# Policies influencing the diffusion of instant messaging

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*Abstract*

*Many information and communication products show characteristics that are called network effects or positive demand externalities, i.e. their utility for users depends on how many other people also use the product. The paper investigates the diffusion of such products. Instant messaging is taken as an example. Strategic options of the players in the instant messaging market are presented and analyzed on the basis of a system dynamics model.*

Despite the bust of the so-called "New Economy" there can only be little doubt that in today's economies networks have become crucial. This statement can be understood in two ways. Firstly, we observe a proliferation of computer networks giving the ability for apparently indefinite chances to communicate and to access information. Secondly, we realize the increased importance of informal networks constituted by users of a product or technology that leads to an inter-dependency of these users (Shapiro and Varian 1999).

The trend towards an information society has emphasized the importance of goods satisfying information and communication needs. Most of these products are said to show positive demand externalities, also called "network externalities". Network externalities are present when the number of consumers who purchase a particular good is an important characteristic of that good, which affects the utility derived by consumers either directly or indirectly (Katz and Shapiro 1985). Classical examples of goods showing network externalities are fax machines, e-mail, or computer platforms.[1]

In a systemic view this can be described as a positive feedback: the more adopters use a product ("installed base"), the higher the utility for others using this product will be, hence, the more likely others will be attracted to its use, and so forth. New adopters are attracted by communicating with current adopters. Ultimately, the number of potential adopters of a product limits the growth process. A causal loop diagram depicting these feedback loops is shown in Figure 1.

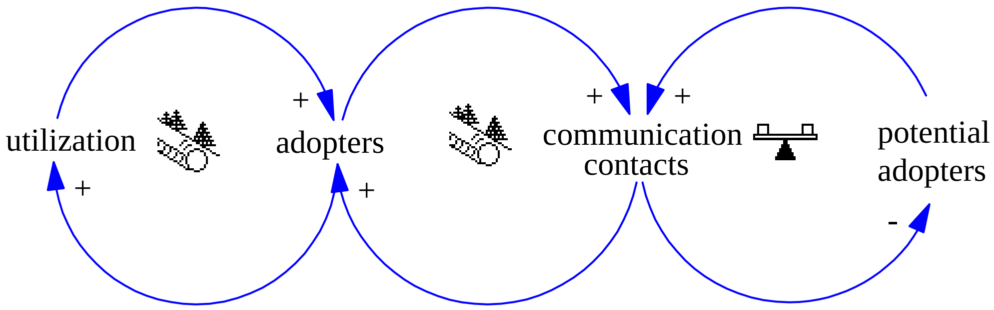


Figure 1: Causal loop diagram of diffusion with network effects

Many implications have been derived from the positive feedback structure, for example the need to grow faster than the competition with the consequence of accumulating high losses during the growth period (Kelly 1998, Evans and Wurster 2000). Also, concepts like compatibility and switching costs of customers have become important (Shapiro and Varian 1999).

The next section contains a brief literature review on system dynamics studies about product diffusion. After that, the domain of application discussed in this paper—instant messaging—is described. The third section presents the structure of a system dynamics model that is used for policy analyses in the instant messaging market. Such analyses are conducted with the help of simulation experiments in the following section. The last section of this paper deals with the transferability of insights to other markets and with future research that needs to be done.

## Diffusion models in the system dynamics literature

Diffusion models are one of the most prominent and wide-spread uses of system dynamics modeling. For instance, one can find papers about diffusion processes in all proceedings of the last five system dynamics conferences (1997–2001). Past issues of the System Dynamics Review contain some articles about diffusion, for instance Milling (1996) and Maier (1998). Areas of application discussed in the system dynamics literature are, for example, the diffusion of computer chips, digital TV, special drugs, online banking, etc.

One of the most popular diffusion models for conventional products is based on the work of Bass (1969). It is the basis of most system dynamics diffusion models. As a mixed-influence model, it integrates effects of mass and personal communication (Mahajan and Peterson 1985). It distinguishes between two types of customers: innovators and imitators. Innovators become customers because they are interested in novelties. Imitators ground their decision to buy a product on the behavior of other members of the population. The basic Bass diffusion model and many derivatives and improvements are reviewed in Mahajan et al. (1990). Some further elaboration and clarification on his model can be found in Bass et al. (1994).

Sterman (2000) gives a basic feedback-oriented interpretation of the Bass model that consists of a balancing (advertising) and a reinforcing (word-of-mouth) feedback loop. The model he develops is a first-order system (with two mutually dependent stocks); the adoption rate is determined by the advertising and the word-of-mouth effect and limited by market saturation. As an example, the diffusion of VAX computers in the 80s is replicated with the help of the small system dynamics model.

Milling (1996) and Maier (1998) have employed and enhanced Bass's ideas in various system dynamics based analyses of product diffusion processes. Their usage of system dynamics is motivated by shortcomings of the original concept that provides no explanation (1) why diffusion actually occurs, and, (2) how the diffusion process can be influenced by management (e.g., using different price strategies). Their modeling approach includes the explicit consideration of competition, repeat purchases and product substitution by newer product generations that are technically more advanced and that cannibalize earlier product types.

Recently, Thun et al. (2000) have conducted a pilot system dynamics study on how to influence the diffusion of products with network externalities. With the help of a relatively small system dynamics model, they investigated different strategies to secure sales growth and market penetration of a single network product. As basic findings they state the necessity to augment "the pool of interesting communication partners of every user in the installed base. Ways to achieve this are

- marketing measures to make users communicate more with each other and also with formerly unknown people (e.g., 'communities'),
- technical advances that make it possible to use a network product in new ways. This would primarily increase the utility of the product but—in a next step—could also make users communicate with new people (e.g., 'SMS'). Furthermore, communication with more than one partner could be made possible (e.g., 'conferencing'), and
- extending the installed base indirectly by creating compatibility to other products." (Thun et al. 2000)

However, their approach is limited to the examination of a hypothetical network product. Furthermore, they do not consider dependencies of competing network products. This paper tries to build on the work of Thun et al. (2000) by applying a system dynamics model of similar scale and scope to the real world diffusion of instant messaging, which is discussed in more detail in the next section.

The model in this paper resembles Sterman's (2000, p. 393) model of network effects. The differences compared to his approach are the threefold: (1) the number of competitors is extended to three because of the instant messaging market's characteristic, (2) a product's attractiveness is described and explained in more detail, and (3) discards and repeat purchases are possible.

**Instant Messaging**

Instant messaging (IM) is an Internet application that allows communicating directly and synchronously with partners all over the world using not only text (like Unix chat programs do for twenty years now) but also other media, for instance, graphics, sound and video. All data is transmitted in real-time. Other than e-mail, instant messages—as the name implies—can be seen instantly on the screen of the communication partner. Users just need to start the application once which then allows to chat, exchange pictures or send files.

A precondition for communication, however, is that communication partners use the same software program because most of the widely used clients are not compatible with each other. They use different, proprietary protocols for data exchange and have different user interfaces.[2] Furthermore, users need to exchange their IM addresses beforehand and they must mutually accept each other as a potential communication partner within the software ("buddy list"). If users log in they immediately get the information which of their buddies is online, and, vice versa, they are displayed as being online as well to their partners. One can exchange messages with one specific communication partner or with a group of partners.

Technically, three modes exist how IM works: (1) a centralized connection, (2) a peer-to-peer connection, or (3) a combination of both. In a centralized connection all users are connected via a network of servers, which handle all data transmission activities. In a peer-to-peer connection only log in information is managed by a central server. After establishing a communication path between two (or more) IM clients, data is transmitted directly between these clients. In a combination solution, small (text-based) messages are send via servers, bigger files (like voice or graphics) are transmitted directly from client to client.

The first successful instant message client was ICQ ("I seek you") from Mirabilis, launched in 1996. In the first two years the program was downloaded more than 10 Mio. times. Shortly after the success of ICQ became evident AOL launched a similar product called AIM (AOL Instant Messenger), which allowed easy communication between all AOL users. In 1998 AOL acquired Mirabilis including ICQ. Microsoft entered the instant messaging market in 1997 with its product Microsoft Messenger and has acted as the basic competitor of AOL since. Furthermore, there exist smaller providers of instant messaging services and applications, for instance, Yahoo, Sonork, Odigo, Gaim and Fire.

All IM clients can be downloaded for free. The providers use IM as public relation tools and try to create synergies to their original businesses. For instance, AOL hopes to attract users as an Internet provider and Microsoft wants to tie instant messaging to the sales of PC operation systems. Additionally, usage data of users of IM can be used for marketing purposes. The display of (personalized) banners on the program's user interface is possible. Another potential business area lies in the sales of content, for example, selling pictures that users want to exchange. Around 200 Mio. people are expected to use instant messaging in 2004.

In order to derive some estimations for parameters used in the model we conducted a small survey among our students at Mannheim University. We asked 200 undergraduate and graduate business administration students about their knowledge about and their usage patterns of instant messaging. 89,5 % claim to know what instant messaging is, 65 % posses an IM user account. Further results of this survey are presented in the next section along with the discussion of the structure and parameterization we used to develop the system dynamics model.

## Model description

As a basis for the simulation experiments we conducted, a system dynamics model was created that builds on the work described in Sterman (2000) and Thun et al. (2000). The basic structure of this model is depicted in Figure 2. As with most diffusion models there is an untapped market (*potential adopters*). Potential adopters occasionally become adopters of the IM client of one of the three players in the market (increasing the *installed base*): for simplification reasons we combine AIM and ICQ as AOL, Microsoft (MSN), and all other instant messaging providers. Some adopters quit using the product, either ultimately or they become again potential users and adopt once more in the future. Furthermore, users switch between the three installed bases when they are unsatisfied with the utility their current application provides. They then change to an IM provider that promises better utility.

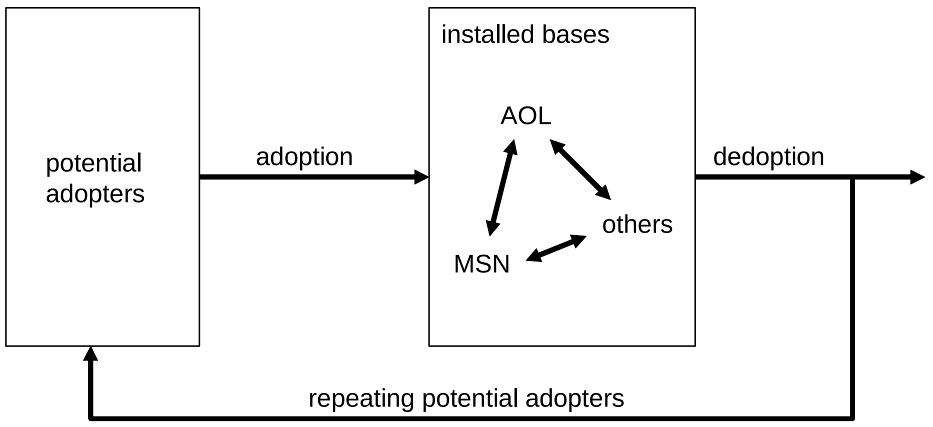


Figure 2: Block diagram of diffusion model

Of course, the actual simulation model is more complex than Figure 2. The stock/flow diagram for one instant messaging provider (AOL) is depicted in Figure 3. The structure for MSN and the other instant messaging programs is equivalent. Thus, basically the actual model is three times the size of the one depicted in the figure. Equations for the complete model can be found in the appendix.

Basically, the structure is similar to the one that was presented in Thun et al. (2000). The *adoption* of an instant messaging client is laid down by the effect of two groups of users: innovators and imitators (Bass 1969). How many potential adopters become innovators or imitators is tied to the so-called innovation coefficients *alpha* and *beta*. In the model used in this study we have endogenously calculated beta (i.e. set its value within a feedback loop), but left alpha exogenous.

Coefficient *alpha*, which determines the fraction of potential adopters that become innovators, is exogenously set as a parameter. For clarification purposes we have split the variable into two parts: the degree of advertisements (*ADV*) placed to support the product and the effect of reports in magazines and other media (*REPORTS*). Alpha causes people to start using the particular instant messaging program without being influenced by direct contact with other users. Innovators are necessary to start the diffusion process (Milling and Maier 1996).

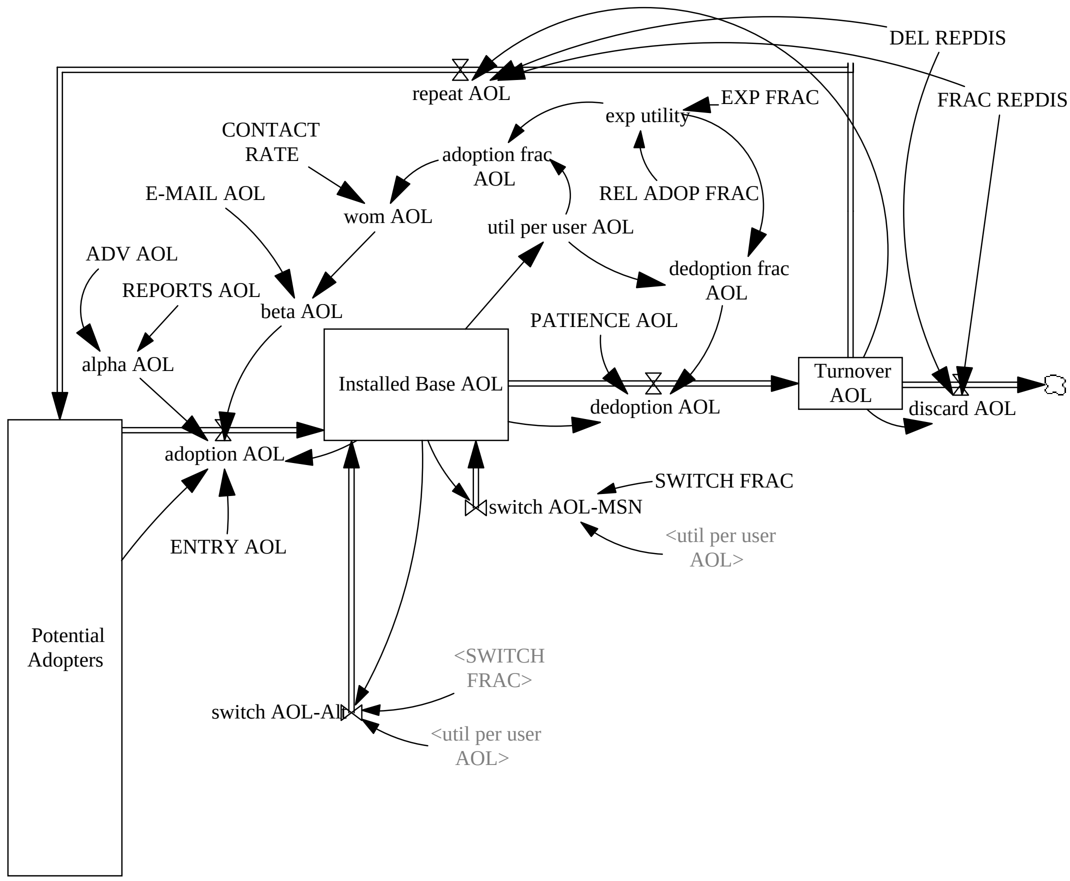


Figure 3: Stock/flow diagram for one instant messaging provider (AOL)

Coefficient *beta* determines the number of imitators. They are responsible for the ultimate success of an innovation because only when imitators are attracted to a product big number of users can be achieved. In contrast to the innovators imitators only start applying the IM program after they had contact with other current users. As a specialty, they can be invited by users via direct e-mail invitation (*E-MAIL*). In the model we assume that potential adopters receiving such an invitation always start using instant messaging. The most important part of the model, however, is the word-of-mouth feedback loop (resulting in variable *wom*). Starting from the *installed base* the utility for each user is calculated (*util per user*), which is simply assumed to be the number of other users in the installed base (number of possible communication contacts) in comparison to all potential users. This (actual) utility is compared to an expected utility (*exp utility*). The higher actual utility is compared to expected utility the stronger is the word-of-mouth effect, i.e. the more potential users can be convinced to start using the IM client. A *contact rate* determines the number of contacts between users and potential adopters. Expected utility is dependent on a relevant adopter fraction (*REL ADOP FRAC*) that symbolizes that usually every user only wants to communicate with a small fraction of other people in the installed base. The relevant fraction of all potential adopters of IM (*REL ADOP FRAC*) is multiplied with an aspiration level (*EXP FRAC*) that represents the fact that people are satisfied when they can reach a certain amount of interesting communication partners via instant messaging.

If the relation between utility and expected utility is not satisfying users start to quit using this instant messaging program (*dedoption*). Two possibilities exist how they can proceed in this case. Firstly, they can completely *discard* using instant messaging at all and for all times. Secondly, the can stop using instant messaging now but might start using it again in the future, i.e. the become potential adopters again (*repeat*). The relation between the two cases is set through a constant variable (*FRAC REPDIS*). In the simulations presented in this paper, repeat purchases are switched off.

Furthermore, users *switch* to other providers of instant messaging. To mimic this case, a certain fraction of users of provider 1 switches to provider 2 if provider 2 offers more utility for its users. The switching function is implemented between all three competitors in the model., i.e. between AOL and MSN, MSN and other providers, AOL and other providers.

The values of the model parameters in the base run can be found in the model listing in the appendix. Most of the variables are accompanied by a comment clarifying their meaning. Constant values were established using three methods: (1) historical values, for instance, the market entry times of the competitors, (2) derived from the survey, for example, the switching fraction, or (3) estimated, if possible according to the literature, like the contact rate.

## Policy analyses

The primary goal of the simulation analysis was to test different policies and to derive recommendations for successful diffusion management of instant messaging. In the base run of the simulation model, the three market players were initialized using the same values for all parameters except time of market entry (*ENTRY xxx*). With this parameter setting AOL always ends up in a monopoly position when it is taken into account that it was first to the market, twelve month earlier than their competitors (Figure 4). As in all following graphs of simulation results, the time scale varies from 0 to 120, meaning it starts in the beginning of 1996 and runs for ten years. The y-axis symbolizes 200 Mio. people at maximum, which is the estimation for the number of potential adopters of instant messaging and, thus, its initial value in all simulations. However, scaling for AOL and Microsoft/alternative providers often vary and differ in the following diagrams. Furthermore, because we do not differentiate between policies for Microsoft and the alternative providers in this paper, simulation results for these two players are basically identical in all cases depicted here.

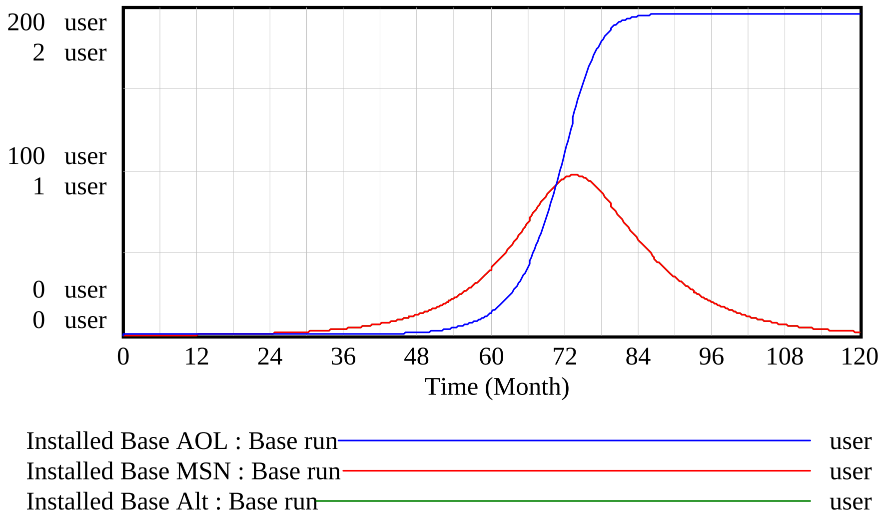


Figure 4: Simulation results for base run of the model

In the base run AOL achieves a monopoly position, absorbing nearly the complete base of potential adopters (some quit using the product and do not start using it again, therefore AOL's installed base is slightly smaller than 200 Mio. people). The diffusion of the product is very slowly in the beginning (1996 until 2000) depicting the so-called "penguin effect" (Farrell and Saloner 1986). However, in the three years after that (2001 until 2003) a rapid diffusion takes place, which is also called "bandwagon effect" (Leibenstein 1950). Microsoft and the alternative providers do not reach a critical mass of users and, thus, diffusion does not take off.

A sensitivity analysis showed that the models behavior is highly sensitive regarding market entry time (Figure 5). In this analysis market entry time for AOL is varied from 0 to 12. One can see that only in a small amount of cases AOL's installed base just reaches a third of the total market, i.e. each of the three competitors got a market share of 66 Mio. customers. This only happens when the market entry time of AOL approaches the entry time of the other two players, i.e. all enter the market around the same point of time (month 12, meaning the beginning of 1997). In the majority of cases, however, even a small lead concerning entry time leads to a significantly bigger market share compared to its competitors. This result is in accordance with the literature, which suggests that—everything else being equal—a pioneer will always succeed when diffusion follows the Bass model. This argument is (particularly) valid for markets with network externalities.

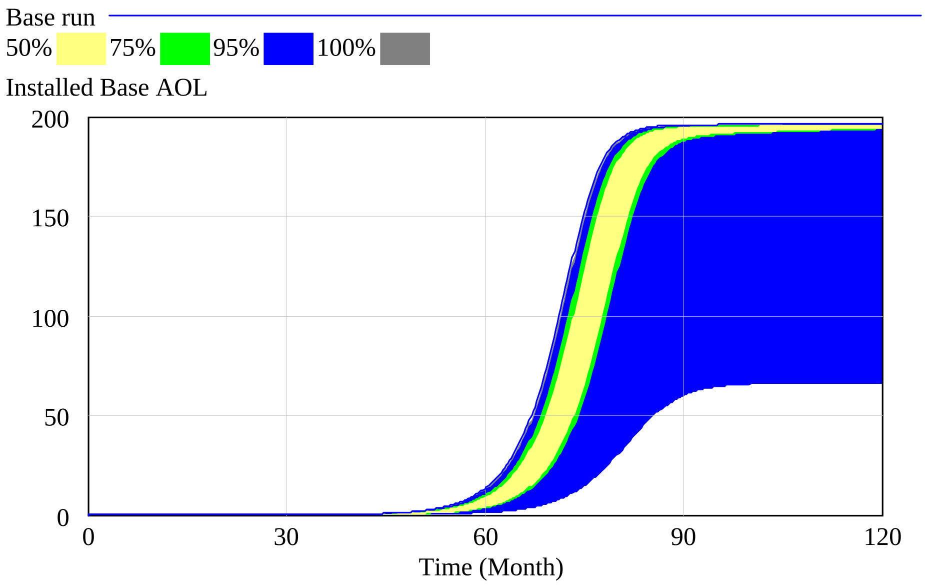


Figure 5: Sensitivity analysis of market entry time (showing installed base of AOL)

Because the earlier market entry of AOL is a historical fact Microsoft and the alternative providers need to take on other measures in order to overrule AOL. Basically, their strategic options offer four possible ways:

1. Increasing the number of innovators (coefficient alpha), i.e. increasing the effect of reports in the media or of advertisement measures.
2. Directly increasing the number of imitators (coefficient beta) which can be achieved by a number of possibilities, e.g. diminishing the gap between actual and expected utility (by lowering the aspiration level or the relevant adopter fraction) or increasing the contact rate between adopters and potential adopters.
3. Indirectly increasing the number of imitators (coefficient beta) by enlarging the installed base, for instance through compatibility to other providers. This, in turn, would increase the actual utility of all users in the joint installed base.
4. Lowering the number of dedopters, for instance through increasing the patience of the members of the installed bases.

In the rest of this section, some of these alternatives are tested and simulation results from the model are presented. If not otherwise stated the development of the installed bases of the three market players is depicted.

In Figure 6 the result for an increase in coefficient alpha for both, Microsoft and the other providers is presented. This case is to a certain degree hypothetical because the main effect of a higher number of innovators occurs in the beginning of a product's diffusion; in the case of instant messaging in the past (around 1997/98). In other words, this simulation experiment does not offer any strategic possibilities which can be employed today. However, one can observe that even if the values for innovators are doubled for Microsoft and the other providers, AOL still reaches a by far better position.

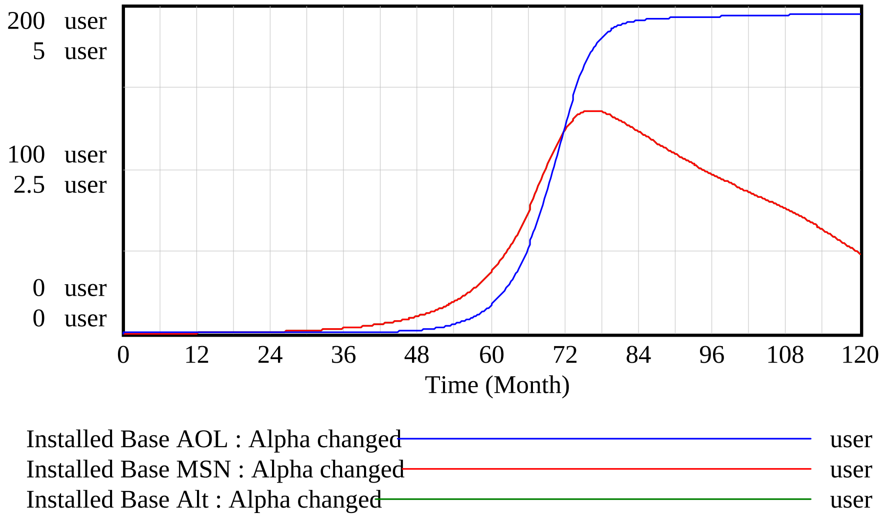


Figure 6: Simulation results for a higher number of innovators for Microsoft and alternative providers

The *E-MAIL* constant for Microsoft and the alternative providers was used in the next simulation experiment in order to strengthen the word-of-mouth effect for these players. It was assumed that people directly invited via e-mail to use a specific instant messaging program account for an autonomous increase of 3 % of imitator adoption. Results of this experiment are depicted in Figure 7. It can be observed that with this setting AOL's success can be hindered; nevertheless, the other two players neither do succeed.

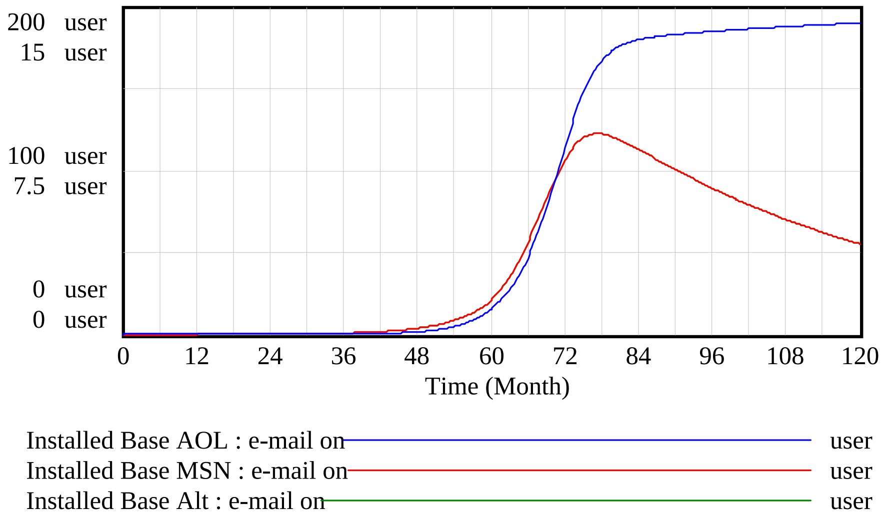


Figure 7: Simulation results for e-mail invitations for Microsoft and alternative providers

In the next simulation run, the utility for adopters in the installed bases of Microsoft and the alternative providers was increased by extending the number of people in the installed bases. In order to achieve this, compatibility between Microsoft's and alternative products was assumed, thus creating one virtual installed base. Results of this simulation are shown in Figure 8. However, because the number of users in their installed bases are relatively small compared to AOL due to the later market entry time compatibility alone does not lead to a significantly better position compared to the base run.

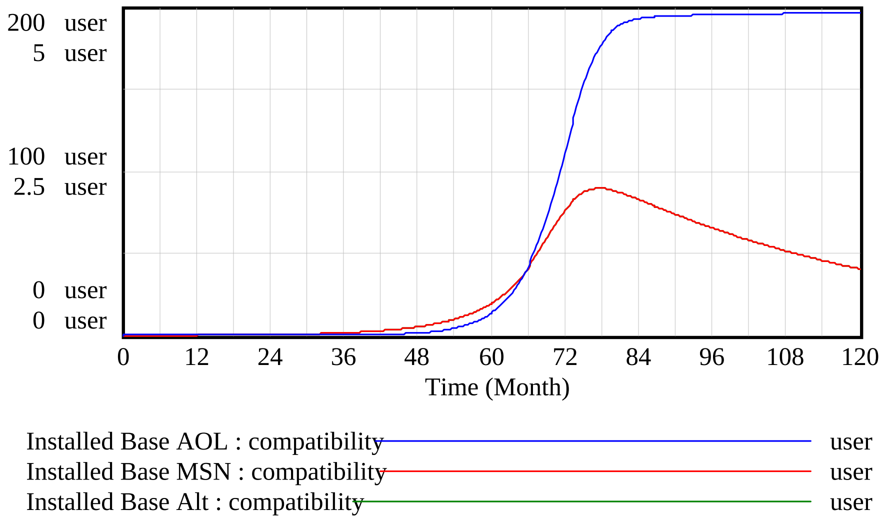


Figure 8: Simulation results for compatibility between Microsoft and alternative providers

The next figure (Figure 9) depicts the simulation's results when the patience factors for customers in Microsoft's and in the other's installed bases are increased. Through public relations, promotional, or technical measures they must therefore achieve that the people in their installed bases wait more patiently for the gap between actual and expected utility to close. In this case the patience time was prolonged from one to two years. As with the case of e-mail invitations this measure alone does not help to succeed against AOL, however, it delays its success.

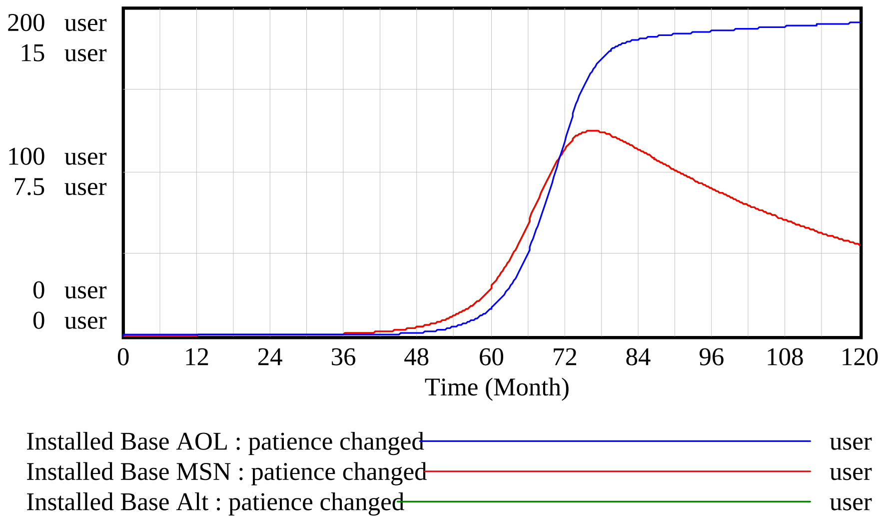


Figure 9: Simulation results for a longer patience of customers of Microsoft and alternative providers

The last experiment described in this paper deals with the combination of all measures discussed so far. Its results are depicted in Figure 10. With this combination of measures Microsoft and the alternative providers succeed over AOL, despite its earlier market entry. Both, Microsoft and the alternative providers get a market share of roughly 50 %, which means close to 100 Mio. customers in their installed bases.

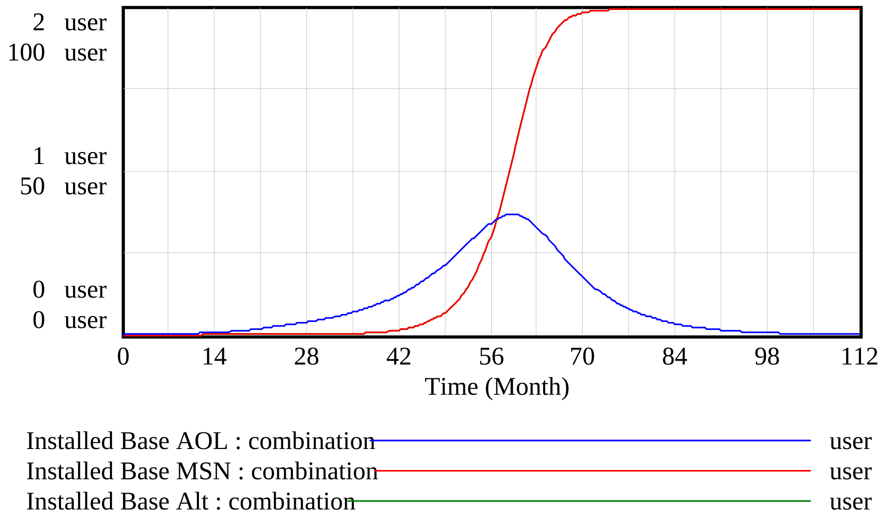


Figure 10: Simulation results for a combination of measures

## Transferability of insights and further research

The system dynamics model presented replicates historical data from the instant messaging market as far as it is available (with the exception of ICQ and some smaller competitors real usage figures can only be estimated). Simulation analyses allow to find leverage points for a successful diffusion of instant messaging. In contrast to many other diffusion models, our aim was to examine competition between different programs providing basically the same functionality. Thus, successful policies for one organization to get the advantage over its competitors were investigated. The model suggests that in the instant messaging market the pioneer (AOL) has a strong position due to its being first to the market. The basic finding from AOL's competitors point of view is that only coordinated measures can help weaken this position and reverse the "naturally" occurrence of the "first takes it all" phenomenon caused by the word-of-mouth reinforcing feedback loop. One promising, but not sufficient measure is compatibility between the Microsoft and the smaller players programs.

We assume that the basic structure of the model can be adapted to many diffusion processes where products with network externalities are involved. The main thing to change structurally would be the number of competitors. Furthermore, some parameter would need a reinterpretation or are obsolete, for instance direct invitation of other users by e-mail.

Of course, many improvements and analyses need to be done within the instant messaging context of the model. Besides always necessary efforts in validating parameter and structure some ideas are:

- We did not analyze different policies for Microsoft and the smaller providers of instant messaging. For instance, it could be tested what effects compatibility working in only one direction has or how different marketing budgets affect performance. Furthermore, the effects of bundling the Microsoft Messenger program to the Windows operation system can be investigated.
- It should be taken into account that potential users make their decision not only based on the comparison of actual and expected utility but to a great amount on expectations of future utility. The same holds true for the discontinuation of usage. Sterman's (1987) TREND function could be used for this purpose.
- Effects of a higher willingness to switch between providers have not been tested intensively so far.
- Some of the individuals in the customer base could be more active in communicating the advantages of the product than others. Thus, the customer base needs differentiation.
- The reinforcing effects of complementary goods should be included. In this way, the focus could also shift to modeling the diffusion of products with indirect network externalities.
- In reality, the number of potential adopters dynamically changes over time. This effect could be incorporated into the model together with influences of economic or demographic factors.
- In the model so far, it is not discussed how the instant messaging providers try to benefit from establishing their product as a quasi standard. This is an important issue because apparently they give away their product for free. Additionally, there is no structural element of financial and other resources that are needed to manage the diffusion process, for instance by advertising.
- Some of the policies presented are hypothetical insofar as it was assumed that their effect would be evident from the time of market entry on. Of course, the past cannot be changed. Therefore, a more detailed investigation of the effects of changed policies in later phases of the diffusion process needs to be added.

Some of these extensions will be addressed in the final version of this papers or in subsequent papers on this topic. In the future we want to extend our work in two directions: firstly, detailing and improving the model of the instant messaging market, and, secondly, applying the core structure of the model to other diffusion processes of products with positive demand externalities.

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## Notes

1. One can distinguish between direct (e.g., e-mail) and indirect network effects (e.g., computer platforms). Products showing direct network externalities do not have any utility per se and are only useful if others also use this product; indirect network externalities exist when both, an original utility of a product and a utility from the usage of others can be assumed (Bental and Spiegel 1995).

2. Currently, the Internet Engineering Taskforce (IETF) works on the development of a standard protocol for the exchange of instant messages (Instant Messaging and Presence Protocol, IMPP). However, so far exist only draft versions of this future standard. Furthermore, it is unclear in how far the big players in the instant messaging market will support the protocol.

## Appendix

adoption Alt=
IF THEN ELSE( Time>=ENTRY Alt , (alpha Alt*Potential Adopters)+(beta Alt/INI*Potential Adopters*Installed Base Alt) , 0 )
Units: user/Month

adoption AOL=
IF THEN ELSE( Time>=ENTRY AOL , (alpha AOL*Potential Adopters)+((beta AOL/INI)*Potential Adopters*Installed Base AOL) , 0 )
Units: user/Month

adoption frac Alt=
1-(exp utility-util per user Alt)
Units: Dmnl

adoption frac AOL=
1-(exp utility-util per user AOL)
Units: Dmnl

adoption frac MSN=
1-(exp utility-util per user MSN)
Units: Dmnl

adoption MSN=
IF THEN ELSE( Time>=ENTRY MSN , (alpha MSN*Potential Adopters)+(beta MSN/INI*Potential Adopters*Installed Base MSN) , 0 )
Units: user/Month

ADV Alt=
1e-006
Units: Dmnl
Effects of advertisment efforts on coefficient alpha for alternative providers

ADV AOL=
1e-006
Units: Dmnl
Effects of advertisment efforts on coefficient alpha for AOL

ADV MSN=
1e-006
Units: Dmnl
Effects of advertisment efforts on coefficient alpha for Microsoft

alpha Alt=
ADV Alt+REPORTS Alt

Units: Dmnl

alpha AOL=
ADV AOL+REPORTS AOL
Units: Dmnl

alpha MSN=
ADV MSN+REPORTS MSN
Units: Dmnl

beta Alt=
wom Alt+"E-MAIL Alt"
Units: Dmnl

beta AOL=
wom AOL+"E-MAIL AOL"
Units: Dmnl

beta MSN=
wom MSN+"E-MAIL MSN"
Units: Dmnl

CONTACT RATE=
0.2
Units: Dmnl
Fraction of contacts between adopters and potential adopters

dedoption Alt=
Installed Base Alt*dedoption frac Alt/PATIENCE Alt
Units: user/Month

dedoption AOL=
(Installed Base AOL*dedoption frac AOL/PATIENCE AOL)
Units: user/Month

dedoption frac Alt=
IF THEN ELSE(util per user Alt>=exp utility, 0 , 1-(util per user Alt/exp utility
))
Units: Dmnl

dedoption frac AOL=
IF THEN ELSE(util per user AOL>=exp utility, 0 , 1-(util per user AOL/exp utility
))
Units: Dmnl

dedoption frac MSN=
IF THEN ELSE(util per user MSN>=exp utility, 0 , 1-(util per user MSN/exp utility
))
Units: Dmnl

dedoption MSN=
Installed Base MSN*dedoption frac MSN/PATIENCE MSN
Units: user/Month

DEL REPDIS=
1
Units: Month

Delay time before finally quit using IM or become potential adopter again

discard Alt=
Turnover Alt*FRAC REPDIS/DEL REPDIS
Units: user/Month

discard AOL=
Turnover AOL*FRAC REPDIS/DEL REPDIS
Units: user/Month

discard MSN=
Turnover MSN*FRAC REPDIS/DEL REPDIS
Units: user/Month

"E-MAIL Alt"=
0
Units: Dmnl

"E-MAIL AOL"=
0
Units: Dmnl

"E-MAIL MSN"=
0
Units: Dmnl

ENTRY Alt=
12
Units: Month
Time of market entry alternative providers

ENTRY AOL=
0
Units: Month
Time of market entry AOL

ENTRY MSN=
12
Units: Month
Time of market entry Microsoft

EXP FRAC=
0.5
Units: Dmnl
Aspiration level: what fraction of relevant adopters should be reached

exp utility=
EXP FRAC*REL ADOP FRAC
Units: Dmnl
Expected utility from using instant messaging

FINAL TIME = 120
Units: Month
The final time for the simulation.

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FRAC REPDIS=
1
Units: Dmnl
What fraction of dedopters finally quit using instant messaging

INI=
200
Units: user
Initial number of potential users (market size)

INITIAL TIME  = 0
Units: Month
The initial time for the simulation.

Installed Base Alt= INTEG (
adoption Alt+"switch AOL-Alt"+"switch MSN-Alt"-dedoption Alt,
0)
Units: user

Installed Base AOL= INTEG (
adoption AOL-dedoption AOL-"switch AOL-Alt"-"switch AOL-MSN",
0)
Units: user

Installed Base MSN= INTEG (
adoption MSN+"switch AOL-MSN"-dedoption MSN-"switch MSN-Alt",
0)
Units: user

PATIENCE Alt=
12
Units: Month
How long do customers wait until they stop using alterative
providers

PATIENCE AOL=
12
Units: Month
How long do customers wait until they stop using AOL

PATIENCE MSN=
12
Units: Month
How long do customers wait until they stop using Microsoft

Potential Adopters= INTEG (
-adoption Alt-adoption AOL-adoption MSN+repeat AOL+repeat Alt+repeat MSN,
INI)
Units: user

REL ADOP FRAC=
0.02
Units: Dmnl
What fraction of adopters is relevant, i.e. the user wants to

communicate with?

repeat Alt=
Turnover Alt*(1-FRAC REPDIS)/DEL REPDIS
Units: user/Month

repeat AOL=
Turnover AOL*(1-FRAC REPDIS)/DEL REPDIS
Units: user/Month

repeat MSN=
Turnover MSN*(1-FRAC REPDIS)/DEL REPDIS
Units: user/Month

REPORTS Alt=
1e-006
Units: Dmnl
Effects of media reports on coefficient alpha for alternative
providers

REPORTS AOL=
1e-006
Units: Dmnl
Effects of media reports on coefficient alpha for AOL

REPORTS MSN=
1e-006
Units: Dmnl
Effects of media reports on coefficient alpha for Microsoft

SAVEPER =
TIME STEP
Units: Month
The frequency with which output is stored.

"switch AOL-Alt"=
IF THEN ELSE(util per user Alt>util per user AOL, Installed Base AOL*SWITCH FRAC
, IF THEN ELSE( util per user Alt<util per user AOL , -(Installed Base Alt
*SWITCH FRAC) , 0 ) )
Units: user/Month

"switch AOL-MSN"=
IF THEN ELSE(util per user MSN>util per user AOL, Installed Base AOL*SWITCH FRAC
, IF THEN ELSE( util per user MSN<util per user AOL , -(Installed Base MSN
*SWITCH FRAC) , 0 ) )
Units: user/Month

SWITCH FRAC=
0.02
Units: Dmnl
What fraction switches to another provider because it provides
better utility

"switch MSN-Alt"=
IF THEN ELSE(util per user Alt>util per user MSN, Installed Base MSN*SWITCH FRAC
, IF THEN ELSE( util per user Alt<util per user MSN , -(Installed Base Alt
*SWITCH FRAC) , 0 ))

Units: user/Month

TIME STEP  = 0.25
Units: Month
The time step for the simulation.

Turnover Alt= INTEG (
    dedoption Alt-discard Alt,
        0)
Units: user

Turnover AOL= INTEG (
    dedoption AOL-discard AOL,
        0)
Units: user

Turnover MSN= INTEG (
    dedoption MSN-discard MSN,
        0)
Units: user

util per user Alt=
    MAX(Installed Base Alt/INI, 0 )
Units: Dmnl

util per user AOL=
    MAX(Installed Base AOL/INI, 0 )
Units: Dmnl

util per user MSN=
    MAX(Installed Base MSN/INI, 0 )
Units: Dmnl

wom Alt=
    adoption frac Alt*CONTACT RATE
Units: Dmnl
Word-of-mouth effect for alternative providers

wom AOL=
    adoption frac AOL*CONTACT RATE
Units: Dmnl
Word-of-mouth effect for AOL

wom MSN=
    adoption frac MSN*CONTACT RATE
Units: Dmnl
Word-of-mouth effect for Microsoft

Back to the Top