

## 6. Discussion and Conclusion

Overall the results of the model appear to be plausible and consistent. Each of the factors explored with the model can potentially lock in the market in favour of a particular format. For example, the effect of entry timing on competition is important. Given similar resource endowments for format supporters, the format most likely to become dominant is the one that gets to the market first, or the one that is most compatible with previous format generations, or the one where its supporting firms learn faster. This kind of behaviour is what was expected in the first place. The simulation model at its current stage of development does not utilise data on any particular competition case neither does it consider explicitly the effect of product prices but only the effect of broad pricing strategy as discussed in van de Kaa et al., (2011). Nevertheless, from the present state of model development there are several development directions that can be followed.

Future extension to the work involves disaggregating the customer stocks with respect to experience. This may be important in exploring firm strategies for customer retention. This is not possible to do at the present phase of model development. The idea is that customers likely to have high switching costs are those from limited experience, not those that have broad experience with products on offer or those that switch suppliers often. Indeed customers with frequent switching behaviour are those considered as lead users, seeking to have the latest most

advanced product in the market. The effect of lead users can be important to the extent that they can constitute a critical mass for new product offerings that reach the market and thus be the stepping stone for a broader rapid diffusion of a competitive format and thus rapid but risky growth path. In contrast, emphasizing the core product value, engaging existing customers with defensive marketing, increasing product complexity, introducing loyalty programs and encouraging broader product use should lead to slower, sustainable growth. In order to test these stylized propositions future extensions to the model should involve at least two or three customer stocks so that the effect of lead users is captured explicitly. This line of research would provide a better appreciation of how customer product satisfaction and switching costs are implicated in customer retention.

A further issue related to switching costs is the effect this can have on customer acquisition. If customers perceive a particular format as having high switching costs that would potentially lock them in for some time if they chose it, they may not choose it. Raising switching costs to retain customers may result in low customer acquisition rate especially of new, inexperienced users i.e. precisely the market segment with the greater retention potential. Lead users may have high tolerance levels to switching costs and thus it may be worth it for the company to attend to this customer segment as well. On the other hand this strategy is risky because lead users switch often. Thus an interesting issue is the trade off between switching costs and the rate of customer acquisition. In order to explore this, disaggregating customer groups becomes necessary. Finally, it is plausible that customers try out new products without adopting them. Thus there is scope for differentiating between trial and switching cost as well.

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