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New ways of innovation: an application of the Cyclical Innovation Model to the mobile telecom industry

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Abstract

New developments in the mobile telecom industry, such as growing transmisson bandwidth and sector-crossing business alliances, change the way in which mobile telco's are innovating. Traditional innovation models, such as the well-known singlecompany linear model ('pipeline model'), do not describe anymore how innovation occurs in today's practice. An alternative way of looking at innovation is the boundarycrossing Cyclic Innovation Model (CIM). It views innovation processes as coupled 'cycles of change', connecting science with business as well as technology with markets, in a cyclic manner. CIM has been applied to 'Lucio', a mobile data productservice combination introduced into the Dutch market by KPN Mobile. The analysis shows that Lucio is a multi-sector, class-2 innovation. It also shows that CIM is capable of giving insight into the complex network of companies involved, making clear how each company brings-in functionality that together consitutes the innovation. CIM can therefore be considered as a promising addition to the growing family of fourthgeneration innovation models.

Keywords

Innovation, innovation processes, innovation models, mobile data services, mobile telecom industry, convergence, unbundling, Cyclic Innovation Model.

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1. Introduction

Telecommunication is already present in our society for a long time, but it is currently receiving more attention than ever before. Many scientific journals and business magazines report on spectacular new technological and market developments in the mobile telecom industry. An interesting example is the uptake of medium broadband GPRS-based services, reaching already a market penetration rate of 70 to 80% in many European countries (Maitland, Bauer & Westerveld, 2002). In addition, we see far-reaching changes due to the unbundling of the mobile telecom sector as well as its convergence with other businesses such as IT and media.

However, the mobile telecom industry also gets large attention because of negative occurences such as the enormous financial debts (mobile) telecom operators have accumulated due to spending huge amounts at UMTS licenses to build and exploit mobile broadband networks for mobile data services. The subsequent massive lay-offs of employees from telco-companies (both telecom operators and suppliers), depreciation of UMTS-licenses, and delays of new investments in the mobile telecommunication infrastructure are consequences of their awkward financial position.

Nevertheless, there is some light at the end of the tunnel. Severe cost reductions have worked out, and gradually telecom operators obtain financial space to think at investing again in a more offensive business strategy. But investing in just product development will not suffice. Utilization of the latest insights in innovation processes might be a better strategy. So, underneath the pressing question for mobile telco's how to improve their financial position, there is the issue of how to innovate successfully.

The mobile telco's are facing a dilemma: on the one hand they need to develop new business, such as new mobile data applications, and on the other they do not have (yet) sufficient financial resources to invest in these emerging opportunities. This dilemma is exacerbated by the insecurity of telecom companies which role to play in a mobile industry that has changed from a simple, linear structure into a complex, nonlinear network, often crossing the traditional sectoral boundary. All this affects the new environment in which mobile telco's have to work. It forces them to rethink the way they need to innovate.

In this article we want to show how an alternative way of looking at innovation, offered by the Cyclic Innovation Model (CIM), is capable of coping with the new challenges in innovation. CIM will be applied to a recent innovation called Lucio, a mobile data service offered by KPN Mobile in the Netherlands.

We start with an overview of current developments in the mobile telecom industry (section 2). In section 3 we discuss the characteristic properties of today's knowledge economy, being the business environment of the telecom industry. Section 4 contains a summary of CIM, in section 5 a description of Lucio is given, and in section 6 we will apply CIM to Lucio. We emphasize the new insights the model offers, and we show how CIM can enhance the development of future innovations.

2. Developments in the mobile telecom industry and their

impact on innovation

To characterize today's mobile telecom industry, we outline five major trends below. In our view, these trends are the most influential to the forthcoming innnovation in the telecom sector. We give a broad view encompassing not only product-innovation but also process-innovation, as well as changes in the way new products and services are offered to the market. Altogether, this will lead to new business models.

1. Increase of bandwidth: extending today's bandwith can be considered as the thread through almost all new developments in the mobile telecom industry. The growing bandwidth largely follows Gilder's law which states that every 12 months the capacity of broadband triples. This trend is illustrated in successive mobile communication standards, starting with 1G for analogue mobile communication (NMT) through to 2G which is the standard for mobile communication today (GSM). We are currently in the 2.5G era, an extension of 2G, having a bandwidth of approximately 25 kbps. Mobile services that fall into this category are GPRS-type of services and 'i-mode'. The forthcoming standard will be UMTS-technology (i.e. 3G). At the start it will have a bandwidth of approximately 380 kbps, growing up to 2Mbps. UMTS will enable to view real video via the mobile phone (Lehr & McKnight, 2003). It is expected that technology beyond UMTS will exceed 10 Mbps. UMTS and beyond are technology push. We know that this kind of push will not automatically guarantee economic value. Commercial success will depend on new applications and new services around new technology.

The trend of growing bandwidth represents new technological capabilities of the communication channel which again facilitates new applications, together defining a range of innovation opportunities.

2. Unbundling of the industry: the telecom industry is being restructured, generally coined by the term 'unbundling'. This trend refers to the development in which vertically integrated telco's, in many situations the national incumbent operators, are being divided into separate commercial organisations. They often become independent companies. This important development is initiated by European policy and forced by national regulators, aiming at liberalizing the telecommunication markets. The result is often expressed in the privatization of the national PTT's (the incumbent telco's), dividing the total company in independent organisations. They can be offered to the market for mergers and take-overs. An example is the splitting-up of the wholesale and retail departments of Dutch telco KPN. In addition, they sold their network-building activities. Unbundling has also a close relationship with the decision of telco's to focus on their core business, and to outsource all those activities that are to be considered as non-core.

The trend of sectoral unbundling shows that innovation in the (mobile) telecom industry is increasingly occurring between different companies that are occupying different positions within the telecom value chain. The combination of different players within the telecom value chain has an important influence on innovation in the sector: innovations are created by external partnerships.

3. Convergence with other businesses: the telecommunication sector in general, and the mobile industry in particular, is no longer a business on its own but has mixed in many ways with other businesses outside the sector. Particularly, it has developed close ties with the information technology business and the media business. This is reflected in alliances, mergers and take-overs between companies from these different sectors, such as the buying of Dutch broadcasting company Endemol by Spanish telecom operator Telefonica. Another, more recent example is the decision of Dutch grocery Albert Heijn, part of global food company Ahold, to sell pre-paid mobile phones in their stores making them a retailer in the mobile communications industry.

Wirtz (2001) mentions three drivers for this convergence-development:

- "technological drivers such as digitalisation, development of intelligent networks, and the technical convergence of media platforms".
- "deregulation, that is cross-sector competition spurred by the liberalization of vertical integration and privatisation of former state-owned PTT's".
- "demand-related drivers as expressed in changing customer preferences such as individualization of customer relations and systematic solutions".

The convergence of mobile communication and Internet also takes place at an individual level where users consult the Internet via their mobile phone. However, the precise course and consequences of this development with regard to the use of the mobile phone in everyday life are still ambivalent and uncertain (Fortunati & Contarello, 2002; Van de Kar & Van der Duin, 2004).

The trend of cross-sectoral convergence forces mobile telco's to cooperate with companies *outside* their own industry to ensure cross-sectoral innovation. This type of innovation can be well identified in the Cyclic Innovation Model.

4. New business models: both the processes of sectoral unbundling and cross-sectoral convergence have resulted in a rearrangement of the position of telco's in this sector. One consequence is that representation of today's value chain by a linear type of model is no longer valid. Telco's and their partners have different roles and functions. Realization of a new product-service combination can no longer be described in terms of a simple pipeline: one company supplying another company higher in the value chain and then again supplies the result to the next company, etc.. Rather, the structure of this new business model tends to look more like a network or 'web'. Nowadays, notions like 'value network', 'value web' or 'business-matrix' are used to describe the complex business interactions of the mobile telecom industry (Ballon et al., 2002; Maitland et al., 2002, Sabat, 2002; Li & Whalley, 2002).

5. New services: the effects of cross-company technology and multi-sector business models are reflected in the development and introduction of new services in the mobile telecommunications market (both business to business and business to consumer). These new services are extending the traditional telecom portfolio far beyond voice-type services. The new mobile services contain an important data element. Below is a table that summarizes which service categories can be distinguished and which specific services belong to one category for both the consumer and business markets (Preez & Pistorius, 2002). It shows an explosion of new services, many of them being not succesful yet.

Market segment	Service categories	Specified services
Consumer	Information services	News headlines; market and financial information; new movie releases; "what's on"
	Personal Information Management (PIM)	E-mail; contact lists; shared scheduling; customised alerts for stock market prices or auction bids.
	Location-based services	Directions from current positions to a specified location; queries for various facilities (e.g., hospital and restaurant) in the user's vicinity.
	Entertainment	Video and audio on demand; mobile betting and gaming.
	M-commerce	Mobile banking, shopping and stock trading; mobile auctions; e-booking and ticketing.
	Interactive communications	One-to-one or multiple participant text-based chat; video telephony and conferencing; interactive games. Remote control of appliances (e.g., alarm/VCR setting).
Business	Remote access to information	Sales force automation through access to stock, product and customer information; remote access to intranet or other corporate repositories; e-mail; online telephone direcctories.
	Job and information dispatches	Informing field staff of their next assignment (e.g., plumbers, electricians and technical support staff). Sending of information to multiple recipients (e.g., notifications of meetings). Focused/personalised advertising.
	Remote transactions	Remote control of processes and devices; placing and processing customer orders.
	Telemetry/device-to-device (or: machine-to-machine)	Price changes being sent from a central controller to all vending machines; meter readings; remote vehicle diagnostics.

Table 1: new mobile data services for different consumer and business segments (Preez & Pistorius, 2002).

Note that the implementation of new services again triggers the demand for new services, which again may force companies to update their innovation programs, leading to a 'circle of change'.

3. Innovation economy

The changes within the mobile telecom industry, caused by the combination of technological and market developments as described in section 2, do not only take place specifically in that industry but are part of a much wider development. Therefore, they have a large effect on national economies. In a national 'innovation economy' it is value creation by perpetual renewal of products and services that is the source of economic growth. An important basis for renewal is scientific progress. An innovation economy is able to rapidly absorb new explicit knowledge from science and on that basis itself generates new knowledge. This new knowledge lies at a higher aggregation level and is directed towards new technology, new product designs, new methods of production, new forms of service provision, and new insights in national and global markets. However, with innovation it is not just explicit scientific knowledge that is used. Much new, often implicit, knowledge also develops outside the confines of science. Indeed, the practical arena has its own kind of dynamics in which new developments are initiated that are perpetually adapted to the aimed-at result. In that way an empirical learning process arises that creates new knowledge, proven to be successful in practice. In an innovation economy explicit scientific and implicit practical knowledge show a cyclic interaction, enhancing each other in learning organizations (Senge, 1990).

What characterizes an innovation economy is the creating of high added value for society. So, companies do not only compete on the basis of lower costs but particularly on the basis of more value. In an innovation economy product-service combinations

are diverse, being directed towards the (latent) needs and concerns of people: less illness and more health, less violence and more safety, less bother and more ease, etc. In other words, an innovation economy demands a new kind of entrepreneurship in which what is central is value creation for society.

Value creation demands that knowledge needs to be implemented in a wide area in which not only the technical-oriented sciences but also the social-oriented sciences have an important contribution to make, and where not just industry but also consumer organizations have a part to play ('dual nature'). Traditional innovation models fail to describe the dual nature of innovation processes as they occur in real life.

Departure from linear thinking

In the classical linear model, innovation is represented by a pipeline of sequential processes that starts at scientific research and ends with commercial applications. Critical discussion has developed around the model and researchers have started to think how things could be improved. A family of second generation models emerged in which more attention was paid to the reversing of information in the linear process chain, starting at the market. Hence, science was replaced by the market as source of innovation. Processes, however, were still largely seen as sequential steps. In the last decade third generation models were introduced that are less linear, and where investments in the innovation chain are also linked to company strategy (Liyanage & Greenfield, 1999). However, all these models have still the disadvantage that they represent some kind of a *chain*, causing science and market to be far away from each other.

In the following, we will introduce a fundamental deviation form previous innovation models, replacing the familiar chain architecture by a cyclical architecture: 'the circle of change'. This circle of change is positioned as *the* innovation arena, where change creates opportunity and opportunity triggers entrepreneurs to innovate.

4. Cyclic Innovation Model

We have seen that developments in the mobile telecom industry have generated a new commercial environment with (business) processes that cross traditional company boundaries and make combinations across industrial sectors. This means that innovation is developing in a new direction, requiring new concepts. These concepts belong to the fourth generation of innovation models (Niosi, 1999). An example of such a model is the Cyclic Innovation Model (Berkhout, 2000) which will be described in this section.



Figure 1: The Cyclic Innovation Model visualizes the 'circle of change', linking changes in science (left-hand side) with business (right-hand side) as well as changes in technology (upper part) and markets (lower part) in a cyclic manner.

The Cyclic Innovation Model (CIM) was developed in the nineties as an instrument for continuous reform that is at the base of ongoing change in public and private

organizations. The model describes the innovation arena by a 'circle of change'. It links together changes in scientific insights, changes in technological capabilities, changes in product design and manufacturing, and changes in markets. To this end, the model moves away from the traditional chain concept and represents a circle with four 'nodes of change', connected by four interacting 'cycles of change'. Collectively, they may be seen as the fundaments of complex, boundary crossing innovation processes as they occur in *open innovation* nowadays. Figure 1 shows the model at its highest conceptual level.¹

In the technical-oriented sciences cycle (upper left part of the model) interaction processes occur that relate to the developing of new technology, and input from different scientific disciplines is required to provide a broad range of specialistic knowledge in fields such as mechanics, physics, chemistry, biology and informatics (disciplines of the 'hard' sciences): technological research is a multidisciplinary activity. Next, in the systems engineering cycle (upper right part of the model) interaction processes take place which relate to the developing of new products and input from different technological areas is required to provide smart methods and tools for new designs and new ways of manufacturing. These two cycles of change border on each other, having technological research in common.

Today, the engineering cycle is not just directed towards the developing of material products in the traditional fabrication and process industries. In modern engineering the focus is also upon biotechnical products, information products, financial products, logistic products, content in the media industry, games in the recreation industry, etc. Note that material and non-material products may represent components in a complex system, such as a telecom infrastructure. And such an infrastructure may again be

¹ Note that a cycle contains a sequence of cohesive processes that perpetually recur with new initial conditions and new boundary constraints.

seen as one 'product' that functions as a component in the total infrastructural system of a nation. It all depends on the scale of application that is considered.

Likewise, in the customized service cycle (lower right part of the model) interaction processes occur that relate to the development of (new) markets, and input from a range of products is required to fulfill the (potential) societal demands. Nowadays, products are increasingly accompanied by services and advanced service provision is increasingly facilitated by technical products. We therefore increasingly deal in innovation with new product-service combinations. What the engineering and service cycles have in common is product development, highlighting the dual function of products in innovation: technical and social. Hence, products should be seen as sociotechnical functions that a company has to offer to its (potential) customers.

Finally, in the soft sciences cycle (lower left part of the model) new scientific insight is gained into the needs and concerns of society. Input from different scientific disciplines is required to provide a broad range of specialistic knowledge in fields such as economics, sociology, anthropology, psychology and law (disciplines of the 'soft' sciences): improved insight in market transitions requires multidisciplinary research. This particularly applies to today's complex commercial processes which aim at creating economic value with new product-service combinations. Since today's markets form a melting pot of technical, economic, social and cultural change, the traditional disciplinary models are not very appropriate in such cases. The Cyclic Innovation Model highlights the dual function of science in innovation: technical and social.

Note that autonomous social transitions manifest themselves in markets as changes in the need for products and services (the demand). Such societal changes will stimulate innovations. On the other hand, autonomous technological developments generate new products and services (the supply). Such technological changes will change

society. It is the cyclic interaction of both those innovation drivers that will create maximal value to the market.

A fundamental characteristic of the proposed innovation model is that it describes a full circle and not a chain. Science is not to be found at the beginning of a chain and the market is not to be found at the end of a chain; both are part of a perpetual learning process along a dynamic path that has no fixed starting or finishing point. Innovation may start anywhere and anytime. The result is an endless building up of value creation that is realized by the reinforcing cycles of the full circle. In CIM, new technologies (e.g. by the origination of new scientific discoveries) and changes in the market (e.g. by the origination of new life styles) continually influence each other in a cyclic manner. This dual nature of innovation will shape the future.

Innovations may introduce small and large changes in society. Often, one refers to incremental and radical innovations. The Cyclic Innovation Model allows a more diverse classification. Innovations of class-1 are based on changes in one node only. For instance, think at existing product-service combinations that are introduced with a fundamentally new marketing concept. Similarly, innovations of class-2 are based on changes in two nodes, etc.. In innovations of class-4 ('the four-star innovations') new scientific insight plays a crucial role, initiating new technologies, new product-service combinations and new changes in the market. For instance, think at the life- and nanosciences that will change our life drastically in the future.

Figure 1 shows the 'circle of change' at the highest conceptual level. At a lower level, each node comprises a group of different organizations, and each cycle comprises a 'matrix network' between two complementary groups (Berkhout, 2000). This means that the innovation model represents a playground of coupled networks that interact in a cyclic manner: the innovation arena. The creation of economic value in this arena requires a new type of entrepreneurship.

5. Lucio, a systems description

Lucio is a mobile data service that was introduced into the Dutch market at the end of 2002. It offers employees of companies the possibility to access their business information such as e-mail, agenda, adress book and Internet when they are mobile. It is being offered as a package of different product-service components implemented by a certified system integrator. The mobile device is a PDA (Personal Digital Assistant). Other product components that are needed to deliver and to make use of the service are a mobile infrastructure, e.g. GPRS and a VPN-gateway (access to Virtual Private Network) at the premises of the customer. All components are based on the presence of a Microsoft Exchange server on a LAN (Local Access Network) and a firewall. Lucio has been developed by KPN Mobile, a Dutch mobile operator and service provider, in cooperation with Hewlett-Packard and Microsoft. Lucio has been marketed by KPN Mobile as a service that is a 'guaranteed total solution', a 'reliable service', and 'easy in use'.



a. the system

b. the screen

Figure 2: Lucio: a mobile system with a PDA and a mobile phone connected to the company's VPN by using GPRS.

It is essential to view Lucio as an innovation by combination (Schumpeter, 1934; Van den Ende, 2003, p.1505): innovation is not at a component level but at a systems level. Lucio represents a new combination of several components: infrastructure (GPRS), device (mobile phone or PDA), software(e.g. information manager), hardware (e.g. intranet, mailservers), and the actual services (e.g. e-mail, agenda).

Integrated systems such as Lucio cannot be developed by just a single company. Until today, no single company possesses the knowledge and experience to develop such a product-service combination.

Figure 2 shows schematically how the device of Lucio is connected to the company's network and how it makes use of different components such as a PDA, network elements (VPN gateway, LAN) and software elements (Microsoft Exchange).

As already stated, Lucio is a cross-company innovation. Below we show the principal business partners and their role in the development of Lucio:

- KPN Mobile: supplier of GPRS-based services, providing secured connection with the customer's local network.
- HP: provider of mobile devices (i.e. the iPAQ 3870), and the ProLiant Server.
- Microsoft: providing software for the PDA-device (Pocket PC operating system), as well as the Management Information System.
- Certified system integrators (such as The Vision Web, Flex IT and CSS): providing support to suppliers and customers, and connecting the company's network to the mobile network.

So far, experience shows that Lucio has a large added value for its users. This is illustrated by two examples:

 'MOJO Concerts', the largest Dutch organizer of pop-concerts and other big entertainment events, is an intensive user of Lucio. Bookers of MOJO use Lucio for their contacts with the agents of pop-artists and with theatres. Employees of MOJO,

responsible for operational activities, use Lucio for fast communication such as changes in drawings of the stage that has to be build or sudden changes in the list of VIP's that attend an event. An important motive for MOJO to use Lucio is that many of their employees are most of the day not at their workplace but are mobile. In addition, Lucio functions independently of local telecom infrastructures. It makes Lucio in the eyes of MOJO a reliable service.

2. Lucio enables employees of 'Sité Woondiensten' (management of rented houses) to control their own appointments, to access the company's information-system (e.g. giving latest information about the availability of their houses to real estate agents), and to synchronize their mobile devices with the Outlook application at their workplace. Taking into account the large amount of houses and the very frequent changes, many employees need be informed with minimum delay. Therefore, for Sité it is important that Lucio prevents their employees for the embarrassment of making wrong or double appointments with customers. In addition, they have access to realtime information about their portfolio.

In conclusion, with respect to the principal developments summarized in section 2, Lucio represents an early example of a mobile data service that makes use of a transmission technology (GPRS) with a higher bandwith than the standard technology (i.e. GSM), it is a service that is not developed and operated by one telco (unbundling), it is the result of a joint effort of mobile telco's with companies from other sectors (convergence), it has a different business model than the 'plain old telephony' (POT), and last but not least, it is one of the first mobile data services that is principally different from the conventional voice-oriented services.

6. Analysis of Lucio with CIM

In this section we will apply the principles of CIM to Lucio. It must be noted that this is an exercise in retrospect, since Lucio was not originally developed on the basis of CIM. Therefore, our account of Lucio in terms of CIM has been discussed and adjusted with the product manager at KPN Mobile being responsible for Lucio (see acknowledgement).

If we reconstruct the innovation processes around Lucio in terms of CIM, then we see that the science and technology nodes did not play any role. New science and technology components were not required to develop Lucio. On the other hand, the market transition node of CIM played a vital role. Large attention was needed to assess the emerging business requirements for access to in-house information and applications at any time and any place. Results of this study were translated to an estimate of the market potential at a very early stage of the project. This was indeed an important starting point for the development of Lucio. An internal paper at KPN Mobile referered to a particular study carried out by IDC (2001) concluding that almost 30% of the business customers was interested in using a broadband mobile data service that could give them access to their intranet as well as Internet. And more than 20% was very interested in using this new service. Given the fact that this study also predicted a significant market growth, a major market transition towards the 'mobile business age' was foreseen by KPN Mobile. To make the predicted market transition really happen, the added value of Lucio was presented to the business community as a productservice combination that offers 'fast and easy mobile access to in-house business applications'. This objective yielded the functional specifications for the product development node of CIM: a suitable PDA, interface to the GPRS-infrastructure, and connection to the LAN of the client. These hardware and software specifications led to requirements for the technological capabilities of partners needed in the engineering cycle: Microsoft for the software, HP for the PDA and KPN Mobile for the telecom

network. In a next step, the constructed image of the future business in the market transition node could be *backcasted* via the service cycle (lower right-hand side of CIM) and via the product development node towards the engineering cycle (upper right-hand side of CIM). At the engineering cycle of CIM, the design of Lucio was a joint venture of KPN, HP and Microsoft, using existing technology. Minor technical adjustments of existing modules were required only. The development of a specific Lucio-gateway was undertaken by KPN Mobile.

In terms of CIM, Lucio is a multi-sector, class-2 innovation (see figure 3). This tells us that Lucio had a low technical risk (using existing science and technology), a medium marketing risk (using known market segments) and a high cultural risk (using sector-crossing partners).



Figure 3: The Cyclic Innovation Model categorizes Lucio as a multi-sector, class-2 innovation. This means that an alliance was made between companies of different sectors, and that two 'nodes of change' were involved.

From conversations with the product manager of Lucio at KPN Mobile it indeed became clear that one of the biggest problems for KPN Mobile was to cooperate with companies from different sectors with a different culture and strategy. For instance, at Microsoft it is accepted to view market introductions as business experiments. This, however, collides with the demand of full reliability which is a must for the telecommunication sector in general and for KPN Mobile in particular. In retrospect, CIM also gave the product manager better insight in the role of the different companies (see figure 3). This is considered to be important, as clarity about the different roles of the different actors turns out to be invaluable in a sector-crossing innovation project such as Lucio. In addition, the use of CIM gives information which bottlenecks to expect during the development. For instance, managing the engineering partnership was taking place in the upper right hand cycle, and issues related to the market introduction of Lucio in the lower right hand cycle. This confirms the dual nature of the development of Lucio: technical and social. Figure 3 shows that the actor in the product development node — KPN Mobile — needed to bridge two different worlds.

7. Using CIM for a second generation LUCIO

Figure 4 shows the role of CIM in creating a second-generation version of Lucio. This will be a different project indeed. Science-based foresight research is required to reveal the (near) future on IC-technology as well as MDS-markets: left-hand siede of CIM. the result gives insight in the forthcoming opportunities both technically and commercially. In addition, business-driven projects are required to design and manufacture product-service combinations to create economic value.



Figure 4: Creating the next generation Lucio. The upper part of CIM shows the innovation activities of the Information and Communication (IC) technology partners; the lower part shows the innovation activities of the Mobile Data Services (MDS) business partners. The lefthand part of CIM shows the science-based foresight activities directed towards new opportunities; the righthand part shows the commercially-driven development activities directed towards new economic value. CIM reveals the necessityu of cyclic interaction between what is technically possible (leading edge of IC) and economically desirable (value creation by MDS).

From the technology point of view the capabilities of UMTS and UMTS-plus will play a vital role in the innovation process. From the market point of view complex mobile services assisted by realtime simulation as well as realtime monitoring will play a vital role. These powerful services may revolutionarize the work processes in decision making on the spot.

If the innovation process would be arranged according to figure 4, the ambition is very high. It would make the second-generation Lucio a five-star innovation.

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