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# Value network dynamics in 3G–4G wireless communications: A systems thinking approach to strategic value assessment ☆

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**Abstract**

This article develops a map to analyze the dynamic forces that influence the structure and development of 3G (third generation) wireless communications value networks. The analysis builds on the Strategic Value Assessment Model (Fine, et al. [Fine, Charles H., Vardan, Roger, Pethick, Robert, El Hout, Jamal. Rapid-Response Capability in value chain Design. MIT Sloan Manage Rev 2002, 43(Winter): 69–75.]) and utilizes a qualitative System Dynamics mapping approach. The map focuses on the driving forces affecting user adoption of 3G services, focusing on customer dynamics, competitive dynamics, and technology dynamics. To analyze adoption of 3G services by customers, the articles maps the dynamics of (1) network investment and user population, (2) entry of service innovators as well as price competitors, (3) the effects of positive network externalities arising from a larger user population, (4) price compression as lower willingness-to-pay users adopt 3G services, (5) scale economies in terminal costs and prices, and (6) new content development as a draw to new users. Applying inductive systems diagrams hypotheses are integrated into a causal loop map and tested with data collected at 15 communications-industry workshops attended by 190 participants in Europe. The map aims to deepen the understanding of the possible evolutionary paths of the 3G wireless value network. The article seeks also to assess which future scenarios are plausible and what dynamic triggers might make them likely.


*Keywords:* 3G wireless; Business dynamics; Wireless value network; Scenario analysis; System thinking

## 1. Introduction and motivation

The rate of evolution of an industry depends on competitive dynamics and customer power, rates of technological and business innovation, regulatory and policy structures, and system complexity, among other factors (Fine, 1999). The wireless communications industry, where competition is intense, growth is rapid, innovation is abundant, local conditions are idiosyncratic, and technological options are increasingly complex, poses great opportunities for all participants in the global value network, but enormous challenges for participating organizations and their business models.

In many European countries mobile phone penetration rates are now reaching saturation, but huge opportunities exist for subscriber growth in less-developed regions such as in South-East Asia and South America. Worldwide, month-on-month minutes of use continue to grow dramatically, but over 95% of subscriber usage remains focused on voice-only communication. In the most competitive markets, falling prices accompany increased usage, which is clearly reflected in the decline of revenue per minute per mobile subscriber. A saturated market and a slow down in mobility voice-price and in premium SMS means operators must hold onto customers and/or develop new, attractive higher-value services.

The advent of 3G wireless capabilities provides a possible platform for service providers to offer a much broad array of content and services that might drive higher revenues and profits across the chain. Some examples of emerging services are mobile TV and 3G value-added services (location based services, mobile commerce, content on-demand etc.).

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## 2. Overview

In the complex environment of this study, both the system itself and the agents within the system influence the industry dynamics (Lane, 1995). The intent is to describe the dynamic forces that influence the structure of the 3G wireless communications value network and analyze:

1. The multiple driving forces that influence the value network structure,
2. Change patterns in the supply chain structure, and
3. The interdependence among the components of the value network structure.

The map builds on the Strategic Value Assessment Model (Fine, Vardan, Pethick and El Hout, 2002) and applies qualitative System Dynamics (Forrester, 1969; Mayo, Callaghan and Dalton, 2001; Mass, 1974; Schroeder, Sweeney and Alfeld, 1975; Sterman and Repenning, 1997; Sterman, 2000) to 3G wireless systems. This methodology has proved to be valuable and capable of supporting decisions (Meadows, Meadows, Randers and Behrens, 1972; Morecroft and van der Heijden, 1992) on even short-term scenarios and measures (Fung, 2001; Strohhecker, 2005).

The article adopts a system thinking approach (Gharajedaghi, 2006) that goes through the process of formalizing and analyzing feedback loops. Applying the mapping process suggested by Sterman (2000) activities are organized across six stages: (1) problem articulation; (2) dynamic hypothesis; (3) formulation; (4) testing; (5) policy formulation and (6) evaluation.

The systems thinking perspective supports understanding of patterns of interactions and the underlying structure of complex systems (Gharajedaghi, 2006; Homer, 1996; Senge, 1990). Finally applying the Inductive System Diagram methodology (Burchill and Fine, 1997) the study builds a simplified model of value chain dynamics. Inductive system diagrams combines aspects of grounded theory methods (Glaser and Strauss, 1967; Glaser, 1978; Strauss, 1987) and System Dynamics (Goodman, 1974; Randers, 1980).

The article first considers the design and development of the industry supply chain embedded in a complex value network. The Strategic Value Assessment (SVA) framework (Fine et al., 2002) guides the exploration of (1) user adoption of 3G services (customer dynamics); (2) provision of product and service features (including prices, quality, etc.) by content providers and wireless network providers (competitive dynamics); and (3) drivers of technological and business innovation (innovation dynamics). For each of three key change drivers multiple loops represented in the casual loop diagram are formulated and tested.

The hypotheses were tested in 15 workshops attended by 190 participants in Europe during the period 2002 to 2003, with participants from fixed/mobile operators, content and application providers, equipment suppliers, providers of financial, retail and transport services.

The analysis results in a deeper understanding of the possible evolutionary paths of the 3G wireless value network that includes customers, network owners, content providers, service providers, and technologies. The map also supports assessment of future scenario plausibility and a better understanding of the dynamic triggers that might make them likely.

## 3. Problem articulation: the Value Framework Network

The concept of value plays a pivotal role in the study of sustainable competitive advantage. Within the strategic management literature, (Mol, Wijnberg and Carroll, 2005) Bowman and Ambrosini (2000) define value creation as the contribution to the utility of the final good or service to end users and distinguish it from value capture defined as the difference between revenue and cost retained by the firm. Mol, Wijnberg and Carroll (2005) think of a passing through the multiple value-adding stages, eventually accumulating into an overall value proposition perceived by a final set of selectors. In their model, each stage contributes a particular percentage of the overall value created, but value capture by each contributor depends on participants' relative bargaining power. Of course, this process may not always be as sequential as this description suggests, but no product or service will result unless a collection of these value-contributing parties can settle on a division of spoils that keeps each party willing to participate.

To approach competitive analysis in the 3G wireless industry the study first identifies the elements of the value chain (Porter, 1985) defined as a map of the entire set of competencies, investments, and activities required to create, produce, deliver, maintain, and reap the proceeds from a product or service, and the relationships among those investments and activities. The profits and competitive advantages of participation in a given value chain reside dynamically within the chain, accumulating at the positions of greatest value and/or power. The enterprises that hold these positions have a great deal of control over how the chain operates and how the benefits are redistributed (Rülke et al., 2003).

Framing the challenge as the need to engineer a value chain simultaneously with the engineering of the products/services and processes for providing value is useful. The study builds on the "three-dimensional concurrent engineering" framework (Fine, 1999), adding value chain engineering to augment the traditional two-dimensional concurrent engineering of products and processes (Fleischer and Liker, 1997; Nevins and Whitney, 1989; Ulrich and Eppinger, 1994;).

Consider the supply chain for five principal actors: the content providers, the application providers, the infrastructure providers, the network providers and the device providers (the connection between buyer and suppliers). The end consumer pulls the supply chain system by creating demand and setting the rules of engagement. Accordingly, the buyer exerts significant influence over the actions of the remaining actors. Following Bitran, Bassetti and Romano (2003), this supply chain system is a buyer-centric network. As such, the focal variable of the causal loop map is customer adoption of 3G wireless services.

Many studies in the literature consider the wireless value chain (Barnes, 2002; Li and Whalley, 2002; Maitland et al., 2002; Olla and Patel, 2002) and try to understand the fundamental business drivers along with the value chain elements of space technologies and their integration capabilities (Olla and Patel, 2002; Talluri et al., 1999; Wirtz, 2001).

In recent years, there has been considerable discussion and research about the evolution of supply chains into value networks. Bitran et al. (2003) define a value network as one in which a cluster of actors collaborates to deliver value to the end consumer and where each actor takes some responsibility for the success or failure of the network.

Rülke et al. (2003), group the participants to the wireless value network into five major elements: content and application providers, portal and access providers, wireless network operators, support services, delivery platforms and applications.

Other researchers (Maitland et al., 2002) believe that the cooperation of network providers and content providers from fixed communication, Internet and mobile services will generate the highest quality of service. Due to the complex nature of the market no single actor can provide a service to the customers with an end-to-end solution on its own, there is a need to sustain viable alliances and to create a value network with the right partners (Barnes, 2002; Pigneur, 2000; Sabat, 2002). Partnership management capabilities will have to be a core competence that new mobile business actors must possess (Pigneur, 2000).

Although no representation will satisfy all concerns of the literature discussed above, we do find it useful to have a working model that represents the value network. Fig. 1 illustrates the attempt at such a representation, using a five-pronged diagram with branches for each of: content value chain, application value chain, infrastructure value chain, network value chain, and device value chain.

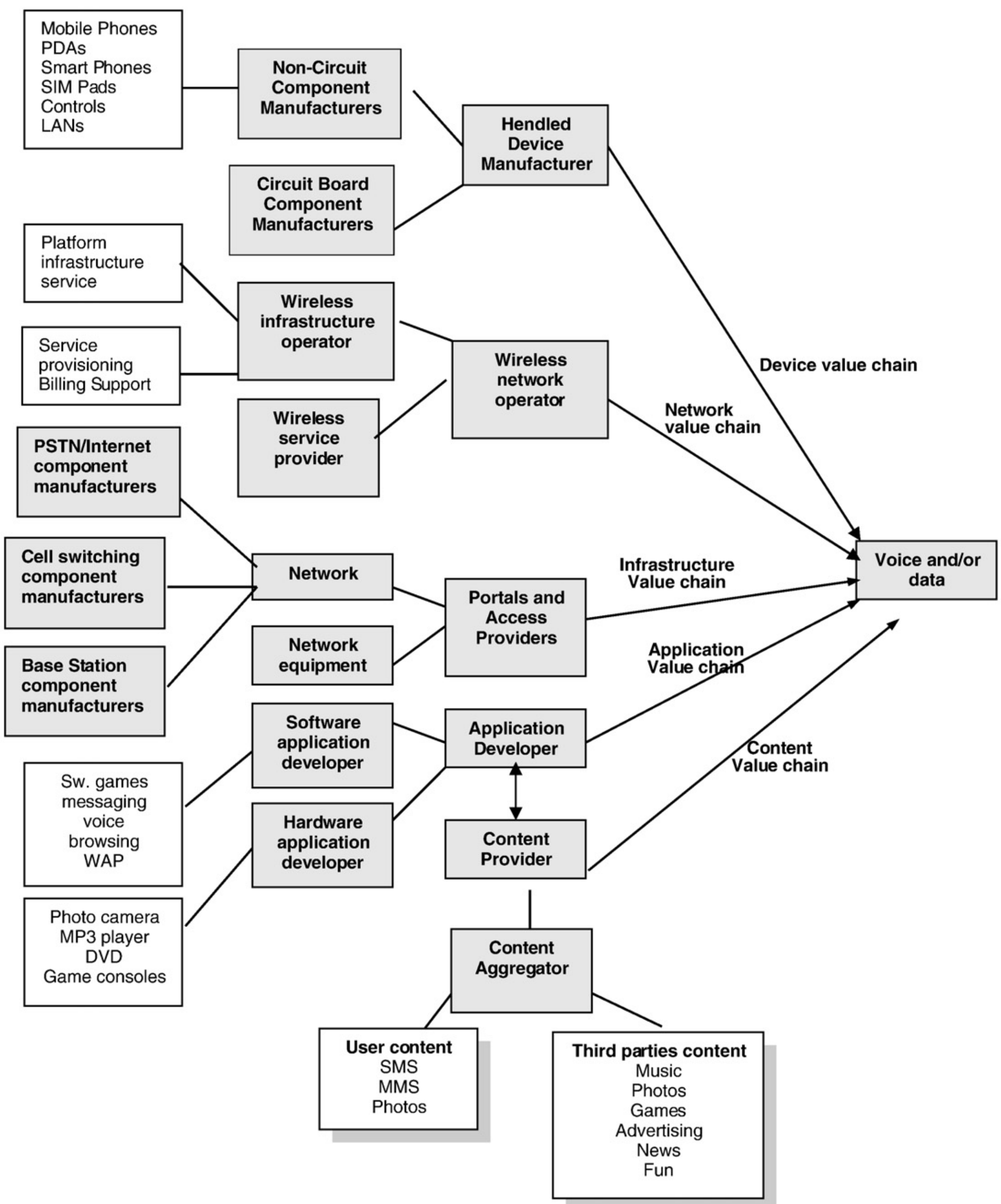



Fig. 1. Wireless Value Network Structure.

## 4. Materials and methods

The SVA framework model (Fine et al., 2002) guides the causal loop mapping to capture three key determinants of 3G wireless communications value network dynamics:

- user preferences and adoption of 3G services (customer dynamics);
- wireless network provider competitive offerings with regard to products, services, cost, quality, and other dimensions (competitive dynamics);
- technology and business model innovations (innovation dynamics).

Applying Sterman's (2000) approach the map formalizes the hypothesized relationships between variables creating a refutable causal map with multiple points of testing (Bell and Bell, 1980). The first part of the study includes qualitative modeling, that is, system thinking (Gharajedaghi, 2006), that goes through the process of formalizing and analyzing feedback loops for each hypothesis.

Although formal system dynamics models are mathematical representations of problems and policy alternatives, much of the information available to the modeler is not numerical in nature, but qualitative (Forrester, 1994; Luna-Reyes and Andersen, 2003). The theme of qualitative work in system dynamics has been developed in many studies (Coyle, 1983; Coyle and Alexander, 1996; Coyle and Millar, 1996; Luna-Reyes and Anderson, 2003; Sterman, 2000; Wolstenholme, 1983, 1985, 1999; Wolstenholme and Coyle, 1983). Qualitative system description improves system understanding even where quantification is impossible. This paper supports Richardson's (1999) identification for the need for quantitative research and proposes an agenda, but places the emphasis on the relative limitations of quantitative versus qualitative models in emerging industry such as 3G wireless.

In line with previous studies describing modeling processes (Roberts et al., 1983; Randers, 1980; Richardson and Pugh, 1981; Wolstenholme, 1990; Sterman, 2000) the study includes three stages:

1. Conceptualization: crafting hypotheses and formulating the initial characterization of the problem for each hypothesis
2. Formulation: For each hypothesis a discussion of the emerging loops
3. Testing: Analyzing and discussing the empirical evidence to support each loop through data gathering techniques such as focus groups with the customers, interviews with operators supplemented by qualitative data analysis technique such as grounded theory methodology recognized to have a strong, critical role in rigorous system dynamics efforts (Sterman, 2000). The study verifies that the map is consistent with the structure of the real systems. Structure verification was realized comparing the map's assumptions to descriptions of decision-making and organizational relationships emerging from 15 workshops attended by 190 participants in Europe ranging from fixed/mobile operators content and application providers, equipment suppliers, providers of financial, retail and transport services. However, we stop short of testing the hypotheses and conceptualizations with computer simulation.

## 5. Conceptual development: customer dynamics as the focal point

Customer adoption of 3G services is the focal variable of the map. Variables that influence customer adoption include: provision of new services, new applications, new content, and new terminals (by established firms and/or new entrants). Also, the price of services, the willingness of customers to pay for new services, and the network externalities of joining a 3G wireless community influence customer adoption. In turn, customer adoption influences the provision of new services, applications, content, and terminals, as well as the entry and investment by firms and customers in the value network.

In the following section the article describes the data collected to support the map formulation and then discusses each of the forces modelled as interfacing with customer adoption of 3G value offerings.

### *5.1. Data collection and analysis*

One of the authors conducted numerous workshops during 2002–2003 with a wide variety of participants from different locales in the global communications value network (Pagani, 2004, 2006). The mapping assumptions on the factors and conditions which enable/inhibit the adoption of third generation mobile services were derived in part through interaction with 24 focus groups conducted in six markets in 2003: Brazil, Germany, Italy, Singapore, UK, US (Pagani, 2004). The interviews focused on the core target market segments for the third generation offering, namely, teenagers, young adults, and family adults, all currently using mobile phones for personal use. The sample was segmented by age (16–19, 20–29, and 30–45). Group interviews made it possible to compare the views of a number of individuals at one time and to achieve synergy of expression. Ease of use and usefulness emerged as the most important constructs influencing adoption. The following factors were indicated as influencing users' perceived ease of use:

- Input device: the different types of input methods
- Output device: different screen size
- Software facilities: graphic layout, clear commands and symbols, help functions
- Bandwidth.

Perceived usefulness was described to be influenced by the following factors:

- Service offerings: the quality and variety of services offered
- Degree of mobility
- Interoperability: mobile devices have to work well with users' existing computing devices if they need to synchronize data or transfer information.

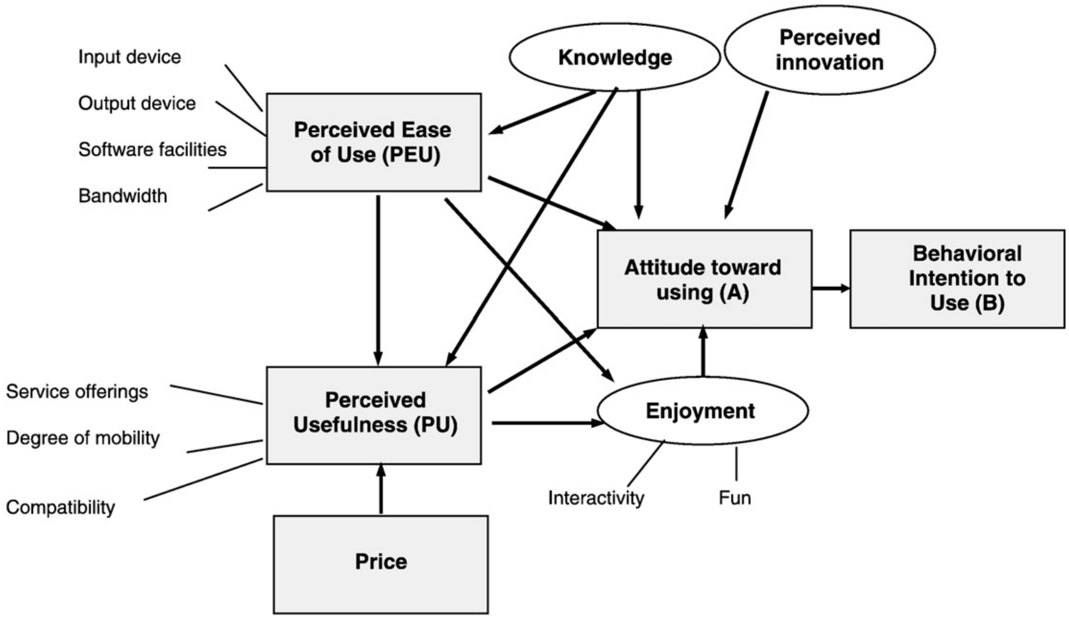



Fig. 2. Structural model.

Also knowledge emerged as an important variable influencing perceived usefulness and ease of use with a positive or negative effect on attitude towards using a new service.

In help define and verify the structural causal loop map, the study includes a review of technology adoption theory such as innovation diffusion theory (Agarwal and Prasad, 1998; Moore and Benbasat, 1991; Rogers, 1995), the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980), the theory of planned behavior (TPB) (Ajzen, 1991), and the technology acceptance model (TAM) (Davis, 1989; Davis et al., 1989).Building from the testing process that Forrester and Senge (1980) suggest, the structure verification was carried out by comparing model assumptions to descriptions of decision-making and organizational relationships found in relevant literature.

Structural Equation Model (SEM) was used to test the proposed theoretical framework (Fig. 2). The Lisrel 8.80 program was employed for this purpose.

The study includes a quantitative exploratory survey in Italy in 2004 on a population of 1000 mobile users. Data were gathered by means of a questionnaire managed by telephone calls. Respondents were asked to rate the attractiveness of a number of possible combinations of customer service elements in order to describe behaviors, roles and test variables influencing adoption of mobile computing (Table 1).

Results emerging from the quantitative survey provided further evidence on the appropriateness of using the TAM model to measure the different dimensions of actual multimedia mobile usage and they illustrate the importance of usefulness related to the adoption of third generation mobile services.

Usefulness and ease of use emerge as the most important factors in the adoption process. Innovations that emphasize these factors should be well received by customers. Price and payment options are additional factors stated as important in the adoption process. Service providers feeling the pinch of price compression should be heartened by the finding that consumers say that service trumps price. This finding should encourage the search for customer-pleasing innovations.

**Proposition 1.** *The network externalities loop (R1).*

For some types of communication services, one aspect of perceived usefulness by consumers is the ability to interact with a population of other users who are using the same service. In cases where a new, consumer-desired 3G service exhibits such positive network externalities, investment in such offerings should return accelerated value opportunities for providers. Consider a new 3G service such as mobile video calling and the 3G device to access this new service. A buyer's adoption of a

Table 1
Importance ranking of features preferred (Base: total respondents = 1000)

| Attribute | Importance | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 18–24 | 25–34 | 35–44 | 45–54 | 55–64 | Over 65 | Average | Ranking |
| Usefulness | 34.5% | 39.6% | 37.6% | 37.6% | 26.9% | 15.1% | 31.3% | 1st |
| Ease of use | 19.0% | 19.3% | 23.7% | 22.3% | 27.6% | 42.9% | 26.7% | 2nd |
| Price | 27.6% | 26.9% | 20.2% | 21.0% | 26.9% | 21.7% | 23.8% | 3rd |
| Speed of use | 19.0% | 14.2% | 18.5% | 19.1% | 18.6% | 20.3% | 18.2% | 4th |

Source: own elaboration, 2004.

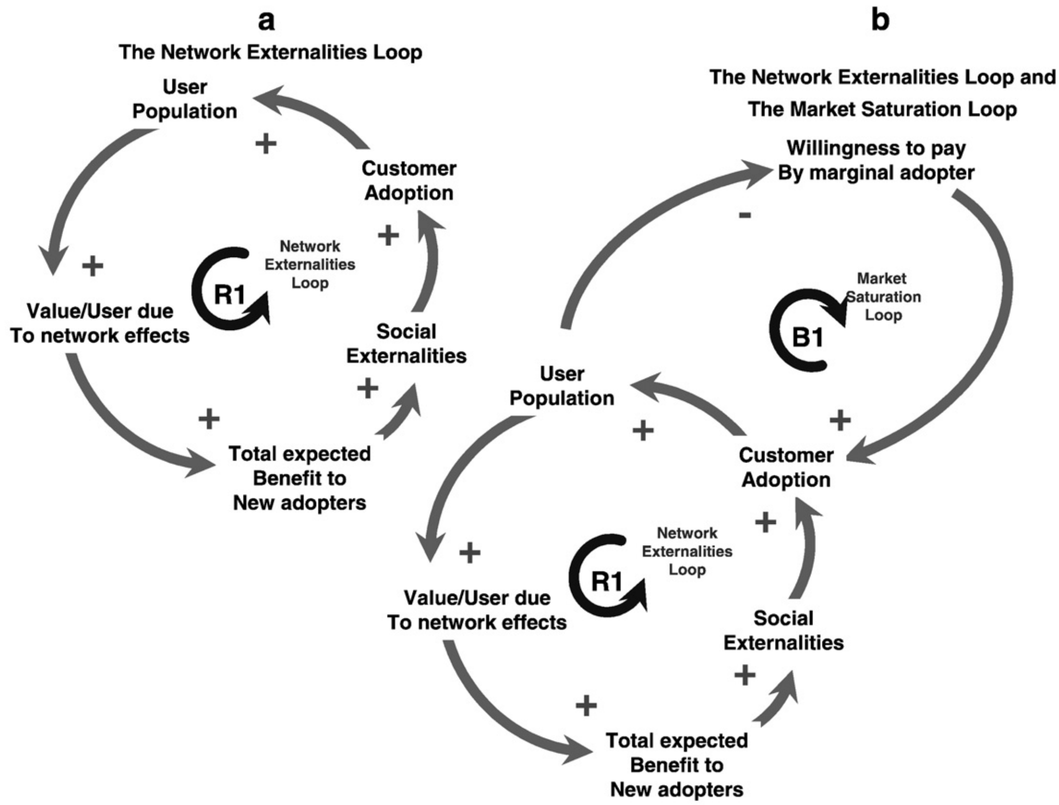



Fig. 3. a,b The network externalities loop and the market saturation loop.

seller's offering increases the market penetration of that offering. As market penetration increases, so does the value per user due to network effects (Grajek, 2003; Gruber and Verboven, 2001; Schoder, 2000). Increasing returns theory and Metcalfe's Law state that the next adopter confronts a more valuable network simply because the network is made bigger by the most recent adopter. This effect is mapped with increases in total expected benefit to a new adopter (Fig. 3). When social externalities are strongly positive (e.g., myspace, some games), the resulting community may begin to drive technological innovation and the creation of new markets (e.g., eBay, i-mode).

**Proposition 2.** *The market saturation loop (B1).*

Typically, increasing adoption returns are tempered eventually by a traditional downward-sloping demand curve (Fig. 3). Early adopters of an offering are likely to be those who have the highest willingness and ability to pay; later adopters experience less value and may only be coaxed to join via price reductions.

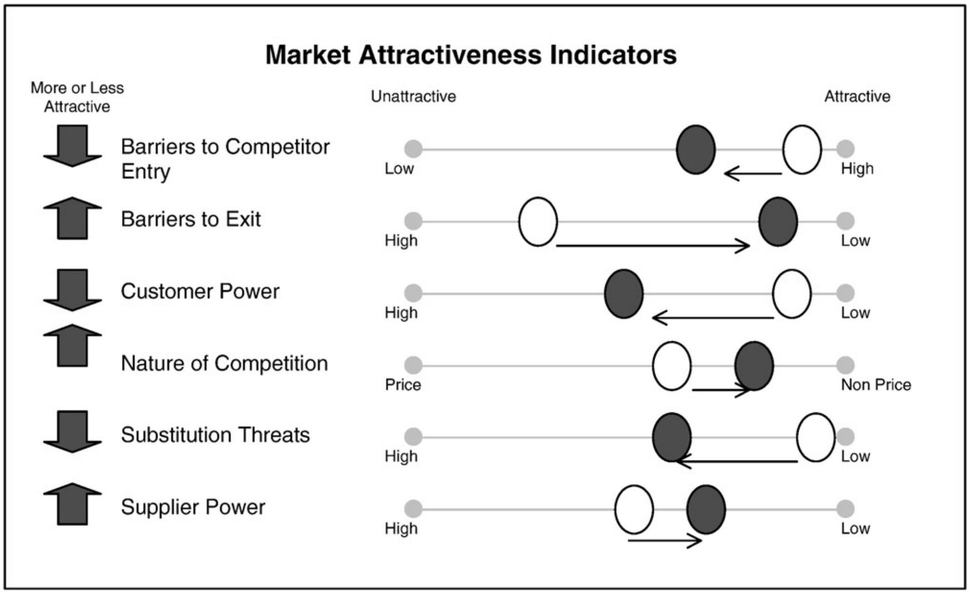
The effect of a downward-sloping demand curve is mapped by attaching a second causal loop, *Market Saturation*, to the *Network Externalities* loop. Adoption increases User Population as above. Increases in User Population, however, also cause decreases in willingness to pay which influence adoption. Market saturation should trigger more search by the provider for another service innovation (killer application), which triggers a new product offering and renews the growth loop again. The market saturation loop balances the effects of the *Network Externalities* loop. As shown in Fig. 3, the map includes separate causal loops to represent each of these dynamics.

### *5.2. Competitive dynamics: network capacity, price competition, and service innovation*

The transition to an IP network for voice and data has had significant impact on the mobile communications industry. Not only does an all-IP mobile network introduce the possibility of interoperability with fixed IP networks, it also facilitates market entry by non-traditional competitors such as WLAN (WiFi) operators or MVNO's—Mobile Virtual Network Operators (i.e., operators that offer service on leased network capacity, rather than on an operator-owned network). In addition, new applications and services are created and offered both by incumbent operators as well as new entrants to the industry. Cost structures, product portfolios, partnership arrangements, and industry structure are all influenced by this technology shift. Some of the potential changes may provide incumbent mobile network operators and application providers with renewed growth and profitability. Other changes will increase the intensity of market competition.

In order to gain empirical evidence to develop the map, the study includes 16 face-to-face interviews with the IT managers of 16 network providers in Europe. These data (see Table 2) inform the analyzes of change expectations in market attractiveness indicators based on the migration to IP-based services. Interviews apply the protocol (Vennix, 1996) that suggests to elicit feedback loops in an interview. Respondents identified the

Table 2
Trends in market attractiveness indicators—most likely case




Source: (Interviews of 16 managers).

following main variables influencing changes in competitive advantages:

- Barriers to market entry will be lowered partly due to the decreased infrastructure costs of an all-IP network. More importantly, the decoupled service creation functions will allow application and service providers to capture a greater portion of the mobile value chain. For the incumbent mobile network operator, the market is less attractive because more and different types of competitors can enter.
- Barriers to market exit will be lowered since services are less tightly integrated to network elements and new services can be tested and launched more quickly and at lower cost. Unsuccessful services can also be withdrawn more quickly. This is a benefit to the incumbent mobile network operator and increases market attractiveness.
- Customer power will increase. Customers will have more service provider choices and more options of how to access mobile and fixed services. This decreases the market attractiveness for the incumbent mobile network operator.
- The nature of competition will change. Voice will become even more price competitive, but this will be offset by increased differentiation possibilities of value-added services. This is positive for the incumbent mobile network operator and increases market attractiveness.
- Substitution threats will increase. There are an increasing number of substitutes for mobile IP services such as public WLAN. There will also be more types of devices from which access the mobile network. Also the technology and price distinctions between mobile and fixed networks and services are diminishing. Users are more able to substitute one service for the other with positive effects for mobile operators and negative impact for fixed operators. This decreases the market attractiveness for the incumbent mobile network operator.
- Supplier power will decrease. Network operators will be less dependent upon specific network infrastructure providers. The wider supplier choice increases the market attractiveness for the incumbent mobile network operators.

Building on this data, Fig. 4 illustrates the map of three additional dynamic forces that interplay with customer adoption of new 3G services:

- Network investment
- Price competition
- Service and application investment and innovation

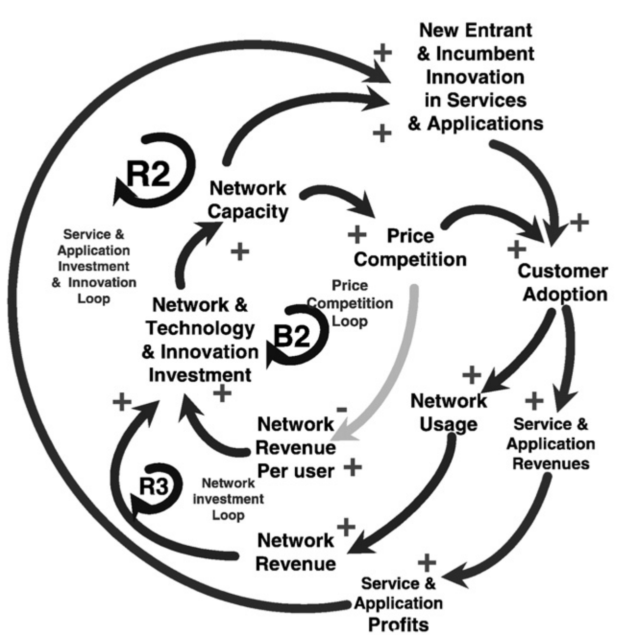



Fig. 4. Price competition, innovation, and investment loops.

**Propositions 3, 4, and 5.** *Network investment loop (R2) Price competition loop (B2), and Service and application investment and innovation loop (R3).*

As more customers adopt 3G communications services, network usage will increase, driving up network revenues and subsequent investment in greater capacity. Such capacity investments are likely to invite more customer adoption onto the network, forming a reinforcing dynamic (R2), as shown in Fig. 4.

Increased network capacity, particularly if offered by new entrants into the industry, can also trigger price competition, which can shrink overall industry revenues and subsequently discourage further investments in network capacity. Such an effect can serve as a limit to ongoing growth, and is illustrated as a balancing loop (B2) in Fig. 4.

Increased customer adoption is also likely to increase revenues and profits from offered services and applications, encouraging further investment and innovation in new services and applications, which will, in turn, likely entice even more customers onto the network, forming another reinforcing loop (R3), as Fig. 4 illustrates. Some of these innovations likely come from new entrants into the industry and some come from incumbents, who will vie competitively for the opportunity to capture revenues from the growing customer base.

## 6. Technology dynamics: Moore's Law and economies of scale

The SVA model posits the importance of the clockspeed or rate of change in the system of interest. Value chain elements with fast clockspeeds often exhibit rapid innovations and are thus more likely to require higher ongoing knowledge investments to maintain technological competency (Fine et al., 2002).

The 3G wireless environment is heavily influenced by 'Moore's law', which asserts that the power and capacity of integrated circuits will double approximately every eighteen months, while cost remains constant.

**Proposition 6.** *The terminal scales economies loop (R4).*

Lower chip costs influence lower terminal prices and boost new functionalities with positive influence on terminal adoption and terminal volumes and related wholesale and retail profits. In addition, terminal appeal and lower prices for terminals partly drive customer adoption. As greater customer adoption drives up terminal volumes, the industry can more easily standardize products and component interfaces, allowing modularity and

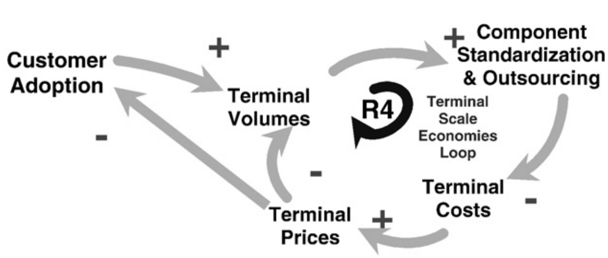



Fig. 5. Terminal scale economics.

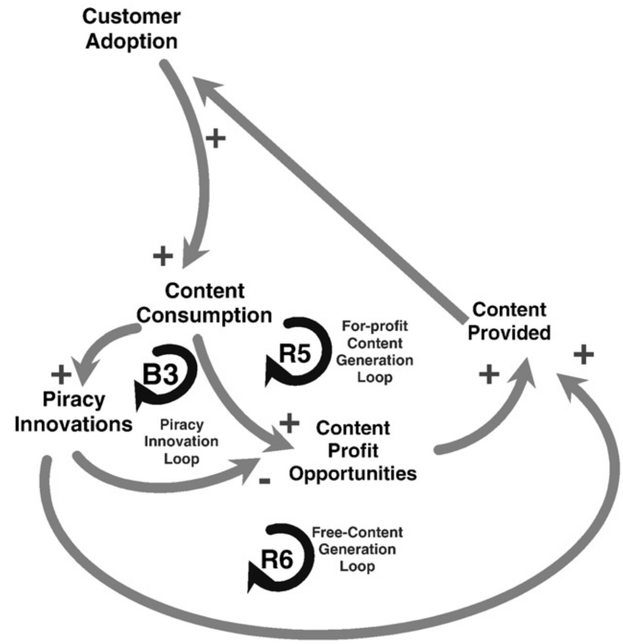



Fig. 6. Content generation and piracy loops.

increased outsourcing of standard components and subsystems. This standardization and outsourcing will likely drive costs and prices down further, encouraging even more customer adoption. influence terminal modularity, the global standard development influence components standard and encourage outsourcing strategies, which allow further cost reduction per unit (Fig. 5).

**Proposition 7.** *The content generation and piracy loops (R5, B3).*

In a 3G wireless system, close cooperation of network, service and content providers will generate the highest quality of service and product offerings. Following the entrance of new service providers, who may acquire ready-to-use applications or raw blocks of information from content providers, the nature of competition may change, whereby content providers become key players who provide increased differentiation offerings of value-added mobile services (service attractiveness).

As offering compelling content that attracts consumer adoption and influence consumer consumption becomes more and more important. New revenue models and content profit opportunities may drive further entry of new content providers. The wider content and service choice further increases market attractiveness and consumer adoption (reinforcing loop R5).

Balancing this growth, one must consider the effect of unauthorized appropriation of 3G content, which can generate significant intellectual property battles and potentially lost revenue from content providers. The resulting "arms war" on DRM and free content distribution (e.g., Youtube) may limit for-profit content distribution models, and thereby inhibit system growth and further customer adoption. On the other hand, piracy innovations may generate more free content available to users, thus driving up customer adoption withouth generating revenues for content providers. The balancing effect is mapped by attaching a second causal loop, piracy innovation loop (balancing loop B3), to the content generation loop. To these, the free content generation loop is added, as a reinforcing loop to customer adoption (reinforcing loop R6) (Fig. 6).

## 7. Basic map formulation and validation

The outcome of the system thinking mapping phase (Sterman, 2000) is a qualitative formalization of one's mental model of a system to aid understanding of how the objects or entities in a system interact.

The overall map (Fig. 7) focuses on the dynamic complexity of the value network. It also focuses on the interdependencies and feedbacks created by the behavior of the actors, particularly interactions between the wireless network providers, service providers, content providers and the customers. The map also includes the introduction of third generation services to capture the dynamics of service transitions.

The map helps to provide a coherent representation of the multi-actor relationships across the wireless communications industry. One can trace the effects of an increase in Market Penetration, for example, to understand how that might affect Switching Costs or Total Investment by suppliers.

Results have been discussed with panels of experts during 15 workshops conducted in Europe in 2004. The emerging diagram was then discussed during three following workshops conducted in 2006 with managers in Italy and USA. New variables were added and relationships modified as dictated by the discussions.

## 8. 3G communications value network scenarios

The inferences and propositions integrated into the inductive system diagram (Fig. 7) are the result of the analysis of numerous forces influencing 3G Wireless Value Network evolution. The range of behaviors suggested in this study is modeled by the inductive system diagrams (Burchill and Fine, 1997). However, the study speculates also on multiple plausible scenarios suggested by the causal loop map.

### *8.1. Scenario 1: cycles of entry and bankruptcy*

If the price competition loop (loop B2) is strong with significant entry and price-cutting for basic network capacity and/or for basic services and applications, then one might expect a scenario of cycles of entry and bankruptcy, similar to the U.S. airline industry post-deregulation. In this scenario the wireless value network might be expected to evolve somewhat erratically. The successful liberalization of telecom regulations in many countries, along with the opportunity to exploit innovative business models and obtain new profits, encourages the entry of new service providers. Some businesses and their models appear stable (e.g., eBay), but others may prove to be quite temporary unstable (e.g., service provider/content providers, dot.coms, etc.) as a result of high entry and establishment costs and intense competition. In this scenario, the combination of competition in infrastructure and service provision and the creation of global markets for third generation infrastructure and terminals may

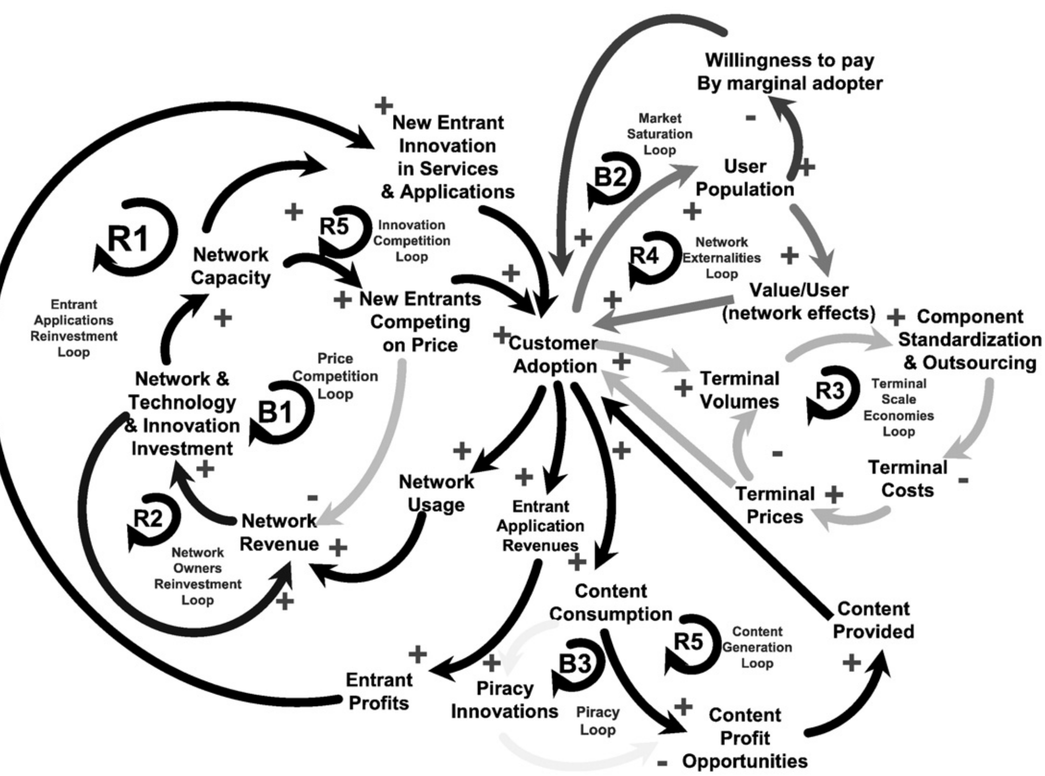



Fig. 7. Comprehensive inductive system diagram.

prove to be a challenging environment for sustainable business models, but the resulting price and innovation competition should be good for consumers.

### 8.2. Scenario 2: stable oligopoly

If the Network Investment Loop (R3) is strong and dominated by incumbents, one might expect a scenario of stable oligopoly (e.g., Verizon & AT&T dominate in USA, Telecom, Vodafone and H3G in Italy, etc.).

Despite liberalization powerful incumbents can discourages market entry by new service providers. In this scenario, such incumbents may sustain relatively high service and terminal prices. A breakdown in collaboration on telecoms and software standards worldwide could lead to a small number of global alliances each developing their own *de facto* standards for multimedia delivery, limiting opportunities for economies of scale. Service interfaces might be too complex for consumers and little account might be taken of their personal tastes and preferences. Further, if governments auction third generation licenses, that may increase the cost of access and limit competition.

### 8.3. Scenario 3: free for all

If R2 Service and application investment and innovation loop and R5 Content Generation Loop and R6 Free content generation loop are strong, one might expect a scenario of "free for all."

In this scenario the Information Society is foreseen to have reached the masses, and mobile multimedia services and applications have played a key role in making it accessible anytime, anywhere.

In this scenario, governments might allow much more unlicensed spectrum; successful liberalization would encourage market entry by service providers and the development of global standards helps to reduce service and terminal prices (handset companies powerful). Service attractiveness is improved through a combination of high levels of IT literacy, artificial intelligent interfaces and agent technology and the continuation of the distributed intelligence network model. Intense competition in service provision draws users and creative entrants. However, the combination of competition in infrastructure and service provision and the creation of global markets for third generation infrastructure and terminals, thanks to successful cooperation in developing a single worldwide standard for third generation mobile systems, push prices steadily down and allow free services.

### 8.4. Scenario 4: appearance of a new dominant force

The fourth scenario is characterized by the appearance of an innovator entrant becoming a dominant force, (e.g., some sort of "Google for wireless" that scans/search all of cyberspace wirelessly and delivers very useful results). Such a dominant force might increase the barriers to entry of other potential new entrants while global standards help reduce service and terminal prices.

High-capacity storage media allows fast cheap access to vast volumes of information, and lowers the cost of providing information services. A stable regulatory environment encourages highly competitive service provision market. Innovative and diverse Internet services appear (i.e. traditional broadcast services are integrated with on-demand TV, video and interactive entertainment). This shift in network paradigm results in the development of services that are simple to use and understand. Terminals are relatively cheap, attractive, easy to use and highly portable.

### 8.5. Scenario 5: piracy development

If the Piracy innovation loop is strong, one might forecast a scenario of slowing growth in profits for content providers. If the free content loop is strong however and the free content attracts many new adopters, network providers might prosper providing service for the customers, while for-profit content providers wither. Legal battles might abound, benefiting the lawyers.

## 9. Conclusion

This article develops a dynamic map to capture the forces that will likely influence the evolution of the 3G wireless communication value network. Building on data collected in a variety of workshops and interviews, the article presents a causal loop map that envisions customer dynamics, competitive dynamics, and technology dynamics each playing a role in the value network evolution.

This map is used to develop multiple plausible future scenarios for the industry, with the expectation that further data collection and ongoing experience with this technology generation will shed increasing amounts of light onto the relative likelihood of each scenario. The conclusions this study reaches about future scenarios have not been tested by simulation of a formal quantitative model but have been judged to be plausible and likely by panels of experts exposed to the complex systems map's assumptions.

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