Product Portfolio Decision-Making and Absorptive Capacity: A Simulation Study

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ABSTRACT

The central decision any firm must make is determining which markets to serve with what products. This core managerial decision-making involves balancing between exploration and exploitation of new technology-market knowledge. We construct a history-friendly empirically grounded system dynamics simulation setting that explores the dynamics of managing firm's product portfolio. Our simulation findings illustrate how managerial decision-making regarding the absorptive capacity may influence the evolution of the product portfolio. The results pave the way for multiple fruitful research avenues for future studies.

Keywords: product portfolio, decision-making, absorptive capacity, system dynamics

INTRODUCTION

R&D of any organization builds on organizational learning that facilitates application of new knowledge and its acquisition (McKinley, 1993, Miller, 1996) in coordinating efforts in adapting and maintaining fit with its environmental changes (March, 1991). Therefore, any organization critically builds on acquiring, and exploiting external information and knowledge accumulation, coined absorptive capacity (Cohen and Levinthal, 1990). Absorptive capacity has been traditionally defined mostly following the lines that it represents a capability of a firm to value, assimilate and apply new, externally sourced knowledge (March, 1991). Absorptive capacity involves organizational processes that deal with managing a) the amount, type and sources of external technological knowledge, b) internal processes of communication and resource allocation patterns, and c) application and use of the external knowledge in combination with organizational existing knowledge base.

Therefore, absorptive capacity is a function of managerial decision making regarding resource allocation patterns in balancing between exploitation of existing knowledge and exploration of new knowledge (March, 1991). Similarly, innovation implementation requires careful implementation of innovation internally (Repenning, 2002). Hence, the search for fit with innovative output in turbulent competitive environment necessarily involves time delays in absorptive capacity process. These delays are accrued from for example gathering external data, internally using it in R&D developing innovations and finally utilizing it in production and operations in launching these new innovations.

In this exploratory research we attempt to build a system dynamic model to investigate the balancing between exploration and exploitation in a turbulent competitive industry environment (Benner and Tushman, 2003). We use a history-friendly approach in our modelling efforts and use empirical data from a global technology industry to derive our model. We further explore boundary conditions of our model with simulated extreme market share changes as a firm loses or wins markets to investigate how exploration and exploitation balance change in time

THEORETICAL BACKGROUND

Absorptive capacity may be viewed as a process involving four different distinct phases, namely acquisition, assimilation, transformation and exploitation of knowledge (Cohen and Levinthal, 1990, Zahra and George, 2002). In this paper we follow the definitions of Zahra and George (2002) in our conceptualization of absorptive capacity and following process model of it. Absorptive capacity as a process of acquiring and exploiting externally sourced knowledge may be divided into four distinct phase, namely acquisition, assimilation, transformation, and finally utilization of knowledge.

Acquisition refers to organizational activities directed in identifying, valuing and acquiring external knowledge that is important for organizational operations, in our context especially for developing products and services to fulfil market needs. However, organization has to analyse, interpret and understand the external knowledge that has been acquired. Therefore, organization needs to assimilate the external knowledge into a comprehensible form that facilitates further the transformation of the external knowledge. As the external knowledge is transformed, it is combined with the existing knowledge structures and becomes codified and usable in the organizational setting. Finally, in the process of absorptive capacity the knowledge acquired, assimilated and transformed becomes usable and is exploited in developing new products and services to match the organizational competitive environment.

These phases of process of absorptive capacity further represent organization's potential and realized absorptive capacities, PACAP and RACAP respectively (Zahra and George, 2002). PACAP represents the organizational capability to explore, evaluate and acquire externally sourced new knowledge. Subsequently, as such it represents a potential that the organization has since PACAP includes acquisition and assimilation phases of absorptive capacity process. Therefore, organization has the potential but it remains as unused potential until acquired and assimilated knowledge is utilized in organizational processes. RACAP includes transformation and utilization phases of the absorptive capacity process. Therefore, RACAP is the fruitful use of knowledge that the organization has acquired and assimilated. In RACAP the organization transforms the potential knowledge and utilizes it in its process.

Especially important distinction between the two is that PACAP represents the absorbed knowledge and RACAP utilization and exploitation of this absorbed knowledge. This distinction helps in differentiating between the acquisition of potential and realization of that potential at organizational level and further facilitates comparison of organizations in meaningful way. Further, the distinction of the two facilitates the construction of *efficiency factor* as a ratio of RACAP to PACAP (Zahra and George, 2002). This efficiency factor informs us at an abstract level of how much of the potential is realized in the organizational operations to find improved ways of creating value. PACAP and RACAP have been criticized as ambiguous (e.g. Todorova and Durisin, 2007) but at the same time, noting the ambiguities, we approach our exploratory modelling effort with simplest form of the basic absorptive capacity model. Additionally, we are interested in investigating the dynamics of efficiency factor resulting from managerial decisions-making.

The efficiency factor facilitates division of particular circumstances in organizational knowledge acquisition and utilization. The organization may have high PACAP but weak RACAP which results in deficient performance improvements as the potential is not realized and this is reflected in low efficiency factor (Baker, Miner, & Eesley, 2003). Similarly on the other end of the continuum organization may have high RACAP but insufficient PACAP which is reflected in high efficiency factor. In this situation it is possible that too little external knowledge is sourced and in time organization will struggle in finding a fit with environmental changes and turbulence.

Absorptive capacity contributing to the activities producing novel offering to marketplace has been long recognized as important factor in organizational survival and profitability (e.g. Levinthal, March, 1993, McGrath, 2001). Especially in turbulent environments appropriate knowledge exploitation activities have been recognized to be central in effectiveness of creating novel products (Danneels and Sethi, 2011) rendering high efficiency factor important in turbulent environments. In general environmental turbulence is used to describe rate of changes in the organization's task environment (e.g. Song and Montoya-Weiss, 2001). Managerial action in this turbulent environment needs to build alignment between the environmental conditions and strategic orientation of the firm in order to be successful (e.g. Romanelli and Tushman, 1985). Especially we are concerning this fit in the present paper as activities exploring new external knowledge and exploiting this knowledge in finding the fit between environmental product competition and organization's offering. Additionally we attest that changes in competitive pressure act to promote or elicit changes in the level of competitive activities (Gresov, Haveman and Oliva, 1993). We also view competitive actions at changing the offering organization is developing and launching to the marketplace as a crucial domain in search of strategic fit in product-market domains (Starr, 1992). Further, these competitive activities are by definition always inertial to some degree, at least with some temporal latency.

As the organization utilizes externally sourced new knowledge, this utilization translates into organizational activities directed towards fitting organization's position to task environment and its changes. Especially activities that are directed towards competitive interaction in the industry are the determinants of organizational success or failure (Porter, 1980). In essence, from engineering management perspective, the organization is exploiting knowledge in its offering development to find the fit in market-technology domains. Exploration-exploitation balance has been traditionally used in describing balance between organizational search and acquisition of new knowledge and exploring new markets and products (exploration) and use of knowledge in incremental improvement of existing products and knowledge base (exploitation) (March, 1991). From absorptive capacity perspective, the exploration and acquisition of externally sourced new knowledge leads to heightened PACAP which may be translated to productive activity patterns in transformation and exploitation of this knowledge at RACAP phase of the process.

Therefore, we may argue that incremental improvements in offering may be exploratory in technology or market or both domains as the organization may be directing its offering to new markets with minimal changes. Similarly, small technological changes may be changing the value proposition of the offering for the end-user dramatically, for example certain software upgrade in consumer electronics. Therefore, we may view the changes in offering portfolio as a critical competitive activity describing the exploratory nature of the organizations knowledge use as management regulates the

PACAP and RACAP. If none of the absorptive capacities are used, then the organization stays in its current trajectory and purely exploits its existing knowledge base. In the search for a strategic fit with its environment, absorptive capacity is the fuel providing process for designing offering that changes the strategic position of the company according to market conditions.

In this paper we consider exploration-exploitation dynamics especially from absorptive capacity point of view since absorptive capacity is about seeking external knowledge to be utilized in creating innovations, whether incremental directed to existing markets or more radical directed to new markets. We therefore consider all the offering portfolio changes to be both critical competitive activities and also to some extent exploratory as they are used a) to fit with environmental industry turbulence b) to change market position to some extent in light of market share changes and c) to apply at least to some extent new information either in technological or market domain. We also consider the temporal latency in turning external new knowledge into PACAP and further latency to turn this assimilated knowledge into RACAP and finally latency in turning exploited knowledge into portfolio of offering. Building on the above we are able to investigate managerial decision-making in a turbulent competitive environment by explicitly considering changes in the offering portfolio that is developed and launched as a result from activities in PACAP and RACAP.

RESEARCH METHOD

Data and main variables

In this paper our research question essentially deals with building an exploratory system dynamics (SD) model. We use the model to study how acquired knowledge being gathered and used by an organisation at some rates influences the knowledge exploration versus exploitation dynamics at the innovative output. Our approach is based on the composition of the elementary dynamics of organizational knowledge related routines and processes into PACAP and RACAP, by which firms acquire, assimilate, transform, and utilize knowledge. Both routine is associated with a dynamics of a simple stock. Each stock accumulates with inertia the correspondingly qualified information, knowledge, and technologies the organization has in its possession (Romme, 2004).

In our modelling effort we build on a history-friendly approach in developing our SD model (following Malerba et al., 1999, Walrave, Oorschot, Romme, 2011, Zott, 2003). The system dynamic simulation allows us to consider various scenarios and experiments in order to have informed settings for making decisions and experiments in real world (Sterman, 2000, 83). Usually, for a decision maker it is very difficult to comprehend the dynamic outcome of a decision or possible effects and causalities created by external shocks. Thus, the simulation of what-if scenarios can be used to aid decision making. However, at the same time system dynamic modelling needs to be theoretically grounded and well-justified, especially if attempts are made to understand real-world phenomena albeit in simplified setting and form. Additionally, we want to identify structures influencing the decision-making regarding acquisition of knowledge and turning this into innovative output with formal mathematical model forcing us to simplify our efforts. Thereby, the system dynamic simulation approach enforces internal consistency on our attempts making them transparent at the same time.

We gathered publicly available empirical data from a global high-tech industry considering product launches of all the companies in the industry. We have attempted to gather all possible product launches in the industry and also we triangulated the data across multiple public sources. Our modelling starts with the basic outline that product launches of a certain company are dependent on the product competition in its industry and its market share changes. Therefore, we assume that managerial decision-making regarding knowledge exploration and exploitation is dependent on the competitive industry conditions and changes in company's market position. Our modelling effort is therefore starting with the input variables that were measured as quarterly inputs.[1] We expect the smoothed time series to be path dependent, at least to some extent, and therefore smoothed this

[1] We expect information from markets to emerge continuously and therefore, our quarterly data does not reflect the process of information accumulation. Therefore, we deem necessary to smoothen our time series to reflect the continuous nature of information accumulation (as companies continuously launch new products to marketplace). Due to the exploratory nature of our study, we acknowledge that there are various different means to conduct this smoothing, but leave these considerations to future studies.

data to weekly time series using moving average with +/- 10 weeks weighted with Gaussian-distribution (max. 0.1) centred at t_0=0:

Corporate product launches; number of products launched by a focal company between 2003 and 2009.

Market share; percentage share of the markets measured with the share of products delivered between 2003 and 2009.

Industry product competition; the number of products launched by all competing companies in the industry between 2003 and 2009.

Using the above input data we simulated a history-replicating SD model. We build our model around theoretical constructs from absorptive capacity and we optimize our model's difference between real *Corporate product launch* time series and the rate of product launches resulting in portfolio stock, in our model by minimizing the sum of squared differences. Therefore, central constructs in our model include

PAC; represents PACAP (potential absorptive capacity)

RAC; represents RACAP (realized absorptive capacity)

PF; represents resulting product portfolio from the exploitation of knowledge that the organization has explored and transformed

With the history-replicating simulation we were able to estimate the additional constants in our model (outlined later in Model description section).

Additionally, we further explore boundary conditions of our model in history-divergent simulations with market share changes as a firm loses or wins markets to investigate how exploration and exploitation balance change in time. For this purpose we fix the *efficiency factor*, temporal inertia factors, and other constants to the values we have arrived in our initial history-replicating simulation.

The SD model

The dynamics of the knowledge processing is determined by the series of organizational phases and a related feedback loops (Romme et al., 2010). The feedback is based on the assumption that the rate of the acquisition is dependent on the need of knowledge in the utilization phase. The assumption is that there exists a negative feedback from the level of PACAP phase to the rate of the acquisition. The more knowledge is available the lower the acquisition rate, and vice versa.

Each stock has a rate of associated phase as an inflow and the rate of next phase in sequence as its outflow. The rate describes the efficiency associated to the corresponding routine of the organization. For example, if the rate of project kick off is high, it means the potential is converted rapidly to realized output. Correspondingly, if the rate of kick off is low, the potential capacity is converted slowly to the RACAP phase information and remains longer in the state of potential information. Thus, the rates can be considered as parameters describing properties of the organization and simulation with different values of parameters represents different scenarios of organizational behaviour. However, for the purposes of the present paper, we treat these as exogenous parameters that remain constant, i.e. represent status quo.

The level of knowledge in a stock is modelled as an integrator. The integrator can be formulated using a differential equation where the level of the stock is described by a variable x_i and the rate of its change as a time derivative $\dot{x}_i$.

$$\dot{x}_i(t) \sim r_i(t-\tau_i) - r_{i+1}(t) \qquad (1)$$

The stock increase is related to the amount of knowledge or decisions the corresponding routine has generated (r_i, where $i = \{acquisition, kick-off\}$) and decrease is related to the amount of the knowledge the routine in sequence has cultivated to the more advanced level. Besides the first order dynamics of the ideal stock, described by the first order derivative, the stock dynamics include also a delay dynamics associated to the stock inflow and presented as a delay constant τ_i. The delay constant represents the organizational inertia in the corresponding activity. The sequence of organizational routines and processes with corresponding stocks are presented in Figure 1.

The need for acquisition is defined by difference of two means; for one thing the rate is set by the desire for technology for exploitation and for another by the actual level of technology for exploitation. The outflow r_{i+1} from the acquisition stock is equal to the inflow to the next repository, stock of realized projects, and the value of the outflow is defined as a difference between the desired and realized stock level x_{i+1}. The need for stock increase and decrease are converted to actual flows by management decisions. In this model the decisions are described by a static factor, decisiveness K_i. Then the relation in Eq. (1) can be presented as

$$\dot{x}_i(t) = K_i\left(r_i\left(t-\tau_i\right)-r_{i+1}\left(t\right)\right) \tag{2}$$

The other stocks are defined respectively. For the stock describing the product portfolio the output describe how part of the portfolio becomes obsolete. This outflow from portfolio is then described by differential equations as follows:

$$\dot{x}_i = o_i x_i \tag{3}$$

where the variable o_i describes the rate of failure or rate of becoming obsolete. The value for rate of becoming obsolete is treated as an exogenous parameter in the present study and is assumed constant and it describes the average lifetime of a product.

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insert Fig. 1 about here

For the simulation purposes the model in Eqs. (1)-(3) is described as a time-continuous model and presented as a set of differential equations. The use of continuous model is justified by the efficiency of the simulation and by the intuitive interpretation of the model coefficients. The model is implemented using Vensim Professional (available from Ventana Systems, www.ventana.com).

The model contains a feedback such that the level of product portfolio is also used to set the desired levels of PACAP and RACAP phases, representing managerial decision-making variable. If the level of portfolio is exceptionally low, the desired levels are increased. The feedback, illustrated in Figure 1, is influenced also by industry turbulence (described by industry product launch rate) and by the company's market share.

In this study the properties of the organization and the managerial decisions are assumed to be fixed and in the model they are presented by six coefficients. The model is tuned such that the coefficients describing the inertias associated to the flow rates between the stocks, coefficients of converting the market-based pressure to the desired levels of stocks, and the decisiveness factor associated to the flow rate between the stocks are fitted to the data. The objective of the data fitting is to adjust the model to produce similar product launch rate as in the operationalization data. In our history-replicating simulations we estimated values for these six coefficients as follows: Decisiveness (0.028), Desire factor (146.86), Pressure factor (255.38), Acquisition Inertia (42.88), KickOff Inertia (4.00), and Launch Inertia (28.16). The model contains also a coefficient that describes the average lifetime of a product. In the simulations it is defined to be 39 weeks. The roles of these coefficients are illustrated in Fig. 2.

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insert Fig. 2 about here

The development of the SD-model contains also the definition of a stationary solution. The model was simulated with stationary input data. The resulting stock and flow values were recorded and stored as the initial stocks levels and initial values for the delayed flows, respectively. The selected values were *PAC* (3.62), *RAC* (3.62), *PF* (19.48), and *Knowledge Acquisition Rate, Product Launch,* and *Project KickOff* (all 0.499). The initial values for the stocks are used also in the simulations where the operational data start with a 28 week period of stationary values.

SIMULATIONS AND RESULTS

Our simulations included both history-replicating and history-divergent simulations with our SD model. History-replicating simulations were used to investigate properties of our SD model, investigate its purposefulness with real life data and estimate the coefficients that we used in our history-divergent simulations. In contrast, history-divergent simulations were used to investigate hypothetical managerial reactions our SD model produces to external market and industry changes.

Fig.3 gives a representation of the input variables of the real empirical data we used in our history-replicating simulation. These represent a case company with *CORP Market Share* and *CORP Product Launch* time series in the selected high-technology industry with *Industry Product Launches*.

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insert Fig. 3 about here

As can be witnessed in the Fig. 3 all the variables are highly dynamic. Market share of the case company has changed rather dramatically in the time frame of our analysis. The amount of products launched by the company has also high variability with harmonic fluctuations in-built in it. Additionally, the product competition represented with Industry Product Launches in the industry has increased during the timeframe, although also this variable shows significant temporal changes. In summary, this empirical setting provides us with fruitful grounds for conducting the history-replicating simulations as it represents various alterations in corporate and environmental conditions.

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insert Fig. 4 about here

In Fig. 4 we present the results of our history-replicating simulation. Interestingly we witness that the dramatic drop in market share before 90 weeks leads (with temporal latency) to sharp increase in RACAP which subsequently draws the PACAP empty. Naturally, RACAP starts to decrease after this, but as soon as it is possible increases yet again depleting PACAP second time. At this point, we see that product launches reach a peak, before turning sharply down after RACAP is depleted by product launches. As the RACAP goes close to halt, product launches also go dramatically down. Similar cause-effect can be witnessed (with longer temporal latency) between PACAP and product launches, as we would expect. However, notably we also see that managerial discretion in decision-making changes the relationships between these variables in time. For example, from around week 300 to week 330 PACAP increases steadily, RACAP decreases steadily, but all the same product launches is increasing steadily. This signifies that RACAP stock is able to fulfill the demand by product launches, and PACAP anticipates the depletion of RACAP and therefore is increasing.

In conclusion we may draw from the above that our SD model behaves as expected but in order to verify whether we are able to generate meaningful output with our model in relation to real world product launches we further studied the real *Corporate product launches* in relation to our model's output of *Product Launches* in Fig. 5.

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insert Fig. 5 about here

Fig. 5 shows the CORP Product Launch time series from our SD model in comparison to the history-replicating time series of real *Corporate product launches*. As can be seen from the Fig. 5, our model produces reasonably good fit with the real time series, mostly following the dynamics of the real time series (correlation being 0.72). However, we also note that our SD model stabilizes on lower levels of product launches than the real time series, although following the dynamics of the real time series. Finally, we also investigated the efficiency factor i.e. RAC ratio to PAC of our SD model in history-replicating simulation in Fig. 6.

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insert Fig. 6 about here

As the PACAP goes near zero three times in our simulation also the efficiency factor rises sharply in the few instances. Therefore, we have restricted the scale in Fig. 6 to highlight the dynamics of the efficiency factor during our history-replicating simulation. Noteworthy in the trajectory of the efficiency factor is the very sharp decline around week 150 as the RACAP nears zero. At this point, also product launches of the company decrease to their lowest point in our time series. This signifies the managerial decision-making of exploiting all possible knowledge at stock and transforming PACAP to RACAP in a speedy fashion. Therefore, the product launches necessarily go down. Therefore, market share stabilizes for a moment to lower levels although it was rising before this rapid decrease in the efficiency factor.

The above history-replicating simulation gives us stable parameter estimates in our SD model that represents the process of our real life case company. Additionally, we wanted to investigate how our model would react to certain external stimuli and what the resulting reaction would be. For this purpose, next we present the results of our history-divergent simulations as we change the input variables representing external environmental condition. We change in our first history-divergent simulation the market share of the corporation with a step function *ceteris paribus*. In our second history-divergent simulation we change industry product competition with a step function *ceteris paribus*.

We determine the step function to the change in the market share +15% and -15% of the organisation and follow our SD model for an impact of these changes in our first history-divergent simulation. Our baseline model is built in such a fashion that the firm falls into the success trap (following Walrave et al. 2011) when the firm encounters positive market reaction. Namely, our *Perceived Pressure* is dependent on *Relative Delta MarketShare* and downplays positive market share changes as percentage changes. This is a reasonable expectation as managerial decision-making would follow its current course as the results in the marketplace are good.

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insert Fig. 7 a, b, and c about here

Therefore, the positive step change in the market share produces only marginal reaction in absorptive capacity process (see Fig. 7a, 7b , and 7c). In contrast, Fig. 8 presents results of our history-divergent simulation with negative market share change.

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insert Fig. 8 a, b, and c about here

As can be seen in Fig. 8b our SD model exhibits long temporal fluctuations resulting from the market disturbance. The managerial decision-making follows the logic of rapidly increasing RACAP in order to have new product launches to react to negative market share change. This necessarily results in a flow to product launches and portfolio PF stock increases with latency after this reaction. PACAP on the other hand is decreasing rapidly as the RACAP depletes this stock, and PACAP is rapidly getting too small to be able to fill the RACAP which results in rapid increase of PACAP at same time as RACAP needs decrease. This resulting increase in *efficiency rate* in Fig. 8 c rapidly after the negative market share change signifies the managerial decision-making of short-term product launch emphasis and subsequently efficiency rate decreases as rapidly as it increased as the increase in RACAP leads to depleted PACAP which then turns to increasing trend but RACAP is already due to latencies decreasing. Importantly, we also note that the resulting efficiency ratio remains under its optimized value in our SD model for about 200 weeks. This inferior efficiency ratio could be avoided with rather small resource allocations in PACAP and long-term orientation in managerial decision-making.

In our second history-divergent simulation set we change the product competition with a step function increasing and decreasing product launches in the industry (increase from 2.85 to 4.0 and decrease from 2.85 to 1.7 weekly product launches).

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insert Fig. 9 a, b, and c about here

When the industry's product competition increases rapidly, managerial decision-making in our SD model (similarly to negative market share change) increase RACAP in order to increase product launches and PF. Resulting this is the depletion of PACAP. Interestingly, though, PACAP increases to a very high level albeit with temporal inertia and PACAP remains at high levels from about week 170 till the end of our simulation run. The increase in industry competition therefore stabilizes our SD model to higher levels in PACAP, RACAP and product portfolio PF. Following, the efficiency factor increases rapidly after the introduction of increased product competition as RACAP is increasing and PACAP decreasing. However, we note the efficiency factor stabilises relatively fast after the external change although PACAP and RACAP remain rather dynamic.

In our final simulation we decreased the industry competition and in Fig. 10 we see that this results managerial decisions to follow suit in the industry trend, much similar to our previous results on increasing product competition.

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insert Fig. 10 a, b, and c about here

The managerial decision-making therefore rapidly decreases RACAP following industry trend of launching less new products to marketplace. But what is really interesting here, is that our SD model increases PACAP, in other words long-term orientation in managerial decision-making is strengthened and managers seek to enhance exploration of new external knowledge. This is also reflected in the sharp rise in RACAP after the initial decrease to higher level than the original stabilized value. PACAP reaches its peak around 40 weeks and RACAP peaks around 60 weeks after the product competition change. The output variables also naturally stabilize in our model to lower levels due to decreased industry competition and the stock levels are changed to represent new industry condition. Also, the efficiency rate initially decreases rapidly after the decreased product competition as RACAP is decreasing and PACAP is increasing. However, the latencies in absorptive capacity process drive the RACAP to fluctuate while PACAP after initial rise falls rather steadily to lower level. This highlights the steady decrease in the PF and signifies the adjustment process in managerial decision-making to new product competition conditions.

CONCLUSION

The core results of our simulations are twofold. Firstly, we were able to reproduce real life dynamics with history-replicating simulation and additionally reveal some interesting phenomena with history-divergent simulations. Specifically, our model may be used to investigate organizational responses and dynamics of decision-making with various what-if scenarios. Secondly, and more importantly, the rate of reactions to external conditions as resulting in product portfolio changes are inertial in nature but also take a long time to stabilize. Our simulations reveal that even singular change in environmental conditions changes the short-term dynamics in managerial decision-making in favour of balancing product portfolio. At the same time, though, the long-term effects of this resource allocation to short-term goals easily leads to inferior position in depleted potential absorptive capacity, PACAP, which then with temporal latency results in inferior realized absorptive capacity, RACAP. Taken together, these effects diminish alternatives in creating innovations in the long-term, and therefore increasing RACAP and subsequently efficiency factor may not lead to superior strategy in comparison to being prepared and increasing PACAP and decreasing efficiency factor (much in the same light as Jansen, Van den Bosch, and Volberda, 2005 found turbulent environment’s influence).

Therefore, our simulations clearly point to the need of balancing the long and short term emphasis in balancing the efficiency factor and call for future research in this avenue.

The considerable deviation between the long- and the short-term orientation in balancing knowledge exploration and exploitation could be decreased by more sophisticated managerial decision-making mechanisms. These mechanisms should especially pay critical attention to the pressure and desire factors in decision-making, and decisiveness of activities in addition to internal inertial conditions. All these are in the domain of managerial decision-making in creating a corporate culture that minimizes the temporal latencies and also reacts swiftly to changes. However, inertia also plays to the advantage of the firm as it levels-out the overly reactive short term activities. Our results may therefore point to the organizational inertia being successful strategy (following e.g. Carroll et al., 1996). Also, our history-divergent simulations reveal some interesting results showing that the managerial decision-making may follow rather closely the industry recipe type of notions (e.g. Matthyssens et al., 2006) and restricting organisations to these activity patterns for rather long time-frames. These results open new fruitful avenues for future research in investigating industry recipe and different competitive actions either following or deviating from the recipe itself.

Naturally, our approach has some limitations. This simulator was implemented with simple feedbacks with unit gains. A more accurate feedback result is possible with increased feedback gain. Additionally, the dynamics of knowledge exploration versus exploitation need to be considered in detail in future research since these co-vary in time. We also expect the managerial feedback loop from portfolio to knowledge exploration and exploitation to have more time varying nature. This is reasonable assumption but relates back to managerial decision making. Similarly, we can identify other managerial parameters that influence the dynamics witnessed in our results. These could pave the way for fruitful future investigations.

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Figures

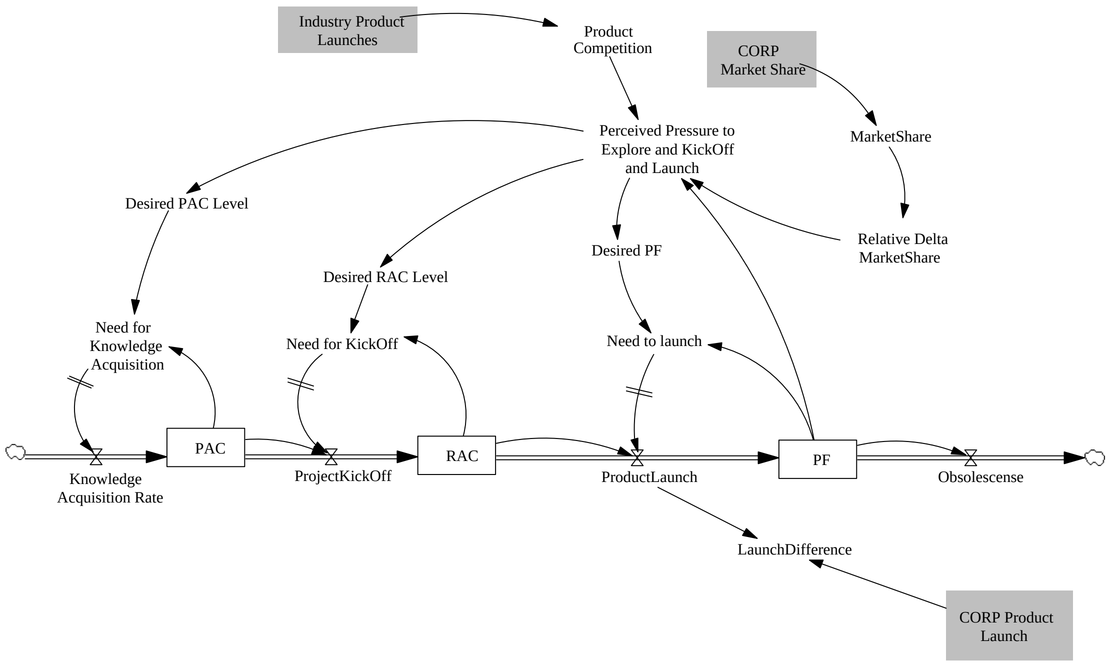


Figure 1. The sequence of organizational routines and processes where the knowledge is acquired, converted to operationalized knowledge and then to existing product portfolio.

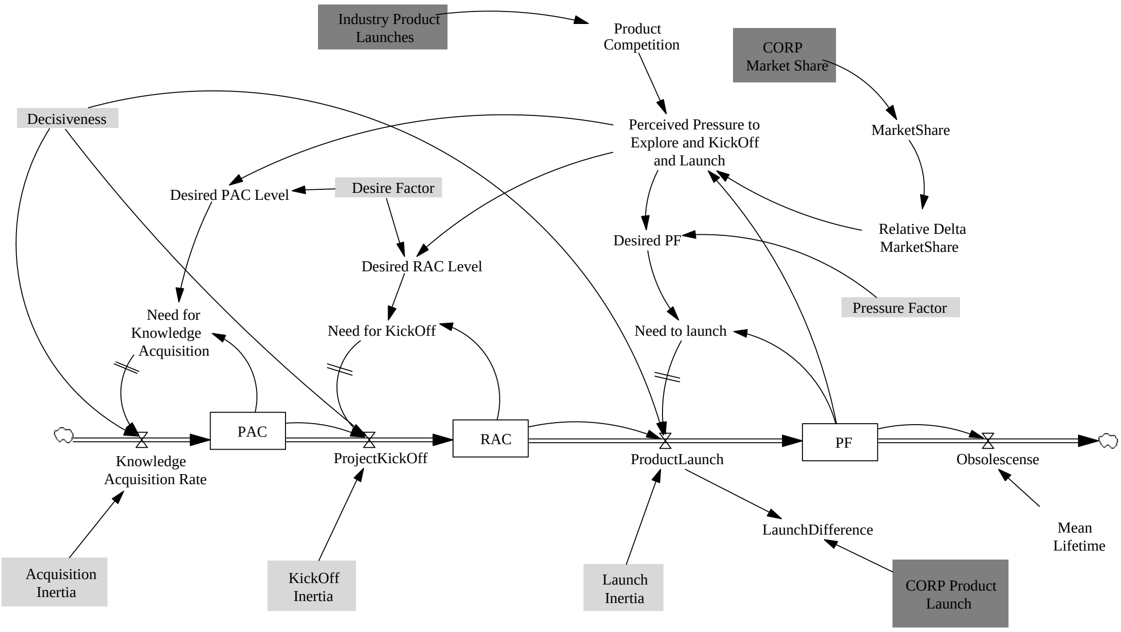


Figure 2. The full model representing organizational and managerial properties and model coefficients.

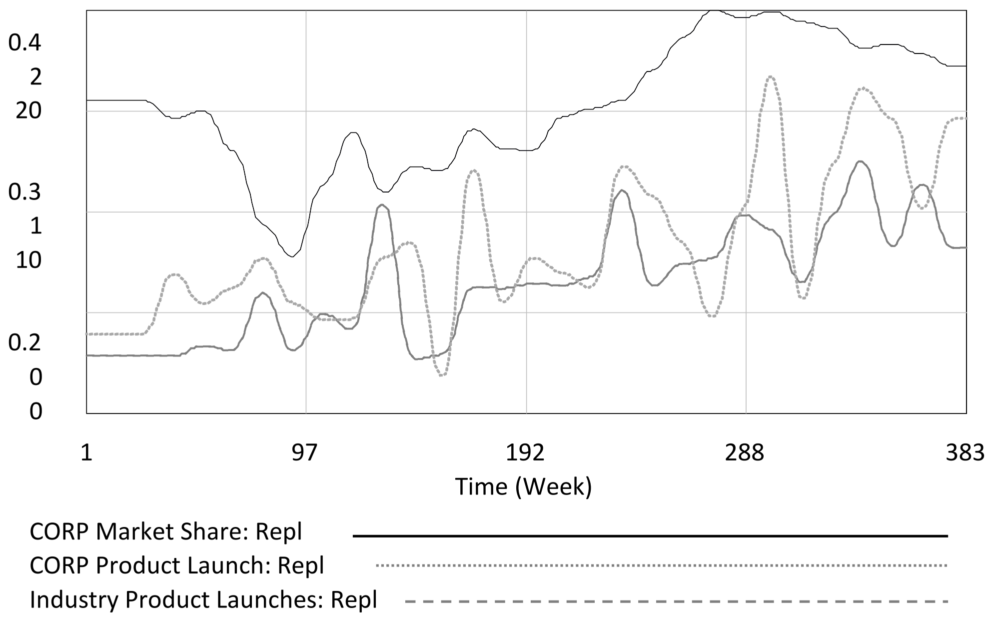


Figure 3. Input variables in our history-replicating simulation.

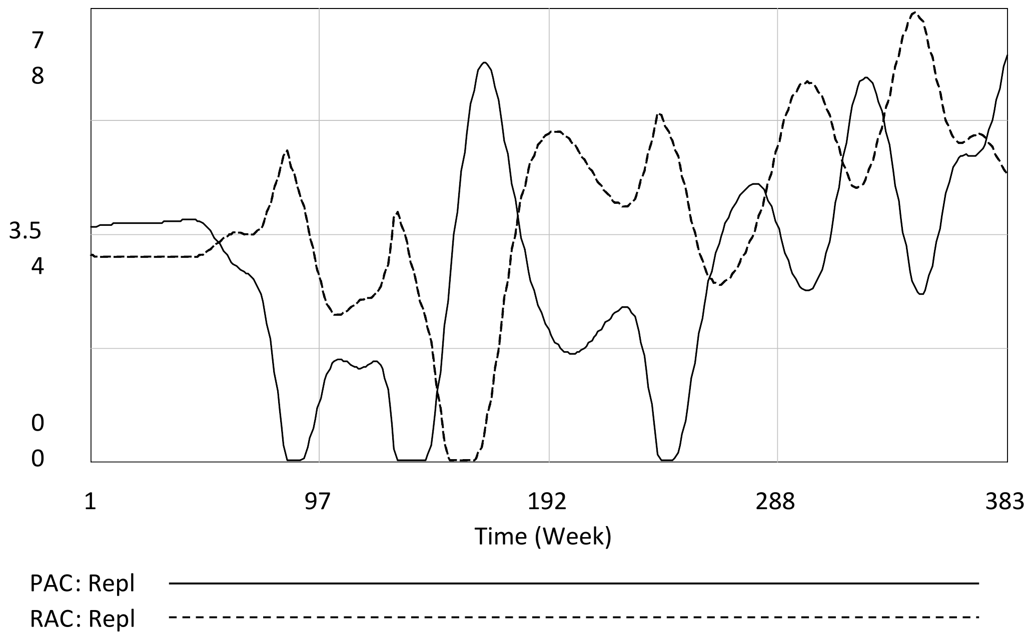


Figure 4. Results of our history-replicating simulation presenting PACAP and RACAP.

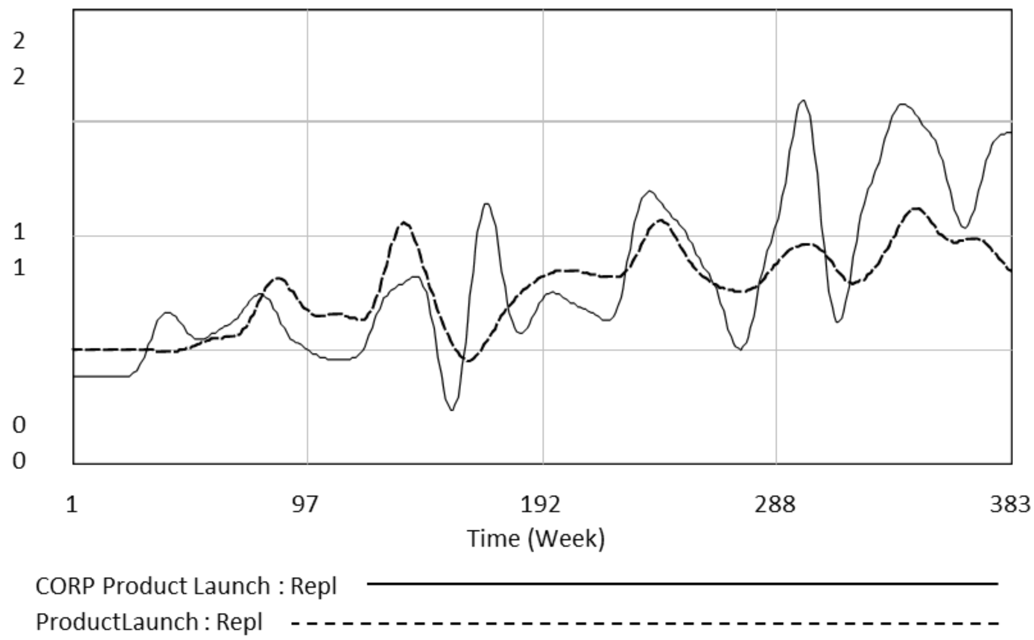


Figure 5. *CORP Product Launch* of our SD model and *Corporate product launch* input in our history-replicating simulation.

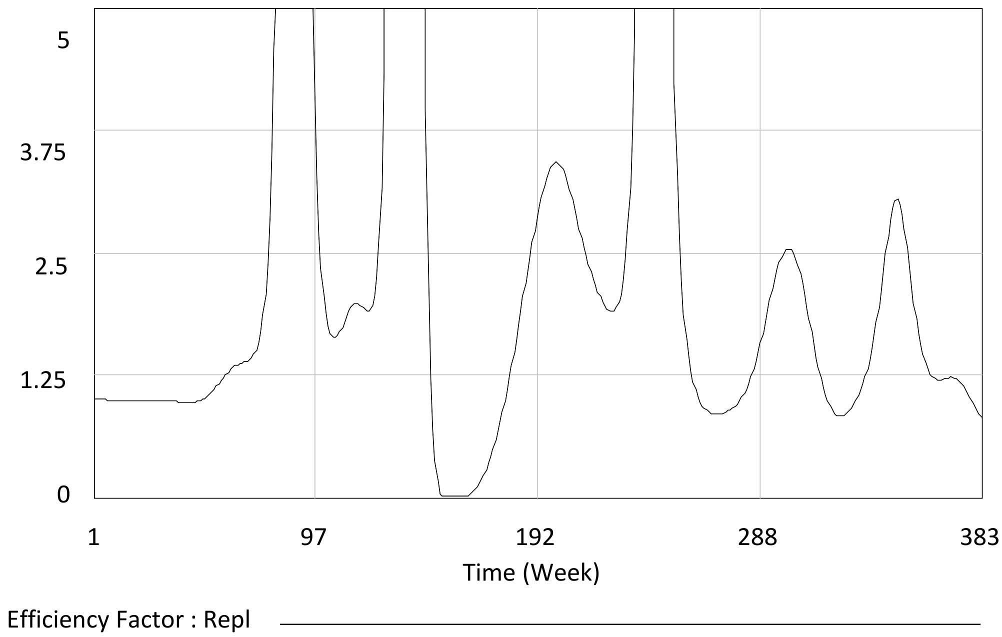
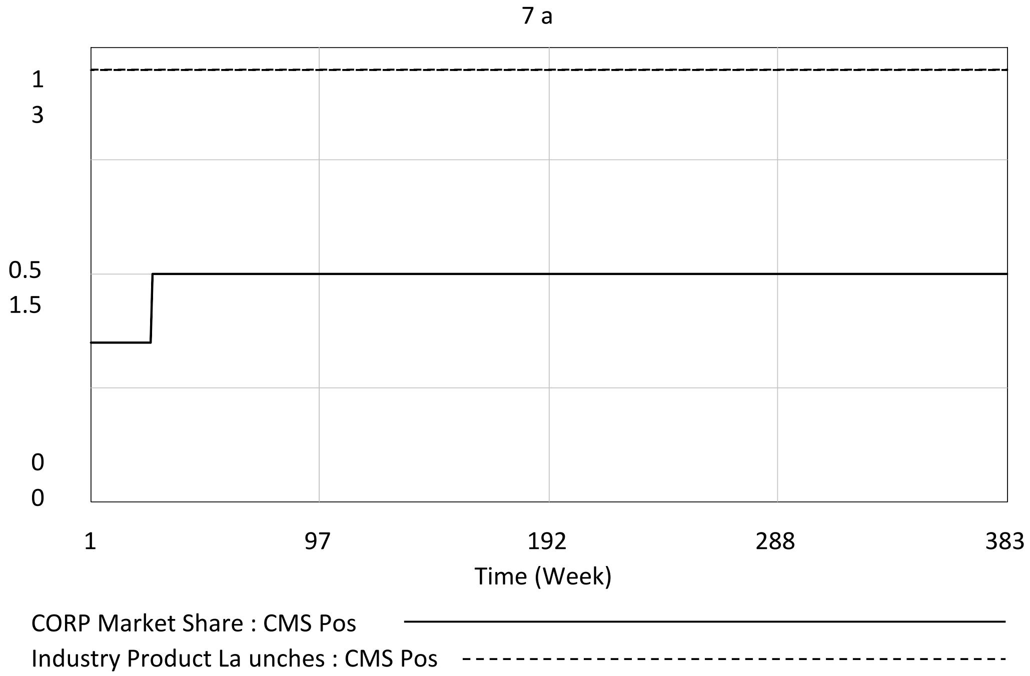


Figure 6. The *efficiency factor* of our SD model input in our history-replicating simulation.


7 a
1
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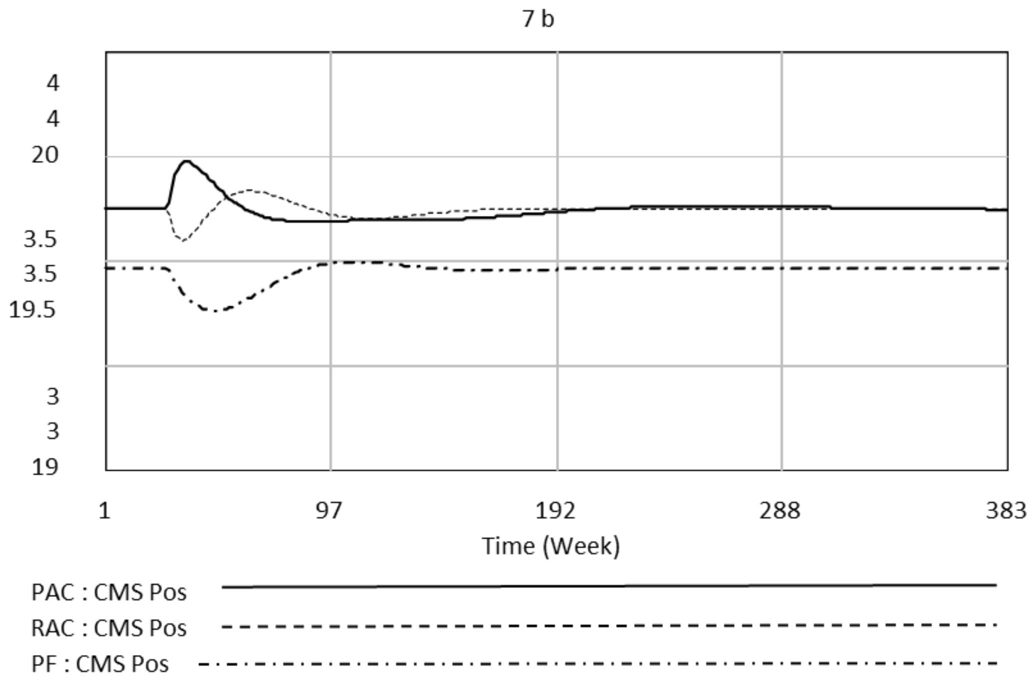
97
192
288
383
Time (Week)
CORP Market Share : CMS Pos
Industry Product La unches : CMS Pos


7 b
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Time (Week)
PAC : CMS Pos
RAC : CMS Pos
PF : CMS Pos

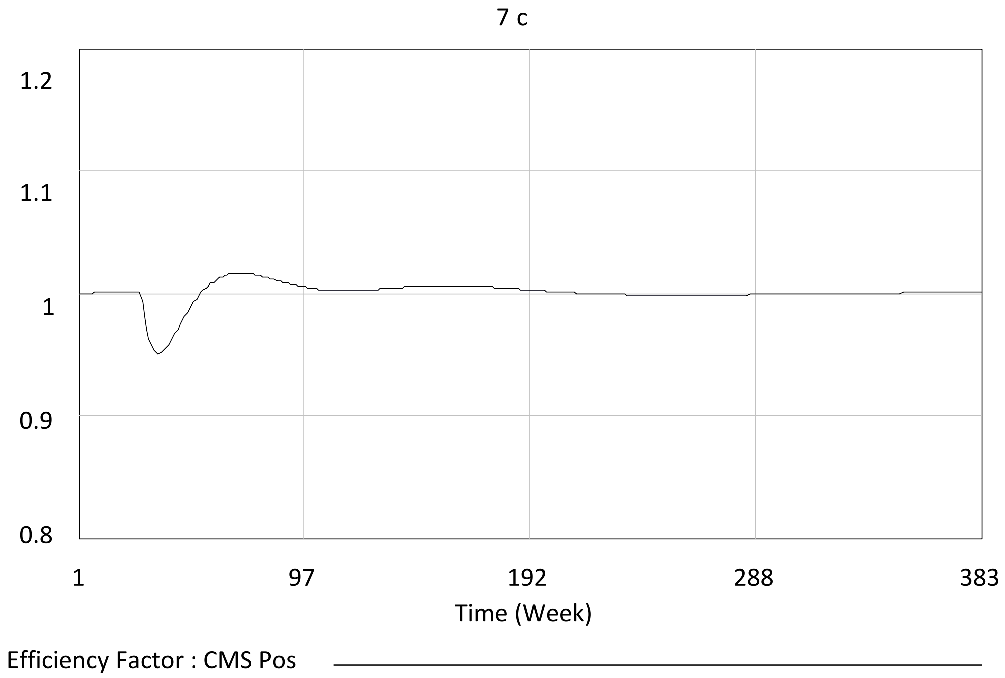
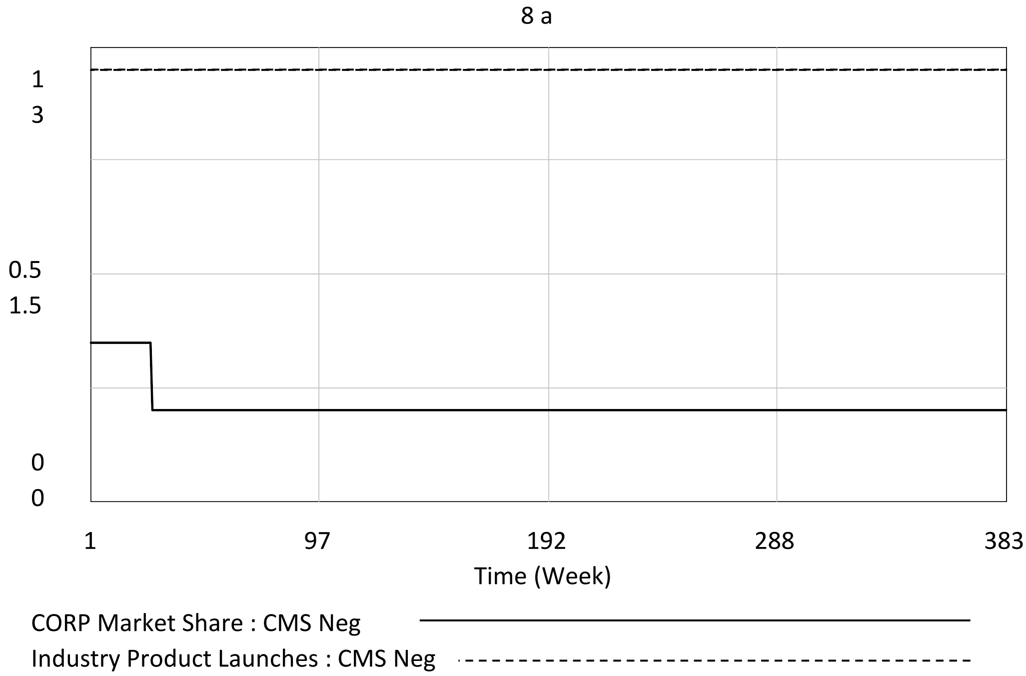


Figure 7. Our history-divergent simulation of positive market share change (share of 35% increases to 50%). Figures represent (a) input data (step-change in CORP market share, constant Industry product launch), (b) PAC, RAC and PF, and (c) efficiency factor.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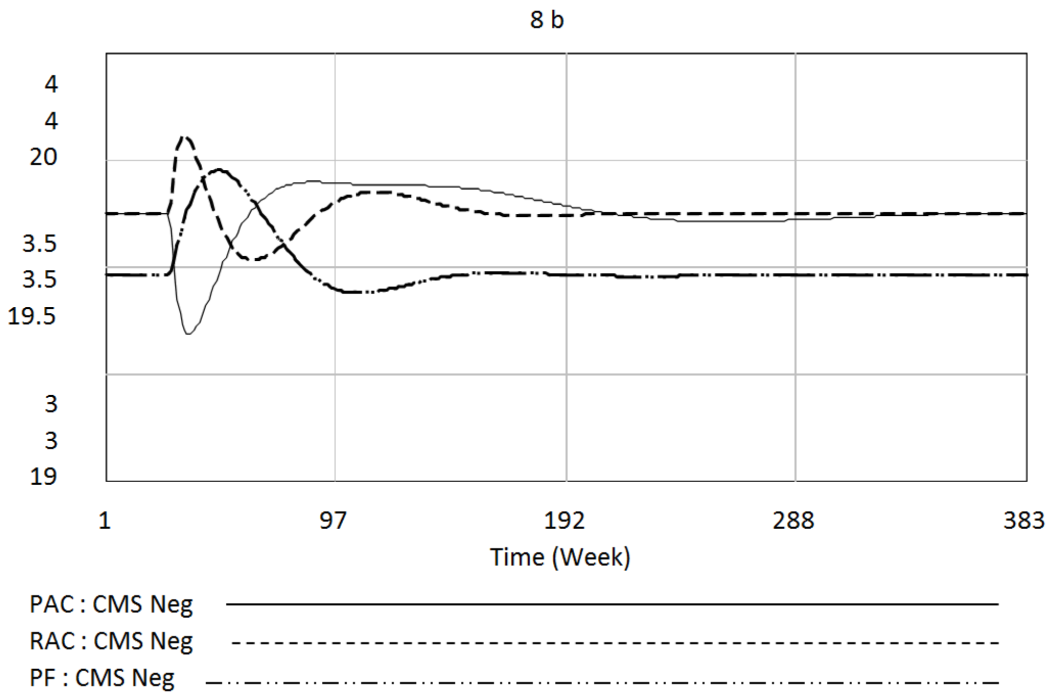
Time (Week)
CORP Market Share : CMS Neg
Industry Product Launches : CMS Neg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Time (Week)
PAC : CMS Neg
RAC : CMS Neg
PF : CMS Neg

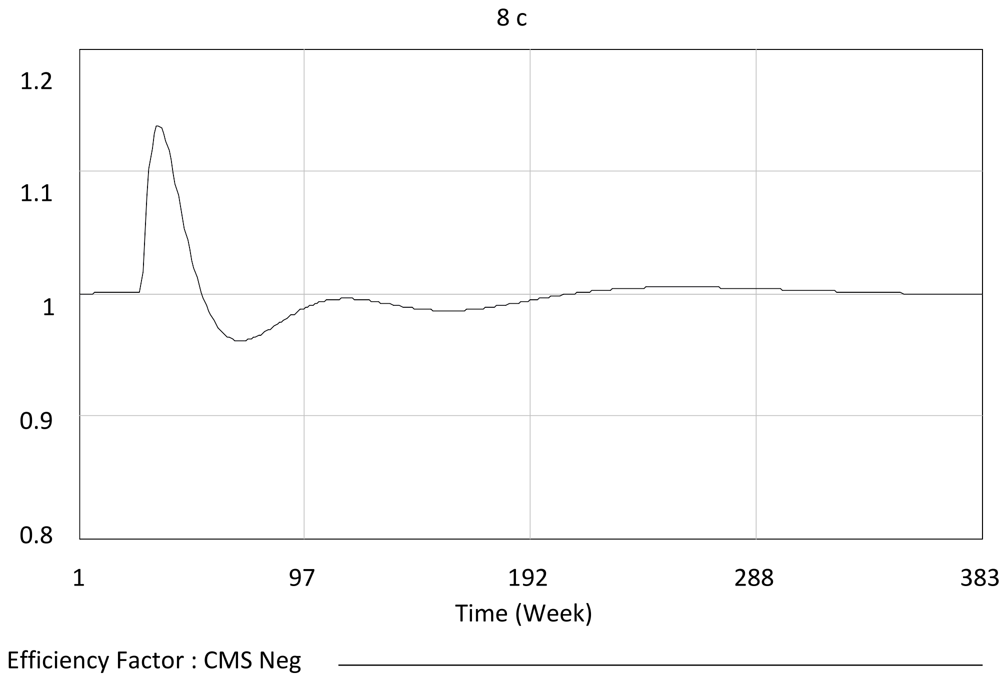
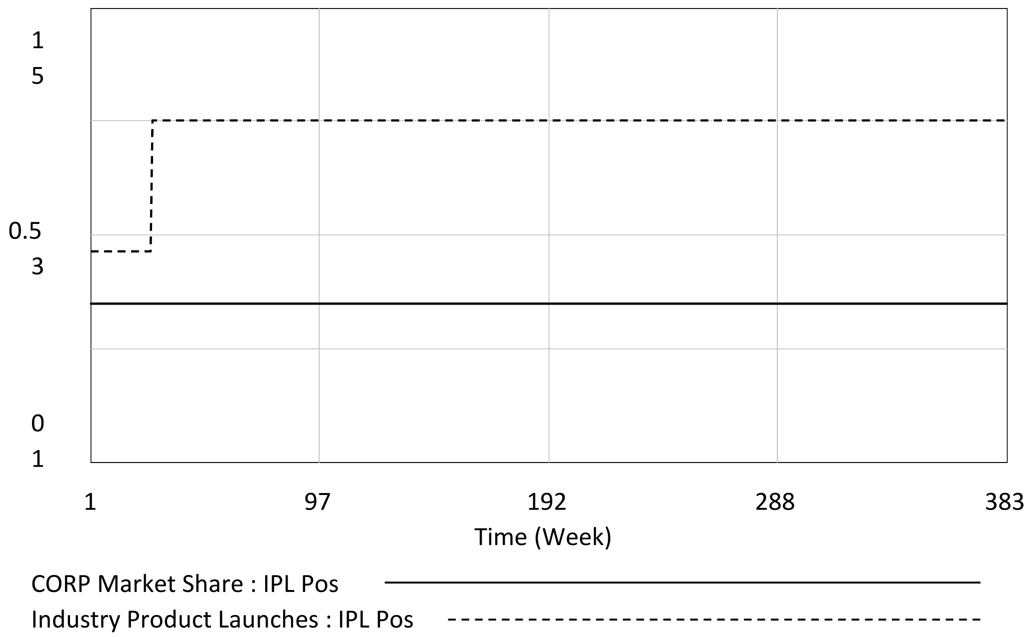


Figure 8. Our history-divergent simulation of negative market share change (share of 35% decreases to 20%). Figures represent (a) input data (step-change in CORP market share, constant Industry product launch), (b) PAC, RAC and PF, and (c) efficiency factor.

9 a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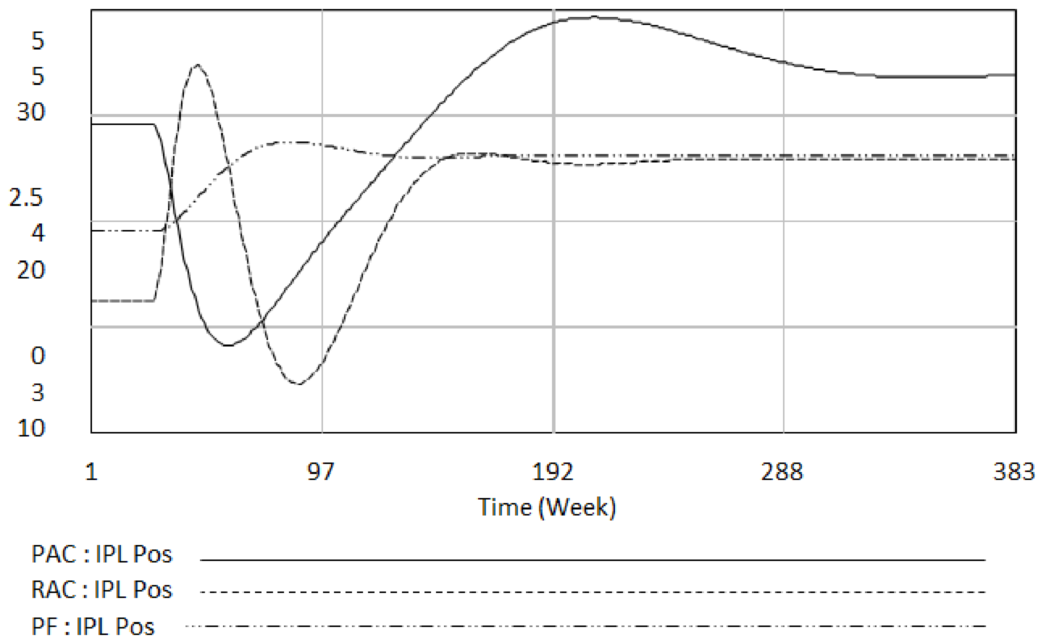
Time (Week)
CORP Market Share : IPL Pos
Industry Product Launches : IPL Pos

9 b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Time (Week)
PAC : IPL Pos
RAC : IPL Pos
PF : IPL Pos

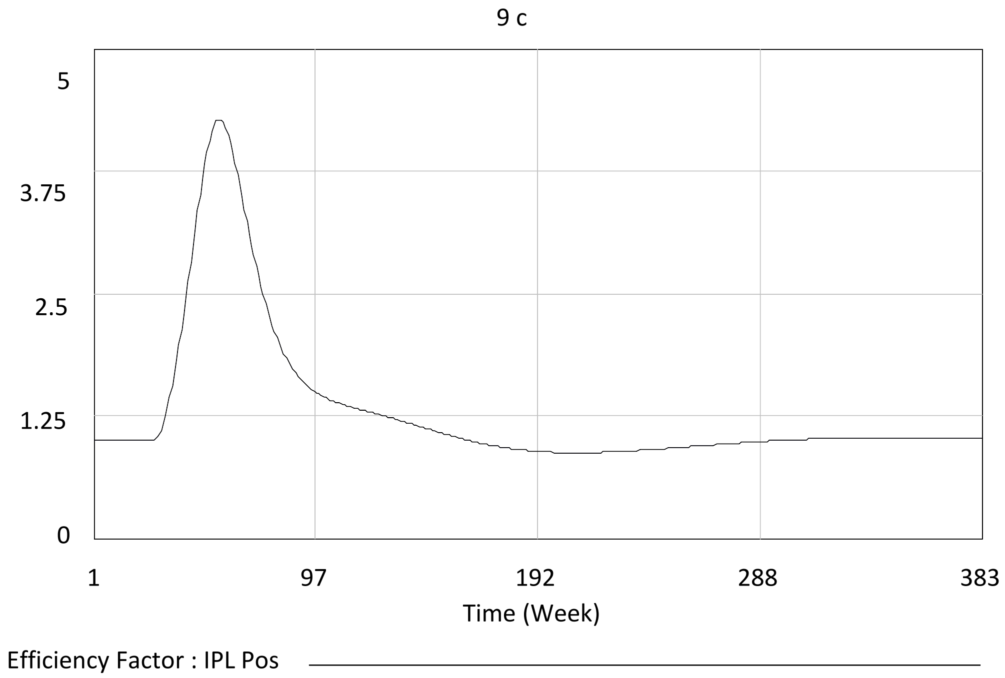
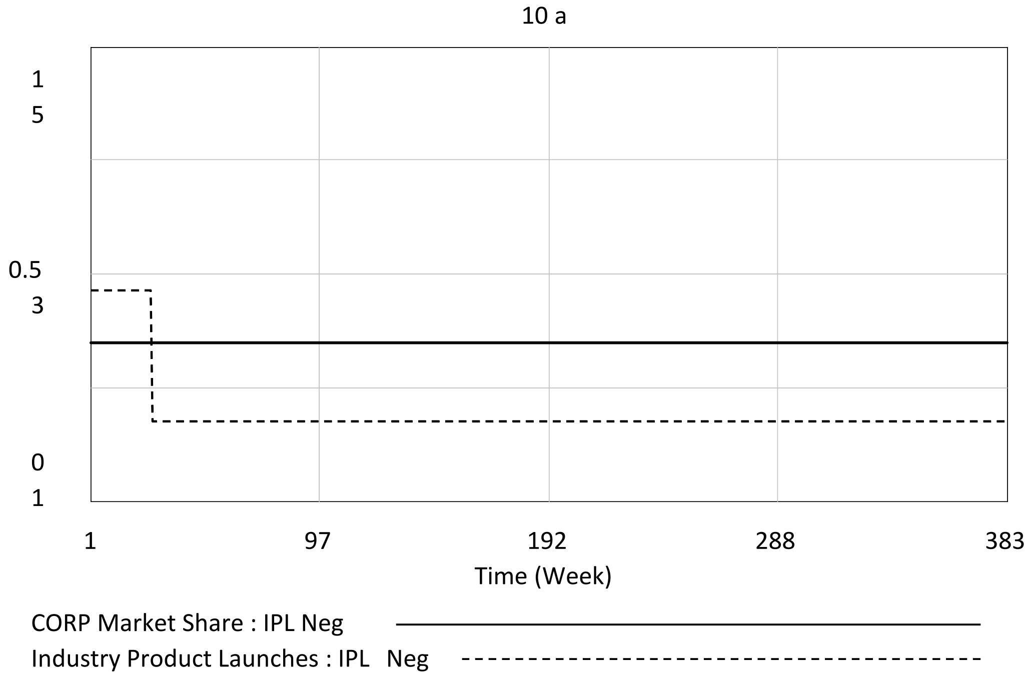


Figure 9. Our history-divergent simulation results of increase in product competition in the industry (Industry product launch increases from 2.85 to 4.0 weekly product launches). Figures represent (a) input data (step-change in CORP market share, constant Industry product launch), (b) PAC, RAC and PF, and (c) efficiency factor.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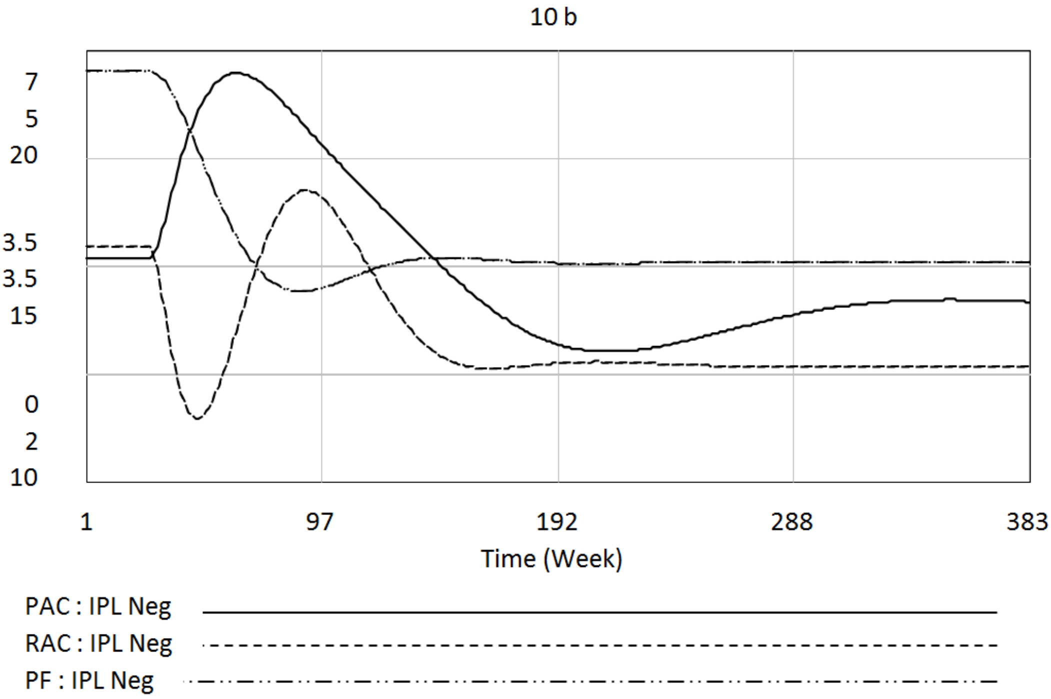
Time (Week)
CORP Market Share : IPL Neg
Industry Product Launches : IPL Neg


10 b
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Time (Week)
PAC : IPL Neg
RAC : IPL Neg
PF : IPL Neg

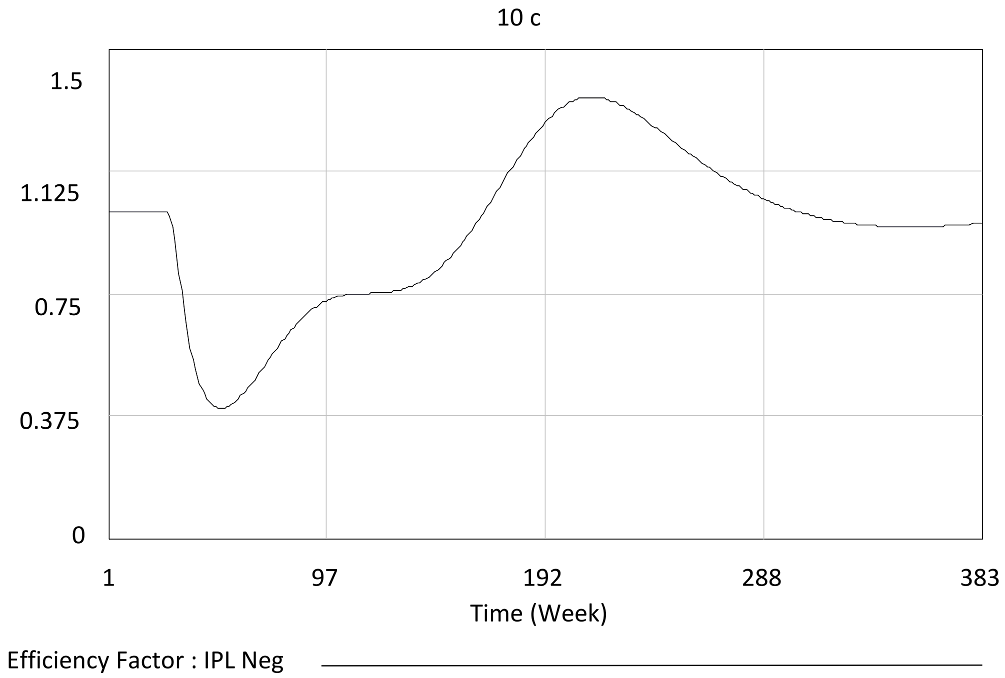

Figure 10. Our history-divergent simulation of decrease in product competition in the industry (Industry product launch decreases from 2.85 to 1.7 weekly product launches). Figures represent (a) input data (step-change in CORP market share, constant Industry product launch), (b) PAC, RAC and PF, and (c) efficiency factor.