An examination of the timing of investments for PayTV operators: System Dynamics Modelling

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Abstract

According to the resource base view, organisations and markets can be described as clusters of interdependent resources stocks and flows. The performance of organisations is influenced by strategic decisions to reallocate resources, such as investments to build up organisational capabilities. Both, the actual amount invested as well as the timing of investments have significant influence on the performance of the whole organisations. An example of a Pay TV company is used to illustrate the application of System Dynamics Modelling within this context and to simulate the performance of alternative investment strategies from a dynamics perspective.

Background

Management struggles continuously with making strategic decisions that enhance organizational performance. Yet, too often strategies are selected that do not improve an organization's performance. The reasons put forward are manifold and often a result of the process of making strategic decisions in environments that are characterized by complexity and dynamics (e.g., Sterman 1989, 2000, Forrester 1971, Lissack 1997). They include path-dependence [i.e., management decisions are biased towards established thinking patterns] and causal ambiguity [i.e., management can not always comprehend all causal relationships-within neither static nor dynamic contexts-between the various factors impacting on strategic performance]. System Dynamics modelling

has become an established methodology to support management in making strategic decisions. While academic researchers have conducted already rigorous work, there is further potential for solid, practical applications.

In this paper, we provide an additional case application of System Dynamics modelling supporting decision-making within the context of business strategy evaluation and formulation. More specifically, we model the complex and dynamic aspects of making strategic decisions within the Pay-TV markets. While our paper builds on the established System Dynamics literature[1], it differs from existing System Dynamics models within the entertainment and media industry in that it examines explicitly the investment decisions of a PayTV organisation over time. An area that is of critical importance to managers when making strategic decisions in the developing industry. By doing so our practical case study application extends existing modelling attempts in this area and provides additional support for using System Dynamics modelling to support strategic decision-making in management. As such, we neither aim to advance theory in the strategic management field nor to further develop the underlying modeling underpinning in system dynamic modeling and simulation, but to offer additional support about its usefulness.

In the following parts of this paper we specify the strategic decision-making context focused on and explain the dynamic and complex characteristics. This is followed by an explanation of the System Dynamics model and some initial simulation results. The paper

[1] For the guiding principles of System Dynamics and for its application in management settings see Forrester 1961: Industrial, Forrester 1968: Principles, Sterman 2000: Business. For examples of applying System Dynamics in the entertainment and media industry see Warren 2001: Strategy, pp. 38 – 50 and pp. 166-172

concludes with a discussion of the findings of our case study within the general context of making strategic decisions within organizational settings.

Introduction to the Case Study

The average growth rate of subscriber numbers of PayTV Ltd. for the last five years has been stagnating and on average been below 6%. Despite substantial investment, *PayTV Ltd*. has been struggling to gain a critical subscriber mass in order to break even. The industry of PayTV is still developing and, like most broadcasters, *PayTV Ltd*. faces numerous uncertainties in a variety of dimensions. Those uncertainties are to a large extend the result of changes within the industry (see Figure 1) (Goldman Sachs 2001, WestLB 2002, KirchPayTV 2001, ABN-AMRO 2002).

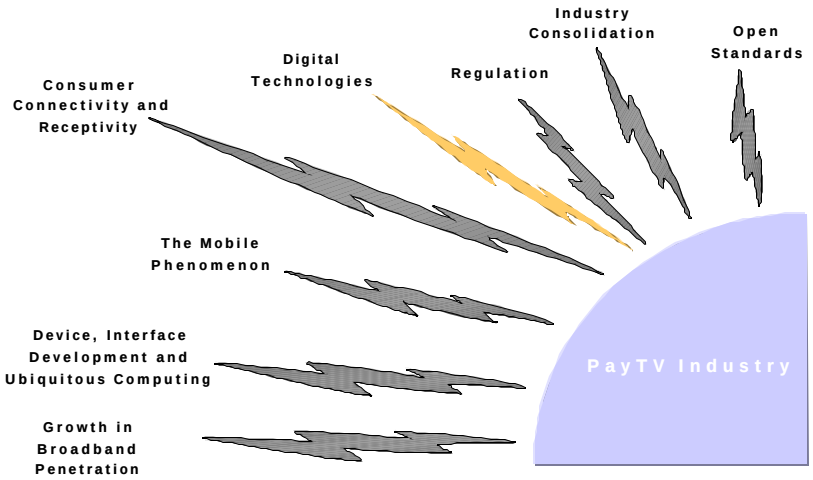


Figure 1: Change Driver of the PayTV Industry

Developments associated with digital television play a central role for the future evolution of the industry. *PayTV Ltd.'s* move into interactive digital Television (iDTV) is hoped to increase their subscriber base and the average revenue per user (ARPU). However, the competitive environment of the entertainment and media industry and the short lifecycles of applications require frequent and significant investment in digital technologies. In vestment in iDTV is creating opportunities[2] and new revenue streams, such as service provision fees, T-commerce commissions, advertising or 'permission marketing' revenues, but it will also generate numerous challenges, eventually changing the nature of the broadcasting business (e.g. Wirtz 2001).

The business of iDTV will have critical success factors that are significantly different from those of traditional TV operators. Those are linked to aspects such as brand management, community building, customer relationship management, alliancing and partnering, and the management of a portfolio of services.

While the industry and all its players are making investment into the necessary technical infrastructure focussed on developing the market, *PayTV Ltd.*, as an individual player needs to invest in its business to stay competitive and claim a share of income from the market. Accordingly, *PayTV Ltd.* needs to build the required core competencies to achieve such a competitive position. However, the investment strategy (investing the right amount, at the right time into the right competency) becomes critical. Available funds for investment are limited and the eventual demand for interactive digital services

2 After going digital, the industry role model, BskyB has increased its subscribers base from 3.5m to 6m, could decrease its churn rate from 16% to 10% and increase its ARPU about 27%. Cf. 0197/, p.89

is uncertain. Limitations on scope of local markets further limit the revenue potential and not all programming or services will drive revenue. Thus, making to little investment at a given point in time can lead to loosing a competitive edge, while over investment can result in resources that are not generating the required return.

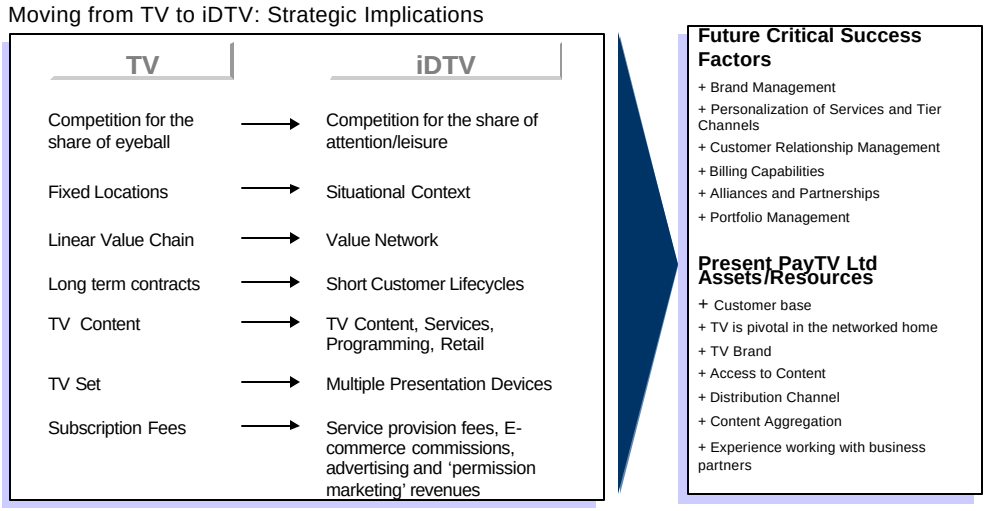


Figure 2: Strategic Implications of iDTV

Making investment decisions in this context is a very difficult issue as management within this industry struggles with making sense of the complexities and dynamics of within the industry. Making these decisions based on management intuition or simple management frameworks can be flawed. Furthermore, historical data and trends can only provide limited decision support where technologies are still evolving and only little experience data is available. The dynamic market environment and quick competitive responses do not allow for playing in the actual market place with various investment strategies and testing them—such plays can be very risky.

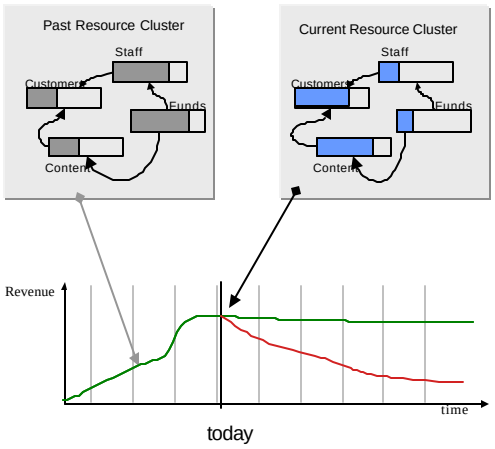
Analytical tools that support management decision-making in this context would assist in making informed decisions. In this context computer simulation can offer practical decision support by simulating and assessing the outcome of alternative investment strategies in a risk free environment. We argue, that System Dynamics Modelling provides a good platform for demonstrating the usefulness of dynamic modelling in and simulation in assessing different investment strategies and making informed decisions. Additional details of the case study context are provided in Appendix 1.

Theoretical Foundation

The resource-based view (RBV) represents the underlying management theory of this study (e.g., Barney 1991, Penrose 1958, Wernerfelt 1984). It describes organisations and markets as cluster of resources that accumulate and disperse over time. The modelling technique System Dynamics has been used to make the RBV operational and to model the structure of resource stocks and flows of the relevant resource cluster that drive organizational performance (see Figure 3). The resource clusters are, in System Dynamics terms, dynamic systems and are therefore characterised by dynamic complexity (Warren 2002, Dierickx and Cool 1989).

Based on this theoretical foundation, we will now present three steps of the System Dynamics Modelling approach: Development of Dynamic Hypotheses; Quantitative Simulation of Alternative Scenarios; and Assessment of the Simulation. The context will

be a case study presents findings of the analysis of PayTV companies. Actual company names and sensitive information from the model have not been disclosed in this paper.



Dynamic Complexity of Resource Cluster

- Resource cluster are networks of internal/external and tangible/intangible resources
- These resource cluster drive corporate performance.
- Resource cluster are characterised by interaction and permanent change.
- Already a small number of interacting resources lead to dynamic complexity
- To understand the impact of past, current and future resource combinations on corporate performance, management decision making needs a tool that can address dynamic complex problems

Figure 3: Resource Cluster and Corporate Performance [Warren 2002: Strategy, Dierickx/Cool 1989: Asset]

Dynamic Hypotheses

We have applied qualitative systems modelling techniques, Systems Mapping and Systems Thinking to structure the management issue and develop dynamic hypotheses that reflect the dynamic and complex context, in which investment decisions are made (Checkland 1989, Senge 1998). This included the graphical mapping of key resource stocks and resource flows and their cause and effect linkages. Figure 4 shows a small excerpt of the resource map.

Based on the graphical representation of the resource cluster, strategic options to manipulate the resource flows were generated. Given that the strategic options have

varying effects on the different business drivers or leverage points, their impact on the overall performance of the business will differ. As investment funds are limited, the allocation of funds to competing investment options is critical to the success of the performance of the organisation.

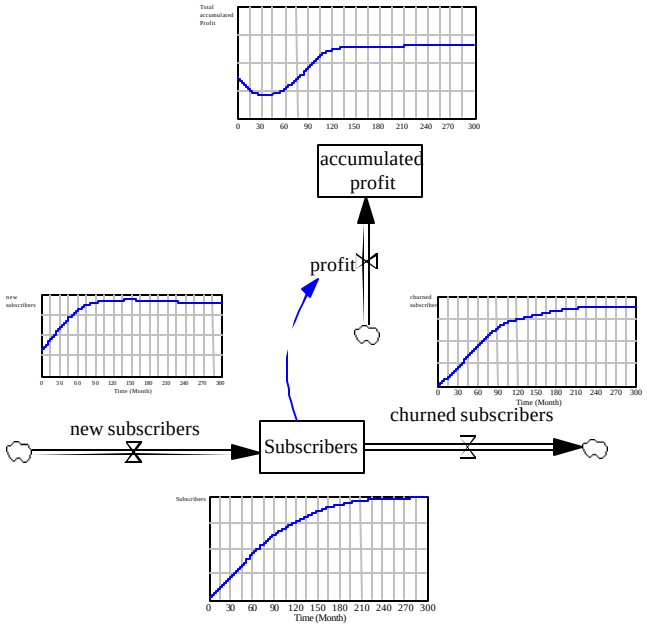


Figure 4: Excerpt of the fundamental resource stock and resource flow relationships

Within the context of PayTV businesses, we can focus on two key drivers to increase their subscriber base, either to increase the flow of new subscribers or reducing the flow of churned subscribers. Warren stresses the importance in managing both of these flows, while there is the possible danger that management will only focus on an aggregated net growth rate in subscribers and will have little understanding about the how each of the two options can assist in achieving the overall performance goal (Warren 2002). Please see also Appendix 1 for some assumptions made.

To illustrate the dynamic effects of different investment options we have selected two exemplary investment options within this paper: One option is to invest in advertisement (marketing) with the objective to attract additional, new subscribers and the other one is to invest in customer service in order to increase the average customer lifetime and, therefore reduce the number of churned subscribes. Clearly, organizations have to invest in both areas over time. However, to understand how to invest over time, the dynamics of both the system and the different investment policies need to be understood.

There exist many other possible investment possibilities, e.g. investment in content, distribution, or interactive services. While the management would benefit from an analysis of the numerous alternative options, we have excluded them in this paper so that we do not increase the scope unnecessarily without adding value to the findings. Adding the question of investment timing results in greater complexity, as the issue is not only to quantify the amount spent at one certain point in time but also to outline how much of the funds should be spent over a period of time at given points in time.

To study the two investment options selected in this paper, we have developed dynamic hypotheses for the behaviour of the business system over time. These dynamic hypotheses explain dynamic phenomena of the management options based on qualitative models (Sterman 2000).

Figure 5 illustrates the systems thinking diagram of the drivers that impact on the number of subscribers of PayTV Ltd. The diagram shows the cause and effect relationships

between investment decisions, financial indicators, and subscriber performance and also the two sectors (market and organisation) of the relevant business system.

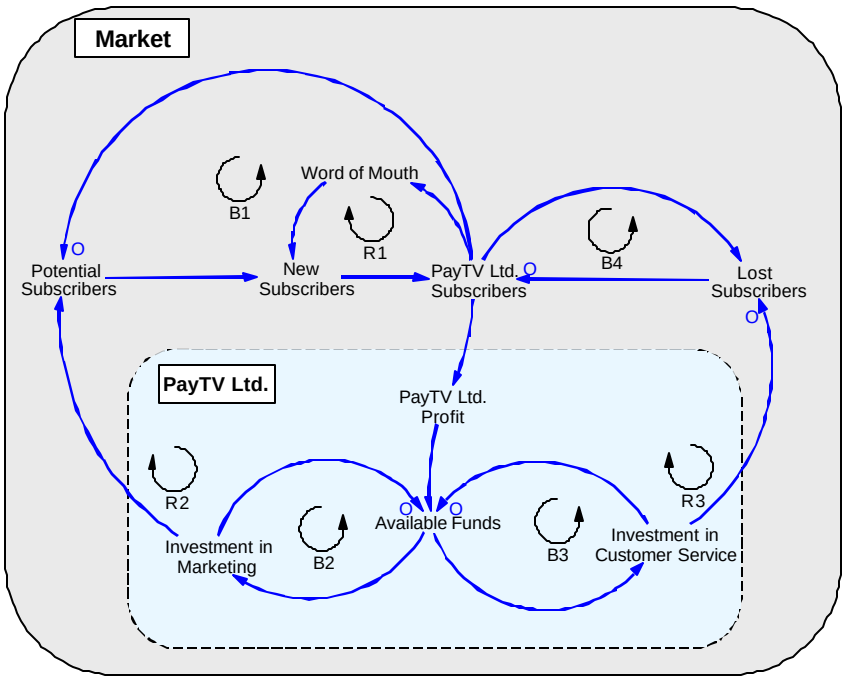


Figure 5: Dynamic Hypothesis in the form of a causal loop diagram, Source: Töpfer/Jarosch wip: Strategic

The key feedback loops, which were identified, are:

- Reinforcing loop R1: Subscribers, greater positive word of mouth communication will result in additional, new subscribers.
- Reinforcing loop R2: More Pay TV Subscribers will lead to more revenue and, therefore, to more available funds. These funds enable more investment in advertising (marketing), which in return leads to more Pay TV Subscribers
- Reinforcing loop R3: More revenue enables higher investment into customer service, which reduces the number of lost customers and increases the number of Pay TV subscribers

- Balancing loop B1: This is the market saturation loop. The greater the number of signed up subscribers, the larger the Subscriber base. Also, the greater the number of signed up subscribers, the smaller the pool of potential, new subscribers.
- Balancing loops B2 & B3: Investments reduce the amount of funds available for (alternative) investments.
- Balancing loop B4: An increasing number of Pay TV subscribers leads to a higher number of lost subscribers (average subscriber life time is set constant) which in return reduces the number of Pay TV subscribers (Töpfer and Jarosch 2003).

Preliminary Conclusions

To provide a basis for analysing alternative investment options, we need to establish a base situation: this is reflected in understanding the behaviour of selected key variables for a base simulation, where an equal amount is invested in both investment options. Please note that the key performance indicators of the Pay TV Ltd. are the number of subscribers and the net present value (with subscription revenue being the main source of cash flow). Within this context the behaviour of the variable subscriber numbers reflects characteristics of the Bass diffusion model.

To provide a better understanding of the behaviour over time of the resource stock of subscribers shown in the top part of Figure 6, we assess the net growth rate (net new subscriber) as well as the inflow (new subscribers) and outflow (churned subscriber) illustrated below.

As in the Bass model, new subscribers are initially driven by both advertising (marketing) and social network effects (in our case by word of mouth communication, represented by the word of mouth loop R1 in Figure 5). These social network effects significantly drive the subscriber growth number, especially in early phases of the simulation. Once a sufficient number of potential subscribers have turned into subscribers the effect of the loop R1 decreases, explaining the flattening of the curve for the resource of subscribers (see Figure 6).

The number of churned subscribers is a function of average customer lifetime and number of subscribers.[3] Therefore, if the number of subscriber increases and customer lifetime remains constant, the number of churned subscriber will also increase, after a certain time delay. This direct relationship can gain critical importance as for each subscriber that cannot be retained; one new subscriber has to be acquired to maintain the existing number of subscribers. This basic relationship implies as well that total cost will increase the more new customers need to be acquired as result of lost customers.

Investment in customer service increases the average customer lifetime for the existing subscriber base. While the inflow to PayTV Ltd. subscriptions stays the same, the outflow decreases leading to a sustainable higher subscriber base in the following periods. This, in turn, has a positive influence on the performance of the business.

[3] $f(churn\_rate) = \frac{Subscribers}{subscriber\_life\_time}$

The graph for net new subscribers (i.e. the subscriber growth rate) shows the difference between new subscribers and churned subscribers. It starts with a high value, which continuous to increase for approximately three years until it starts to decline. This implies that Pay TV Ltd still wins more new subscribers than it loses. Yet, this margin between new and lost subscribers per month is shrinking.

In period 95 (indicated by arrow A) PayTV Ltd becomes profitable and starts to reinvest parts of its profits into the business (50% in the inflow and 50% in the outflow). These investments turn around the trend of a declining net subscriber growth rate as the number new subscriber per month exceeds the number of lost subscribers. However, despite an increasing level of investments, subscriber growth starts declining again month 135 (shown be arrow B). Starting at this point in time, the gap between the graphs for new and churned subscribers decreases until both growth rates are identical. At this point in time, net subscriber growth is zero. This outcome is driven by the market saturation loop. Pay TV Ldt. has penetrated the market and fewer new subscribers can be acquired as explained through the advertising (marketing) and the word of mouth loops. The result is reflected in the stagnating subscriber numbers, which can be observed in the top of the graph.

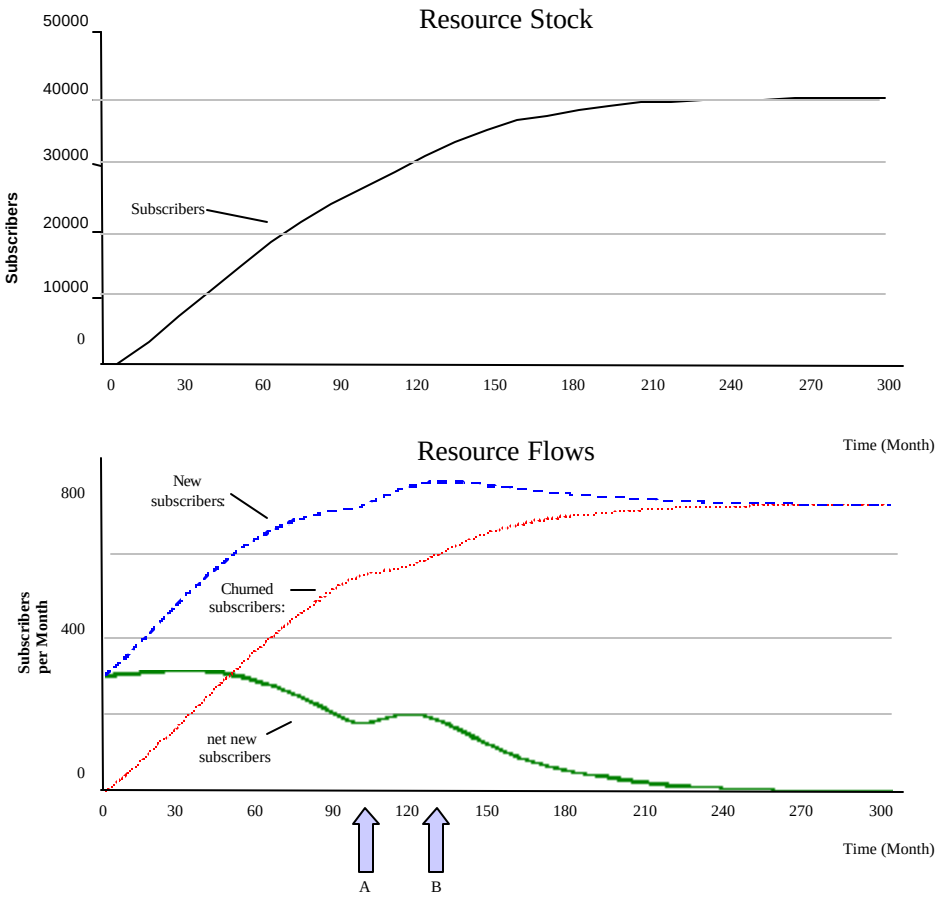


Figure 6: Resource Stock and Flows - Base Scenario

Building upon our understanding of the behaviour of the base simulation, we have analysed four different investment strategies. These investment strategies can be classified into a:

- Static Investment Strategy: The proportion of the investments in advertising (marketing) and in customer services remains constant over the complete simulation period.
- Dynamic Investment Strategy: The proportion of the investments or reinvestments in advertising (marketing) and in customer services varies over the different periods of the simulation. Figure 7 illustrates the proportion as a percentage of reinvestments.

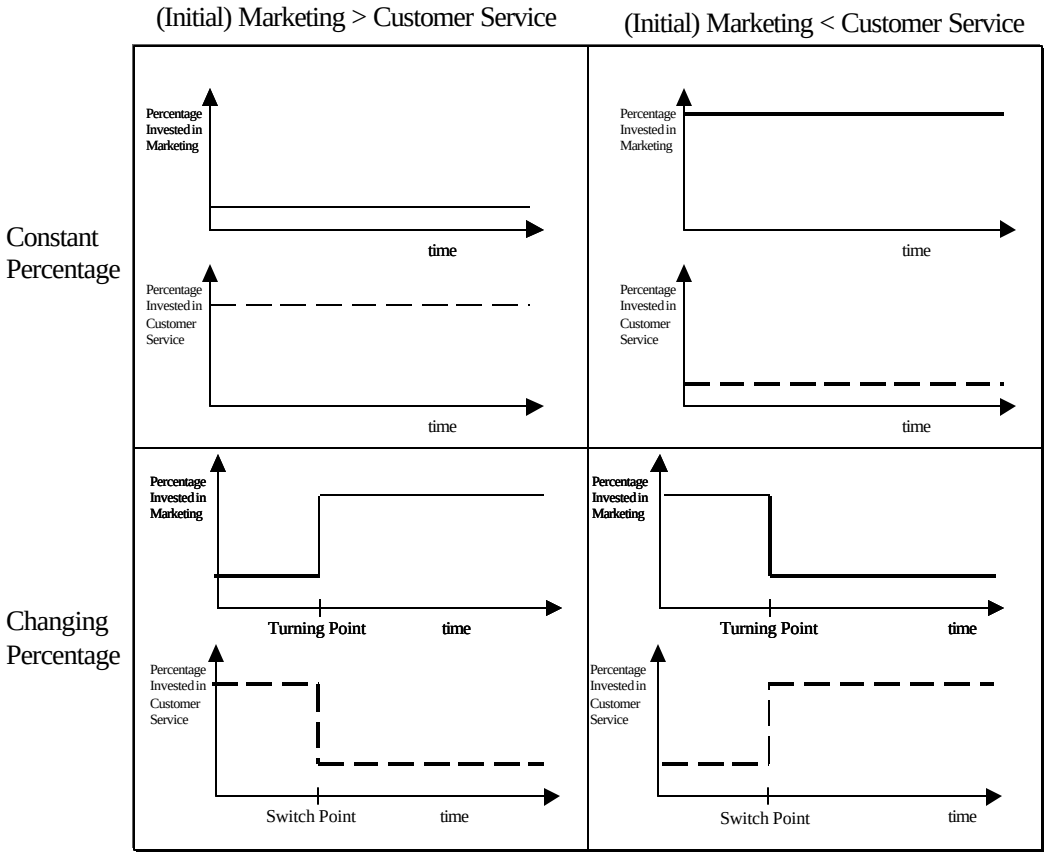


Figure 7: Matrix of Investment Strategies under study

The simulations of the alternative investment strategies expose significant performance variations at different times in the simulation. For instance, at the end of the simulation run the performance difference in NPV between the best and the worst scenario is 14.8%.

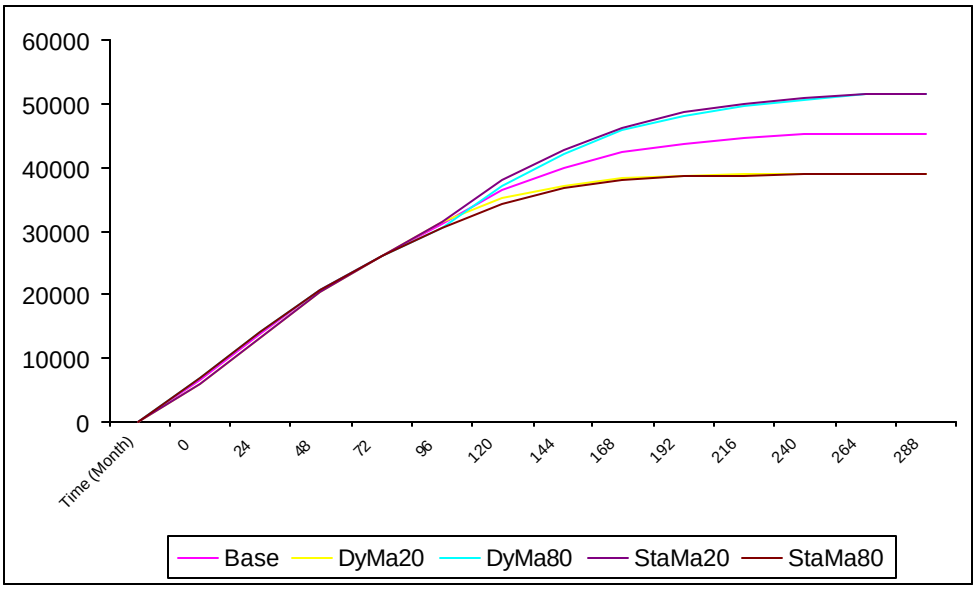


Figure 8: Comparison of Subscriber Graphs for alternative Investment Strategies

The simulation of the four alternative investment strategies show, that after 240 months those businesses perform better where an investment strategy has been put in place with a greater proportion invested in customer service relative to advertising (marketing) in later stages. However, at different times of the simulation different investment strategy options are superior. In the beginning of the simulation investment strategies with advertising (marketing) focus outperform those that are tailored to reduce the outflow. However, at later periods of the simulation the key leverage point of this business system is the outflow, i.e. managing churn. Examining investment over a very long time horizon led to additional insights. Basically, in those contexts business performance over time improves, if a dynamic investment strategy is chosen that shifts the focus of the investments from initially the inflows to the outflows at a later stage.

In conclusion, the simulations have provided evidence for the hypotheses that the timing of different investments has a significant influence on the success of businesses. The effects associated with the timing depend on several factors, including the time horizon of the investments and the strength of the self-enforcing word of mouth loop (R1), which in return is influenced by the market penetration.

Summary

The analysis has provided the management of PayTV Ltd. with a simple stock and flow structure of its business. The model aspects discussed in this paper illustrate that two main leverage points can be targeted to influence the business' subscriber base: To increase the inflow or to decrease the outflow of subscribers. Within the context of limited resources, the question has arisen to understand how much investment should be allocated to each leverage point at what point in time.

The simulation illustrates that both the proportion of investment dedicated to either of those leverage points as well as the timing of these investments is critical for understanding the performance of the company.

Moreover, the simulations demonstrate that companies within the context discussed should assess dynamic investment strategy option even if the market structure does not change. In general, such companies should start with a high investment in advertising (marketing), and at a certain point decrease their investment in this area to free funds so

that increased investments in customer service can be made. The simulation also highlights the fact that if such companies invest in advertising (marketing) early, without appropriate investments in service capacity, those companies would have faster subscriber growth in early periods than companies that invest a higher proportion in customer services. Therefore, such companies should initiate the "word of mouth" loop R1 with high initial advertising (marketing) investments. Loop R1 significantly drives the adoption of such kind of services. Again, a decreasing number of potential subscriber will constrain the overall growth (loop B1). Hence, once a certain level of market penetration has been reached, investments should be shifted from advertisement (marketing) to customer service, as churn rates would increase strongly, and those companies would loose subscribers unless an investment in customer services is made.

Thus, this case study demonstrates how System Dynamics can support management decision-making on three levels: It enables the structuring of management issues, it supports the identification of management options, and finally it enables the quantitative assessment of alternative options and scenarios. Simulations tailored to the individual organisational and external context of PayTV companies can support the determination of the optimal timing and investment amounts.

In conclusion, System Dynamics modelling provides a practical and comprehensive platform for testing alternative investment strategies. The simulation described in this paper provides further evidence for not only the usefulness of the methodology but also the fact that not only the absolute investment amount matters but also the sequence in

which investments are done. Hence, with this paper we support the notion that System Dynamics modelling is of valuable support to management in making strategic decisions and that such contributions are not only rigorous but also and practical.

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Appendix 1

The structure of the simulation is based on the Bass model, an established model of the diffusion theory.[4] The model has been added with structural detail drawn from the empirical analysis of Pay TV operators. Although the companies under study differed in performance of key indicators and market structure (i.e. number of free to air broadcaster, regulation, market size etc.), they provided many structural similarities in regards to the key driver of their business and organisational policies.

The focus of this study is on the investment policies available to PayTV Ldt. As described earlier PayTV Ltd. re-invests a fixed proportion of its profits into either advertising (marketing) or customer service. The funds available initially are 10,000,000 Euro and they can be invested over 24 months. Although, the re-investment proportion is fixed, the split between the two investment alternatives can change over time.

[4] Since its first publication in management science [Bass 1969:] the bass model has been applied, refined and extended.

For the first simulations, we have assumed that management can only change the investment percentage once during the simulation period, i.e. a one-step change at a point in time.[5] This is a simplification as other more flexible in its investment decisions could be made and different key performance indicators in regards to the investment options could be added. The following table outlines additional key assumptions that have been made in the simulation.

Competition	Excluded
Costs	Costs are split into fixed and variable costs and have been extrapolated from historical data.
Historical data	The first 8 years have been calibrated against historical key performance indicators.
Inflation and currency effects	Excluded
Initial available investment funds	PayTV Ltd. has initially 10,000,000 Euro of available funds for investments in the first twenty-four months.
Pay TV Universe	100.000 potential subscribers
Programming costs	Fixed over the whole simulation period
Revenues	Only subscription revenues have been included. ARPU is assumed to be constant for the whole simulation period and equals the subscription fee of 40 Euro per month. The ARPU drivers Discounting Offers, Price rises; Premium services and Pay per view have been excluded
Sensitivity to investments	It is assumed that the relative sensitivity of both management options to investments is identical.
Subscription acquisition costs	Market saturation levels have a strong impact on subscriber acquisition costs. They are variable costs per user. To reduce their effect in this simulation the value is set constant.
Time delay lost subscribers	A time delay of 24 months between terminating a subscription and becoming a potential subscriber has been assumed.
Time horizon	Time horizon 20 years, in monthly time steps. (Simulation runs were extended to 25 years to reduce horizon effects.)
Total - Reinvestments	Investments into marketing and customer service always add up to 100 percent of the total re-investments.

[5] Other possible scenarios are to analyse several changes and the option to have continues changes, as opposed to the dscreet step assessed in this case. However, the fundamental dynamics of the system under study need first to be understood. For this purpose the simplification was justified.

Back to the Top