D3.2.1

The Akogrimo Consolidated Value Chain

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Context

Activity 3	**Architectural Framework**
WP 3.2	**The Akogrimo Consolidated Value Chain**
Dependencies	**This deliverables uses input of the deliverables D2.1.1., D2.2.1 Vol. 1 and D6.3.1. It can be used for WP7.1 in order to identify relevant partners for the application of a demonstrating tool.** **It will be the basis for deliverable D3.2.2**

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Executive Summary

This Deliverable 3.2.1 – "The Akogrimo Consolidated Value Chain" deals with economic opportunities that are available to the different participants in a value chain for solutions based on Mobile Grid Services. Forecasts for their opportunities are quite speculative due to the high innovation potential of Mobile Grid Services. For this reason the deliverable takes several steps in order to approach a "consolidated value chain". It has to be stated that today's inter-organisational value chains of telecommunication services are expected to change and move towards Mobile Grid Value Chains. For this reason they have to be examined in more detail. The discussion begins with an explanation and foundation of value chains by analysing The Porter Value Chain. However Porter's generic value chain approach does not represent complex value network structures which are perceived to be a more comprehensive and elaborate procedure to cover all the different aspects that contribute to develop Mobile Grid Services. Furthermore the process logic of future Mobile Grid Value Chains is currently not known and is expected to develop over time when formal processes are instituted. That is why a generic value network approach without too much process logic is chosen and adapted to a generic Mobile Grid business scenario as it has to be expected to from today's viewpoint. In order to analyze possible changes in today's value chains economic theories have been used to assess the development of transaction costs and information asymmetries respectively for each participant in the value network. Therefore two economic theories – The Transaction Cost Theory and the Principle Agent Theory have been described and used to analyze various roles that have been previously identified (WP 2.1.1, 6.3.1 etc). Based on these considerations first predictions on changes in the value chain concerning the number of participants and their market power can be given. Afterwards value networks are identified for Akogrimo's e-health and e-learning scenario and then their economic development is considered. Thus, it is possible to apply the prior generic considerations to concrete scenarios which have also been attempted within this document. Furthermore it is possible to propose essential participants for the deployment of a demonstrating system at the end of the Akogrimo project. Finally the participants of the value network discussed in the deliverable are brought into a first process logical order. This is done on the basis of the consideration of all dyadic relationships of the participants as well as on a proposal provided by TID. Further research in order to further consolidate the value network towards a consolidated value chain has to be done.

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Abbreviations

2G	2nd Generation
2.5G	2.5th Generation
3G	3rd Generation
Akogrimo	Access To Knowledge through the Grid in a Mobile World
AP	Access Provider
APO	Advanced Planner and Optimizer
ARPU	Average Revenue Per User
ATM	Asynchronous Transfer Mode
BCI	Business Collaboration Infrastructure
cHTML	Compact HTML
CP	Content Provider
D	Deliverable
DAME	Distributed Aircraft Maintenance System
DP	Device Provider
ebXML	E-Business XML
ECG	Electrocardiogramm
FT	Field Trip Grid Service
GEMSS	Grid-Enabled Medical Simulation Services
GEP	Grid Equipment Provider
GGSN	Gateway GPRS Support Node
GO	Grid Operator
GPRS	General Packet Radio Service
GPS	Global Positioning System
GRP	Grid Resource Provider
GSM	Global System for Mobile communications

HMES	Heart Monitoring and Emergency Service
HTML	Hypertext Markup Language
IP	Internet Protocol
ISDN	Integrated Services Digital Network
IT	Information Technology
LRP	Local Resource Provider
MMS	Multimedia Messaging Service
NEP	Network Equipment Provider
NO	Network Operator
NSP	Network Service Provider
PCP	Payment Clearing Provider
PDA	Personal Digital Assistant
PIEP	Plug-in Equipment Provider
PP	Payment Provider
P2P	Person to Person
PSTN	Public Switched Telephone Network
SGSN	Serving GPRS Support Node
SMS	Short Messaging Service
SOAP	Simple Object Access Protocol
SP	Solution Provider
VRML	Virtual Reality Modeling Language
WAP	Wireless Application Protocol
WLAN	Wireless Local Area Network
XML	Extended Markup Language

1. Introduction

As proposed in the Akogrimo "Description of Work" it is self-evident that today's telecommunication network and service operators have to develop new business activities and "provide profitable services […] based on Grid and Mobile communications concepts" [Akog2004, 5]. Many different enterprises take part in providing telecommunication services as can be seen in Figure 1. For each participant within this proposed value chain it is important to add value and generate relevant margins. The same goal must be pursued by participants within a future inter-organisational value chain for Mobile Grid Services that will partly result from the telecommunications value chain as demonstrated below.

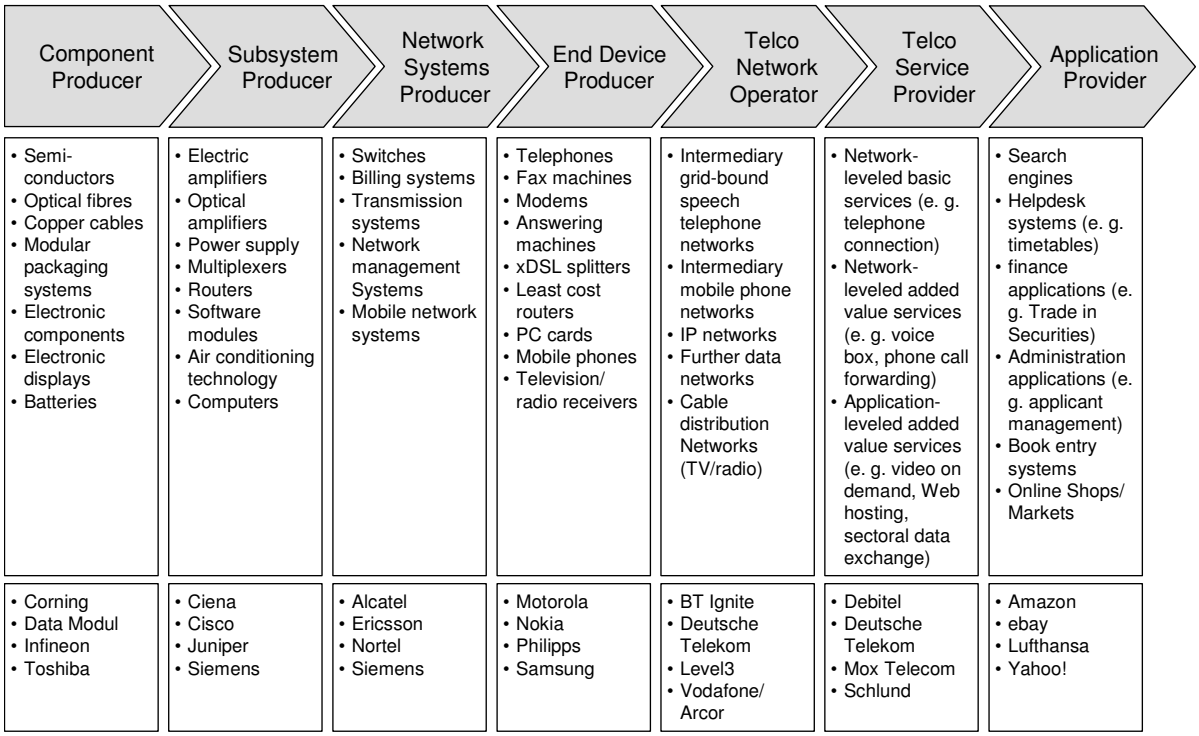

Figure 1: Inter-organisational Value Chain of Telco Providers [1]

For this reason it is important to research forecasts on how the development and provision of Mobile Grid Services will change the current inter-organisational value chain in Figure 1 which focuses on providers but not on customer-oriented service integrators and distribution channels which also will play a significant role and have to be discussed in this deliverable (section 3.1).

Furthermore there are only two cases that assure any success of Mobile Grid Services. Either Mobile Grid Services push away existing structures that are providing accordant services today, or Mobile Grid Services build new structures which will develop new business segments that can not be accessed in a different way. A more detailed description of this fact is given by Callon in the context of the competitive advantage of IT [2]:

A positive contribution can come from

- Efficiency measured by productivity (doing things better)
- Effectiveness (doing better things including: what an organisation could never do before)
- Competitive advantage (doing better and new things for the customer)

For this reason chapter 2.1 will discuss the generic approach of the value chain that has to be complemented in chapter 2.2 by more detailed as well as further approaches that are able to explain the preconditions of successful Grid services. Consequently chapter 2 provides consolidated knowledge about economic interrelations regarding supply and value network structures respectively, as well as competitive advantages, enterprises' attitudes and market structures, in order to be able to accomplish some appropriate analysis in chapters 3 up to 5 on the basis of such a fundament.

In chapter 3 the very generic analytical approaches for describing value networks and economic interrelationships between their participants are adapted to the Mobile Grid Services' situation. Furthermore the specific roles are analyzed according to the economic theories. Chapter 4 provides the example application of the analytical approaches of chapter 3, while chapter 5 offers a proposal for a consolidated value network for Mobile Grid Services.

The final value network is not reduced to a "consolidated value chain" yet, because of temporal reasons. In order to provide a valid "consolidated value chain" further research still has to be done as outlined in chapter 6.

2. Analytical Approaches for the Development of a Consolidated Value Chain

Starting from the description of Porter's generic value chain (section 2.1) of one single enterprise which is compatible with the reflections of section 1 as it considers the added value of an enterprise's activities, an analytical framework for the description and economic analysis of a single provider in the Mobile Grid Value Network will be developed (section 2.2).

2.1. The Generic Value Chain

The value chain is a systematic approach to examining the development of competitive advantage. To analyze the specific activities through which firms can create a competitive advantage, it is useful to model the firm as a chain of value-creating activities.

The value chain was created by M. E. Porter in his book, Competitive Advantage [3]. Porter identified a set of interrelated generic activities common to a wide range of firms. These activities create and build value. They culminate in the total value delivered by an organisation. The *Margin* depicted in the diagram is the same as added value. The organisation is split into *Primary Activities* and *Support Activities* as it's showed below figure

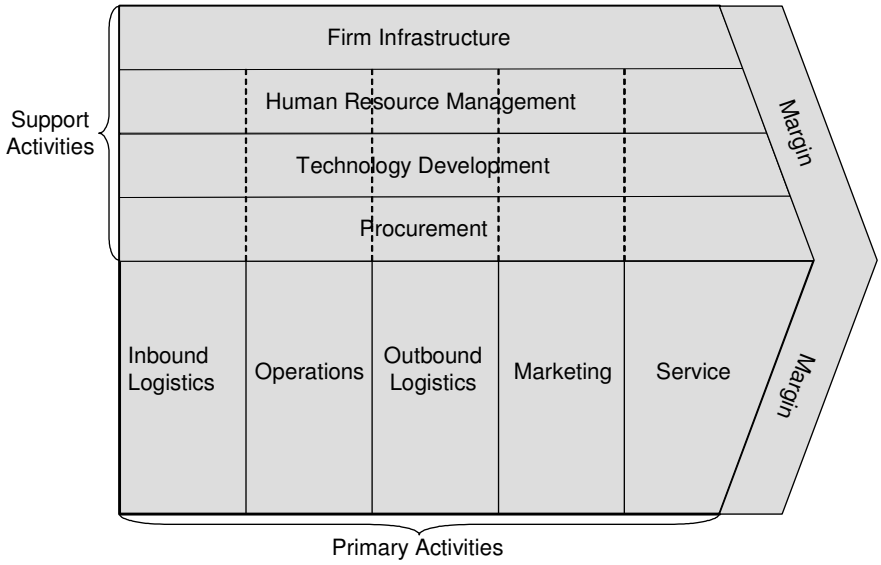

Figure 2: Generic Value Chain [3]

2.1.1. Primary Value Chain Activities

The goal of these activities is to create value that exceeds the cost of providing the product or service, thus generating a profit margin.

- *Inbound logistics* include the receiving, warehousing and inventory control of input materials.
- *Operations* are the value-creating activities that transform the inputs into the final product.
- *Outbound logistics* are the activities required to get the finished product to the customer, including warehousing, order fulfilment, etc.

- *Marketing & Sales* are those activities associated with getting buyers to purchase the product, including channel selection, advertising, pricing, etc.
- *Service* activities are those that maintain and enhance the product's value including customer support, repair services, etc.

2.1.2. Support Activities

The primary value chain activities described above are facilitated by support activities. Porter identified four generic categories of support activities, the details of which are industry-specific.

- *Procurement.* The function of purchasing the raw materials and other inputs used in the value-creating activities.
- *Technology Development.* Includes research and development, process automation and other technology development used to support the value-chain activities.
- *Human Resource Management.* The activities associated with recruiting, development and compensation of employees.
- *Firm Infrastructure.* Includes activities such as finance, legal, quality management, etc.

Support activities are often viewed as "overhead", but some firms have successfully used them to develop a competitive advantage; for example, to develop a cost advantage through innovative management of information systems. Nevertheless they will not be further discussed here.

2.1.3. Application of the Value Chain

In order to better understand the activities leading to a competitive advantage, one can begin with the generic value chain and then identify the relevant firm-specific activities. Process flows can be mapped and used to isolate the individual value-creating activities.

Once the discrete activities are defined, linkages between then should be identified. A linkage exists if the performance or cost of one activity affects that of another. Competitive advantage may be obtained by optimizing and coordinating linked activities.

The value chain is also useful in outsourcing decisions. Understanding the linkages between activities can lead to more optimal make-or-buy decisions that can result in either a cost advantage or a differentiation advantage.

The firm's margin or profit then depends on its effectiveness in performing these activities efficiently, so that the amount that the customer is willing to pay for the products exceeds the cost of the activities in the value chain. It is in these activities that a firm has the opportunity to generate superior value. A competitive advantage may be achieved by reconfiguring the value chain to provide lower cost or better differentiation.

The value chain model is a useful analysis tool for defining a firm's core competencies and the activities in which it can pursue a competitive advantage as follows:

- *Cost advantage.* By better understanding costs and squeezing them out of the value-adding activities.
- *Differentiation.* By focusing on those activities associated with core competencies and capabilities in order to perform them better than the competition. If an enterprise is highly focused on its differentiation it follows a so-called niche strategy.

- *Technology*. A change in technology can impact competitive advantage by incrementally changing the activities themselves or by making possible new configurations of the value chain.
- *Linkages between value chain activities*. Value chain activities are not isolated from one another. Rather, one value chain activity often affects the cost or performance of other ones.
- *Analyzing business unit interrelationships*. Interrelationships amongst business units.
- *Outsourcing value chain activities*. A firm may specialize in one or more value chain activities and outsource the rest.

2.1.3.1. Cost Advantage and the Value Chain

A firm may create a cost advantage either by reducing the costs associated to individual value chain activities or by reconfiguring the value chain itself. Once the value chain is defined, a cost analysis can be performed by assigning costs to the value chain activities. These costs obtained from accounting reports may need to be modified in order to allocate them properly to the value creating activities.

Porter identified 10 cost drivers related to value chain activities:

- Economies of scale[1]
- Learning
- Capacity utilization
- Linkages among activities
- Interrelationships among business units
- Degree of vertical integration
- Timing of market entry
- Firm's policy of cost or differentiation
- Geographic location
- Institutional factors (regulation, union activity, taxes, etc.)

A firm develops a cost advantage by controlling these drivers better than its competitors. A cost advantage also can be pursued by reconfiguring the value chain. Reconfiguration means structural changes such a new production process, new distribution channels, or a different sales approach.

2.1.3.2. Differentiation and the Value Chain

A differentiation advantage can arise from any part of the value chain. For example, procurement of inputs that are unique and not widely available to competitors can create differentiation, as can distribution channels that offer high levels of service.

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[1] There are further „economies“ offer cost adavantages, such as economies of scope (usage of existing variants), economies of integration (common system architectures, usage of model toolboxes), or economies of interaction (efficiency in resource allocation by high proximity to customers) [4]. Among other things they play an important role in mass customization scenarios such as the eHealth scenario.

Differentiation stems from uniqueness. A differentiation advantage may be achieved either by changing individual value chain activities to increase uniqueness in the final product or by reconfiguring the value chain.

Porter identified several drivers of uniqueness:

- Policies and decisions
- Linkages among activities
- Timing
- Location
- Interrelationships
- Learning
- Integration
- Scale (e.g. better service as a result of large scale)
- Institutional factors

Many of these also serve as cost drivers. Differentiation often results in greater costs, resulting in tradeoffs between cost and differentiation.

There are several ways in which a firm can reconfigure its value chain in order to create uniqueness. It can forward integrate in order to perform functions that were once performed by its customers. It can backward integrate in order to have more control over its inputs. It may implement new process technologies or utilize new distribution channels. Ultimately, the firm may need to be creative in order to develop a novel value chain configuration that increases product differentiation.

2.1.3.3. Technology and the Value Chain

Because technology is employed to some degree in every value creating activity, changes in technology can impact competitive advantage by incrementally changing the activities themselves or by making possible new configurations of the value chain.

Various technologies are used in both primary value activities and support activities:

- Inbound Logistics Technologies
  - Transportation
  - Material handling
  - Material storage
  - Communications
  - Testing
  - Information systems
- Operations Technologies
  - Process
  - Materials
  - Machine tools
  - Material handling

    - Packaging
    - Maintenance
    - Testing
    - Building design & operation
    - Information systems
- Outbound Logistics Technologies
    - Transportation
    - Material handling
    - Packaging
    - Communications
    - Information systems
- Marketing & Sales Technologies
    - Media
    - Audio/video
    - Communications
    - Information systems
- Service Technologies
    - Testing
    - Communications
    - Information systems

Note that many of these technologies are used across the value chain. For example, information systems are seen in every activity. Similar technologies are used in support activities. In addition, technologies related to training, computer-aided design, and software development frequently are employed in support activities.

To the extent that these technologies affect cost drivers or uniqueness, they can lead to a competitive advantage.

2.1.3.4. Linkages Between Value Chain Activities

Value chain activities are not isolated from one another. Rather, one value chain activity often affects the cost or performance of other ones. Linkages may exist between primary activities and also between primary and support activities.

Consider the case in which the design of a product is changed in order to reduce manufacturing costs. Suppose that inadvertently the new product design results in increased service costs; the cost reduction could be less than anticipated and even worse, there could be a net cost increase.

Sometimes however, the firm may be able to reduce cost in one activity and consequently enjoy a cost reduction in another, such as when a design change simultaneously reduces manufacturing costs and improves reliability so that the service costs also are reduced. Through such improvements the firm has the potential to develop a competitive advantage.

2.1.3.5. Analyzing Business Unit Interrelationships

Interrelationships among business units form the basis for a horizontal strategy. Such business unit interrelationships can be identified by a value chain analysis.

Tangible interrelationships offer direct opportunities to create a synergy among business units. For example, if multiple business units require a particular raw material, the procurement of that material can be shared among the business units. This sharing of the procurement activity can result in cost reduction. Such interrelationships may exist simultaneously in multiple value chain activities.

Unfortunately, attempts to achieve synergy from interrelationships among different business units often fall short of expectations due to unanticipated drawbacks. The cost of coordination, the cost of reduced flexibility and organisational practicalities should be analyzed when devising a strategy to reap the benefits of the proposed synergies.

2.1.3.6. Outsourcing Value Chain Activities

A firm may specialize in one or more value chain activities and outsource the rest. The extent to which a firm performs upstream and downstream activities is described by its degree of vertical integration.

A thorough value chain analysis can illuminate the business system to facilitate outsourcing decisions. To decide which activities to outsource, managers must understand the firm's strengths and weaknesses in each activity, both in terms of cost and ability to differentiate. Managers may consider the following when selecting activities to outsource:

- Whether the activity can be performed cheaper or better by suppliers.
- Whether the activity is one of the firm's core competencies from which a cost advantage or product differentiation advantage stems.
- The risk of performing the activity in-house. If the activity relies on fast-changing technology or the product is sold in a rapidly changing market, it may be advantageous to outsource the activity in order to maintain flexibility and avoid the risk of investing in specialized assets.
- Whether the outsourcing of an activity can result in business process improvements such as reduced lead time, higher flexibility, reduced inventory, etc.

2.1.4. Conclusions

There are several conclusions from the above consideration of the generic value chain:

- Added value is generated by primary activities which have to be identified in this deliverable by considering the different roles of a Mobile Grid Value Network.
- The core of a provider's activities in a Mobile Grid Value Network are "operations" that need providers of inbound products and services as well as sales and operational channels for its devices needed and outbound services respectively.
- In order to identify the added value of each participant in the value chain their interactions must be analyzed. Therefore three different approaches have to be considered.
    - *Value Networks.* The interactions between all participants are not as linear as proposed by Figure 1 and Figure 2. For this reason a generic value network will be introduced in order to describe the roles of the participants in a Mobile Grid Value Network.

- *Transaction Cost Theory.* As all assumptions of the theory are fulfilled (enterprise perspective, efficiency of transactions as one important driver, limited rationality, opportunistic behaviour, existence of institutions, relational contracts, existence of transaction costs) all dyadic interactions will be illuminated by this theory.
- *Principal-agent theory.* The more and more all participants within a Mobile Grid Value Network are specialized, information asymmetries will arise. Furthermore the participant's behaviour and single interactions will undergo a closer examination.

2.2. Generic Analytical Approaches for the Description of the Mobile Grid Value Chain

The following generic approaches are more sophisticated than the original value chain. By means of these approaches it is possible to develop the preconditions for successful Mobile Grid Services in a systematic way.

2.2.1. Model of a Value Network

For the reasons provided in chapter 2.1 a generic model that is different from Porter's value chain is introduced as it considers the network character of the participant's interactions in a better way. As the process logic of a future Mobile Grid Value Network is not clearly defined as of today, a model is introduced that does not state much about process logical aspects.

Figure 3 shows an example of a generic value network whose participants interact by means of a business collaboration infrastructure that could be regarded from different levels of detail:

- Business level, e. g. service level agreements, ebXML
- Process level, e. g. ebXML, process models
- Application level, e. g. ebXML, compliant industry standards
- Software level, e. g. SOAP

As this aspect is not very relevant for the Mobile Grid Value Network the Business Collaboration Infrastructure itself will not be considered in further detail.

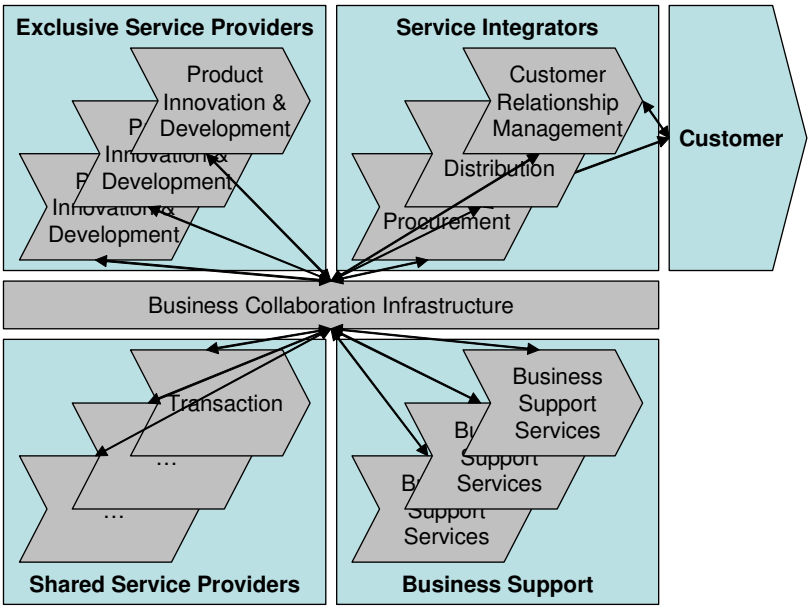

Figure 3: Generic value network [5]

Figure 3 allocates examples of traditional business processes to value network component types such as shared and exclusive service providers, service integrators and business support services. The different types of the network pursue different strategies in order to generate added value:

- *Service integrators:* customer intimacy type business strategies
- *Shared service providers:* factory type business strategies
- *Exclusive service providers:* specialist type business strategies

This classification is mainly oriented according to the competitive advantage of the different participants in the network. While exclusive service providers offer quite differentiated or even niche products and services respectively, shared service providers try and offer low-cost services for different service integrators.

Together with the considerations of chapter 2.1 it is evident that most of the primary activities of Porter's value chain can be transferred and in a certain sense mapped to the inter-organisational generic value network:

- *Inbound logistics* are concerned with exclusive or shared product and service providers.
- *Operations* focus the recombination/coordination of all inbound goods and services are mostly performed by the service integrator
- *Outbound logistics,* Marketing and Sales, as well as Services need adequate interaction channels towards outbound business partners respectively and end customers. The different channels can be realized by the service integrator, but do not necessarily have to.
- *Firm infrastructure,* human resources management, technology development etc. are represented by business support services which are not further considered here.

Of course in reality the primary activities are not as clearly assigned as it is described above.

2.2.2. Transaction Cost Theory

The Transaction Cost theory is part of new institutional economic theory. It is relevant in order to answer the question under which circumstances providers in a Mobile Grid Value Network

will be successful. For example if transaction costs can be cut, the change from hierarchical towards adding-value market structures will take place.

The transaction cost approach to the theory of the firm was created by Ronald Coase [6]. Transaction cost refers to the cost of providing for some good or service through the market rather than having it provided from within the firm. In order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed and so on. Transactions are integrated when the internal cost of exchange is less than the external cost of exchange. More succinctly transaction costs are:

- search and information costs
- bargaining and decision costs
- policing and enforcement costs

Ronald Coase noted that there are inconveniences of market transactions, but if transactions are not governed by the price system there has to be an organisation. The object of a business organisation is to reproduce the conditions of a competitive market for the factors of production within the firm at a lower cost than the actual market. But if an organisation exists to reduce costs then why are there any market transactions at all? Two reasons:

- The costs of organizing additional transactions rise with scale and are equated with the costs of additional market transactions;
- The organisation of bigger firms may not reproduce the effects of market conditions.

2.2.2.1. Behavioural assumptions

- Human beings are rational (uncertainty, complexity)
- They sometimes show opportunistic behaviour (predominantly in small numbers exchange)

2.2.2.2. Dimensions of transaction costs

- Uncertainty
- Asset specificity *(not only does the seller have a problem with non marketable assets, if he needs credit this problem is simply transferred).*
- Frequency of transaction (cost of specialised governance have to be covered)

2.2.2.3. Features of Transaction Cost

This theory of Transactions Cost specifies the composition of various archetypal control structures and links these to their respective habitat [7]. These are:

- *Arm's length control* – featuring outcome control based on market-derived standards or predefined contractual provisions
- *Machine control* - which is administrative control based on codification of behaviour or predefined performance targets;
- *Exploratory control* - that works from converging insights that accrue and spread during the process
- *Boundary control* - boundary control that is proscriptive in nature, emphasizing actions to be avoided

These archetypal control structures differ in their problem-solving ability, which make them appropriate for the governance of some activities and contributions, but not for others. Moreover, they differ in respect of cost, and ultimately, an empirically observed alignment of an activity with a control structure is explained by delineating the relative efficiency properties of the match. Figure 1 summarizes the basic explanatory structure of this approach.

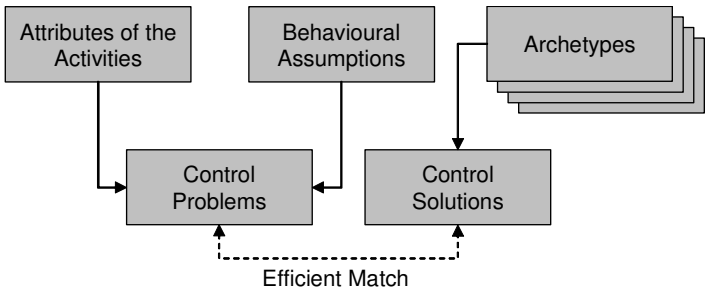

Figure 4: The structure of Transaction-Cost Theory-based explanation

2.2.2.3.1. Arm's length control

Where control takes a prescriptive orientation, the emphasis will be on compliance to the predefined norms and standards. When asset specificity is moderate, promulgation and sometimes even enforcement of these norms and standards may partly be left to the market, and managerial involvement in control may be limited correspondingly. Because in this situation there is at least some competition between alternative sources of supply and demand, the question as to what constitutes adequate performance is answered in part by the market, thus giving contracting parties some common reference point against which to assess the reasonableness of their expectations and on which to base the control structure. However, asset specificity being moderate, competition is not strong enough to provide self-sufficient safeguards and additional control mechanisms will be installed. Within arm's length control, these include continuous access to the rich repertoire.

2.2.2.3.2. Machine control

High programmability is associated with prescriptive control and a focus on compliance to pre-set norms and standards. However, given a high degree of asset specificity, these norms and standards cannot be culled from market interaction as in arm's length control, but need to be defined within the organisation. The resulting structure strongly resembles the mechanistic organisation that features standardization and regulation of behaviour, codification of budget targets, detailed monitoring, systematic measurement of performance on pre-defined dimensions, and clearly identified areas of accountability, usually mirrored in the organisational structure. Its emphasis on programming, progress monitoring, and correcting deviations from pre-set directions suggests the label machine control for this structure. The machine control archetype is a structure that is associated with mature programs and routine activities. This archetype can be refined by distinguishing action oriented and result oriented machine control types. In the action oriented approach, control is predominantly achieved via codification of actions and supervising observance of the rules and instructions, whereas control of the result oriented kind hinges primarily on target-setting, accountability, and reward structures that serve to encourage target-directed behaviour. In many instances, there will be no real choice between action oriented control and the result oriented approach, simply because the available information enables the one and not the other. Then, straightforward feasibility considerations will be decisive. But when both approaches are feasible, result control will usually reign for it tends to require less elaborate structuring –thus relieving the pressure on bounded rationality-, is likely to demand less higher

level involvement, and is more supportive of adaptation. The latter aspect is important when – low uncertainty notwithstanding- there may still be some unanticipated disturbances or opportunities demanding a flexible response. The result control variant may rely on a performance-dependent reward system to provide the incentive to elicit that response, whereas the action oriented alternative has no such option and needs to revert to time-consuming hierarchical redefinition of required behaviour.

2.2.2.3.3. Exploratory control

Low programmability implies the inability to define in advance the attainable outcomes of the activity. Also, it implies that any up front selection of the courses of action that are most likely to contribute to satisfactory outcomes is bound to require revision along the way. Explicit contracting for concrete actions or contributions is not feasible, and such activities must start out with little preconceived guidance, i.e. as steps on an uncharted route, the travelling of which requires considerable discretionary authority at the level of the travellers. Following that route, however, is a learning process, and in that process, participants acquire an increasingly deeper understanding of the activity and how they should go about with it. This understanding arises from experience, and is thus likely to be asymmetrically distributed (it is only gained by those who actually had the experience) and dispersed (different individuals have different tasks in the activity and their experiences relate to different aspects of the project). Sharing of information, then, becomes vital to decide on the next step on the route and to encourage a sense of coherence in participants' efforts. Prompt and undistorted sharing of information, however, may conflict with perceived self-interest, because individuals may expect that this information will not only be used for learning purposes and as input for emergent patterns of action, but also for ex post evaluation of individual performance. In that case, one must expect the information to be biased in an attempt to inflate the perception of the quality of performance. In that process, relevant details may be suppressed or become twisted, thus diminishing the value of the information flows for evaluative purposes, but also for learning purposes. To find a way out of this dilemma, formal instruments of control have not much to offer and exploratory control is highly informal in nature.

2.2.2.3.4. Boundary control

For activities that feature incorrigibly high levels of ex post information asymmetry, it is not possible to define and evaluate performance, not even after the contribution has been made. This situation arises in the control of activities that require input of highly specialized knowledge and skills. The treasury function could be a good example. It is quite common that this function is largely beyond the reach of rest of the organisation (including its top management), for the financial literacy required to understand the particulars of the treasury function and its performance is often present only in the treasury department itself. In that case, the rest of the organisation is unable to assess the quality of treasury's performance and, a fortiori, unable to provide much guidance to that department. However, even though one may be unable to specify what one expects from the activity, one will usually have at least some notion as to the factors that may actually jeopardize the business. These factors become the primary object of control. Thus, the aim of control shifts from ensuring desired contributions to the prevention of unwanted actions or outcomes.

2.2.3. Principal Agent Theory

The principal agent theory is also part of new institutional economic theory. It is relevant in order to answer the question under which circumstances providers in the Mobile Grid Value Network

will be successful. For example it is necessary that any of the participants of the value network tries to develop the market and to keep his hegemony.

There are different expressions for the same approach, called "principal-agent problem", "principal-agent theory" or just "agency-theory". It discusses the particularities in cases of incomplete and/or asymmetric information in economic relationships. The scientific roots lie in the approaches of Coase in the early 20th century (The nature of the firm, 1937). The theory is part of the New Institutional Economics, which consists in analyzing institutions (e.g. property rights, contracts, markets, hierarchies) and their economical exchange. Main goals of the New Institutional Economics are to analyze and show behavioural dependencies, efficiencies and change of all economical institutions. This theory describes actions between persons in hierarchy and designing of contracts.

First to talk about this in 1976 were Jensen and Meckling in their work. They define "… an agency relationship as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegation, some decision making authority to the agent". The assumptions of the principal-agent theory describe limited rationality of all involved economic agent, especially in case of asymmetrical allocation of information. Mostly, humans have fragmentary information about assessing actions of other humans. Also there are many different ways of risk affinity of the economic agents. But a principal uses and needs an agent to fulfil his own goals and expects from the agent to subordinate to principals' goals. As humans are, everyone has its own goals, position, ideas etc and will not strictly follow advises to get the principal satisfied.

The problem of motivating one party with the right instruments to act on behalf of another is the core of the principal-agent theory. A principal could be anyone in a higher position, e.g. board-member, director or supervisor which is disciplinary able to delegate someone. But it's not just bound to this - it depends on the economical situation which two or more persons are in. E.g. a board-member has to report to the shareholders about the companies' situation. In general said the problems arise every time, when a principal compensates an agent for performing certain acts which are useful to the principal and costly to the agent. Additional matters are that the performance is not observable because of arising transaction costs and so opportunism is possible for the agent.

Problem in this situation occurs from achievement of objectives. It's just possible to see results and quality of it but not the process itself or efforts to reach the goals. On the opposite the agent has more information to fulfil own goals by fulfilling principals' advices. The agent avoids any (high) risks to get the task done, but the principal in this sense can be seen as risk neutral – he just wants to have his instructions implemented.

Following problems let agency costs arise because of asymmetric distributed and imperfect information:

- "Hidden Characteristics": Before signing a contract there are lot of uncertainness for both sides. Principal has to find a way to screen potentials of the agent. But how? E.g. by giving the agent the possibility to self select contract options. So the principal is able to find out what could be the agents' strategy from a very vague point of view. To lower risk for the principal the agent's characteristics must be signalled in any way before giving him a contract. E.g. by notarized certificate, testimonial, references which can't be easily copied by anyone else.
- "Hidden Action and Hidden Information": Asymmetry of information is the problem in the post-signature phase of a contract. The agent has tolerance by fulfilling his contract because the agent can't be controlled every time. So the agent can do things for his own advantage

and for the disadvantage of his principal. Hidden information can be found when a principal can't judge an agent because he has too little knowledge about the others actions.

- "Hidden Intention": Even if it possible to monitor the work of an agent at any time and there are no hidden actions or information, there can be problems caused by intentions of the agents.

Controlling the "right agent behaviour" leads to disproportional (high) transaction costs. So the only way is to harmonize the relationships. Solutions to these difficulties can be found in incentives for a right behaviour of the agent. Via performance based-payment the gap to any wrong direction will be closed. Also common (corporate) culture with shared preferences, values and goals helps minimizing coordination costs. But efficiency goes before a homogenous culture, so setting up this seems difficult. Measurable results will be taken for setting up any kind of result and lead to contracts which agents motivates better. The meaning of the principal-agent theory is to give help in typical decision problems via contract design. But on the other hand to have ideal economic transactions one would every time need individual contracts.

2.3. Summary and further Research Process

Transaction cost theory and agency theory together predict that

1. the higher the level of uncertainty surrounding the business context
2. the greater the information asymmetry between resource exchangers,
3. the greater the specificity of investment required for the economic activity in question,
4. the more difficult it is to relate the marginal contribution of different resources to the final value, and
5. the greater the conflict of interest between resource exchangers,

the higher the likelihood of the establishment of an integrated or consolidated value chain. That is, the more likely it will be that a greater proportion of the value adding-activities will be organized within a few firms.

Alternatively,

1. the lower the uncertainty surrounding the business context,
2. the lower the information asymmetry between resource suppliers,
3. the greater the fungibility of investments required for the economic activity in question,
4. the greater the alignment of interests between resource exchangers, and
5. the easier it is to relate the marginal contribution of each resource to the final value,

the greater the likelihood of a fragmented value chain with different activities controlled by different firms. That is, the more likely it will be that value-adding activities will take place among a long sequence of firms, rather than within a single firm or a few firms.

In chapter 3 the three generic approaches for the analytical description of a Value Network and its participants from the business point of view are adapted to the special case of Mobile Grid Services. The resulting value network model as well as the economic theories will be applied to certain Mobile Grid Service scenarios from a business perspective in chapter 4.

Value networks involve cooperative effort – between individuals, teams, and firms. People exchange resources, information, knowledge, financial capital, products, and services, sometimes within firms and sometimes across firm boundaries. Whereas the two economic theories, both

based on efficiency arguments, make some specific predictions about the interaction of the participants of a value chains under different conditions (for example before Mobile Grid Services and after their wide-spread introduction).

3. Adaptation of the Theoretical Approaches from a Mobile Grid Services' Perspective

In this section special aspects of the value network introduced in section 2.3.1, for the Mobile Grid World are discussed (section 3.1). The participants mentioned in the adapted value network are described in more detail in section 3.2, especially considering their inputs, outputs and values added. Chapter 3.3 provides an examination of all the roles from the economic theories view.

It has clearly to be stated that the basis of this chapter consists of theoretical considerations. This seems to be an adequate way to deal with the certain degree of evidence that some roles in today's value chains will change by being aggregated or further differentiated. Because of the high innovative potential of Mobile Grid Services empirical forecasts are not supposed to deliver highly valid results without any preliminary theoretical considerations.

3.1. Special Aspects of a Value Network

As Service integrators need not necessarily perform marketing, sales, as well as service activities and provide accordant channels, the value network of section 2.3.1 has to be expanded. Another reason for its enhancement is the fact that customer-oriented solutions based on Mobile Grid Services are sometimes distributed by companies that originally are rather network operators than solution providers. In another context this is denoted in Figure 1 for example where 'Deutsche Telekom' provides Telco Network Operations as well as customer-oriented Telco Services. Another example that is more obvious is the fact that Vodafone takes such a dual role in the Vitaphone case (chapter 4.1.1.1).

Furthermore it is obvious that according to Akogrimo's "Description of Work" the Business Collaboration Infrastructure of chapter 2.3.1 is partly represented by the Mobile Grid Infrastructure. For this reason Figure 3 has to be adapted and therefore Figure 4 shows the model of a Value Network for Mobile Grid Services. The generic participants of the Grid are chosen as far as possible according to the deliverables D2.1.1, D2.2.1 Vol. 1 and D6.3.1.

Figure 4 shows that there are participants that only interact via conventional business collaboration infrastructures as well as participants that only interact via the Mobile Grid. Finally there are participants that use both platforms within the Mobile Grid Network.

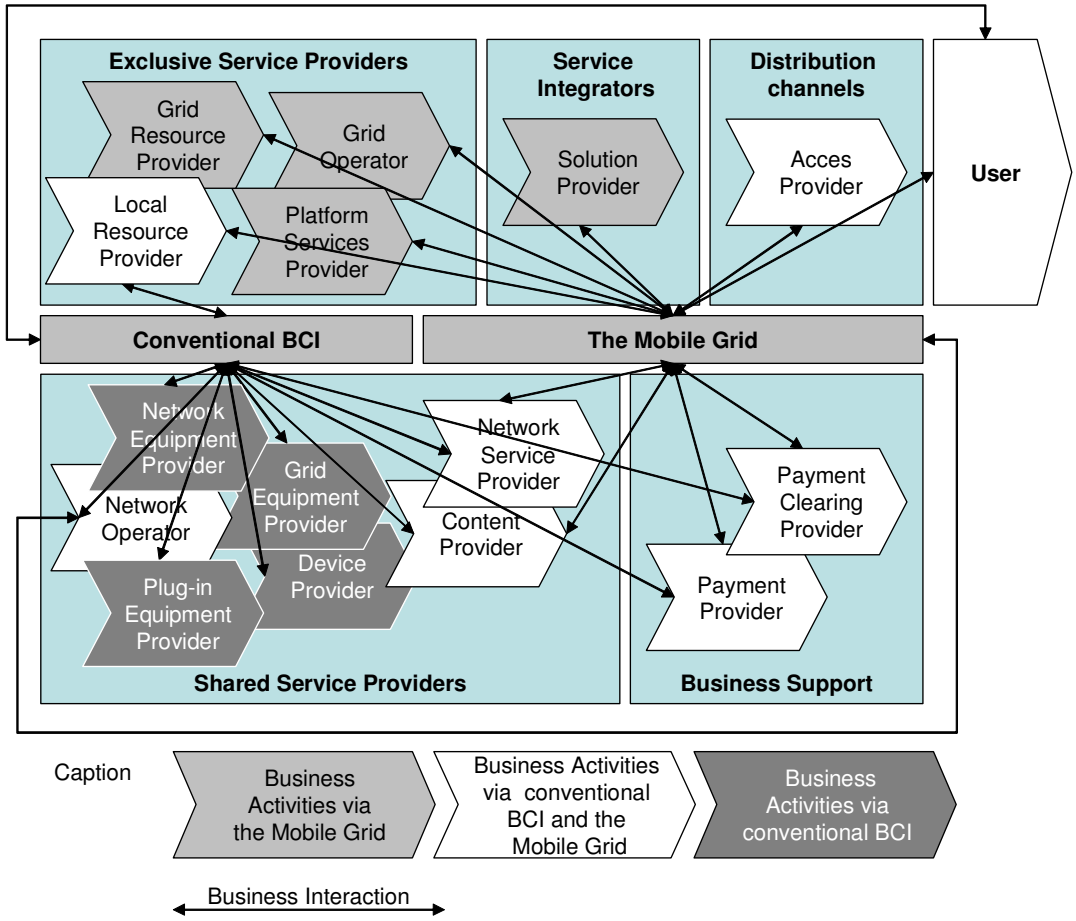

Figure 5: Mobile Grid adapted value network model

3.2. Description of the Participants in the Value Network

In this section the participants identified during the consortium's meeting in Aveiro and shown in Figure 5 are described in more detail.

3.2.1. Network Technology Provision

This section contains all participants around the network technology that is essential for making available Mobile Grid Services.

3.2.1.1. Network Equipment Provider (NEP)

The network equipment provider gives support to the mobile network operator and to the fixed network operator, providing them all with network equipment. It has to be distinguished between the wireless/mobile network infrastructure market and the fixed network infrastructure market.

The mobile/wireless infrastructure providers provide the following equipment:

- Radio access network equipment for 2G, 2.5G, and 3G wireless networks.
- Core network equipment for 2G, 2.5G, and 3G.
- Radio and base station systems.

- SGSNs, GGSNs
- Messaging and location-based technologies.
- Others.

The fixed network providers will take over providing equipment to different kinds of fixed network, such as: PSTN, ISDN, Frame Relay, ATM, and IP networks.

Input	Value Added	Output
Not considered here.	Not considered here.	Equipment for the Network Operator

Table 1: Input, Value Added, and Output of a Network Equipment Provider

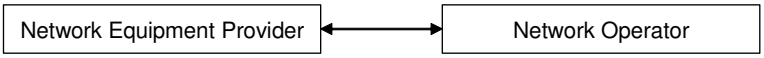

Figure 6: Value Network Relationship of a Network Equipment Provider

3.2.1.2. Network Operator (NO)

Network Operators are telecommunication companies which provide network and communication services and therefore offers the technology which enables Mobile Grid Application.

The Network Operator will most likely as well be the Akogrimo Platform Provider, because the network resource is the most expensive resource. However, there are possible business models where the Platform Provider rents Network capacity from the Network Operator and runs Akogrimo on its own. This second case is followed in Section 3.3 as well as in the description of the Grid Operator in Section 3.2.2.3.

Input	Value Added	Output
Equipment provided by the Network Equipment Provider	Implementation of a system of high speed wireless connection to be easily accessed and offering real-time functionality	Whole network infrastructure with its business models

Table 2: Input, Value Added, and Output of a Network Operator

Whoever the Platform Provider is, together with the Network Operator it plays a main role within the Akogrimo business model, because they provide the bridge between the Mobile World and the technological implementation (Grid World)

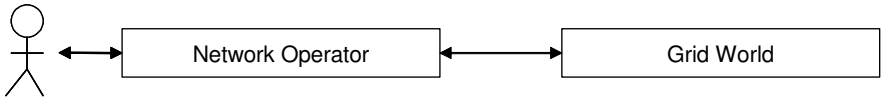

Figure 7: Value Network Relationship of a Network Operator

3.2.1.3. Network Service Provider (NSP)

A Network Service Provider is a business or organisation that sells bandwidth or network access by providing direct backbone access to the Internet and to its different network access points. For such reason, network service providers are usually referred to as backbone providers.

Network service providers may consist of telecommunication companies, data carriers, wireless communication providers, Internet service providers and cable television operators offering high-speed Internet access

Input	Value Added	Output
Equipment provided by the Network Equipment Provider (in case of a NSP carrier) or the Network Operator (if not NSP carrier)	-	Network Access Providing backbone access to Internet and usually access to its network access points

Table 3: Input, Value Added, and Output of a Network Operator

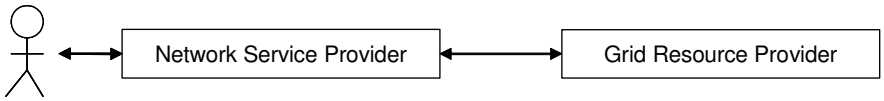

Figure 8: Value Network Relationship of a Network Service Provider

3.2.2. Mobile Grid Technology Provision

This section contains all participants around Mobile Grid technology as well as infrastructure-oriented devices that are essential for making solution-based Mobile Grid Services work. The descriptions of the main roles (Grid Equipment Provider, Grid Resource Operator, Grid Operator) sometimes are still not very focused from the business point of view. Nevertheless more detailed role descriptions are given for most of the aggregated participants (main roles) mentioned above, even if they are not further analyzed in section 3.3.

3.2.2.1. Grid Equipment Provider (GEP)

Grid Equipment Providers provide the technological environment for Grid services. It is mainly selling computing power and according software that is strongly related to the needs of Grid Resource Providers. Starting from other infrastructure providers there could be more and more Grid Equipment Providers in future, offering the technological basis for Grid Resources.

Input	Value Added	Output
Cf. sections 3.2.2.1.1 and 3.2.2.1.2	Cf. sections 3.2.2.1.1 and 3.2.2.1.2	Equipment for the Grid Resource Provider

Table 4: Input, Value Added, and Output of a Network Operator

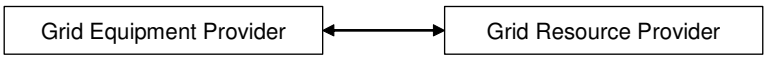

Figure 9: Value Network Relationship of a Grid Equipment Provider

3.2.2.1.1. Grid Software Provider

In order to provide services based on Grid middleware toolkits it is necessary to perform tasks to consolidate software releases potentially from different sources to a Grid software toolkit. Furthermore as Grid middleware, higher level services and the underlying libraries and toolkits undergo version changes and must follow updates e.g. security or performance patches a consolidation of these software packages need to be performed

Input	Value Added	Output
Software and libraries from software vendors (e.g. the Microsoft .NET toolkit), libraries and toolkits from the open source domain or self developed software in order to build consolidated releases of Grid Software potentially targeting a particular market or domain	Selection of appropriate software parts that can be combined to a Grid Software Toolkit, the provision of updates, security and maintenance patches, adding the appropriate documentation and providing support for installation and operation of the software	Consolidated software products combining the available software and in-house software to a ready-to-use solution

Table 5: Input, Value Added, and Output of a Grid Software Provider

3.2.2.1.2. Grid Solution Provider

The Grid solution provider is delivering hardware and software components that are tailored for the provision of resources and services of a Grid Resource/Service Provider. Depending on the type of Resource Provider different configurations, technologies and hardware components are necessary.

Input	Value Added	Output
Hardware resources Grid Software Providers' output	Selection of the appropriate size and configuration of hardware resources and adequate software components. This might include depending on the case also the integration with legacy systems and enterprise services such as accounting systems.	Integrated solution consisting out of hardware and software components that are ready to be used for the provision of Grid resources and services respectively.

Table 6: Input, Value Added, and Output of a Grid Software Provider

3.2.2.2. Grid Resource Provider (GRP)

Basic elements of virtual organisations are the provider of resources/services to be shared. These providers use Grid Software and appropriate hardware to deliver them according to the policies and agreements of the VO.

There is a wide range of different type of these providers. This role covers small service providers that offer a single service e.g. on best effort basis, large service providers that control a large set of resources doing also optimisation, load balancing, execution of workflows and more.

Input	Value Added	Output
Grid Solution based on Grid Software and fitting hardware in order to provide the resources to a Virtual Organisation	Delivery of one or several Grid Resources offering capacities finally needed by Grid operators and solution providers.	Set of services or resources to the members of the Virtual Organisation. The services might be provided together with a set of guarantees on service quality and reliability.

Table 7: Input, Value Added, and Output of a Network Operator

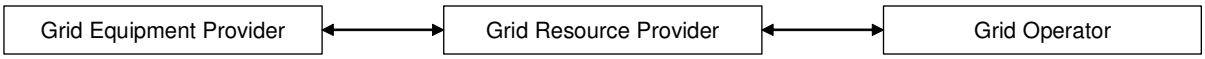

Figure 10: Value Network Relationship of a Grid Resource Provider

3.2.2.3. Grid Operator (GO) in a broader sense

The Grid Operator in a broader sense provides and runs the mobile Grid platform Akogrimo. This platform is sold to Solution Providers in order to build solution-oriented applications. The Grid Operator buys resources from the Grid Resource Providers. It delivers a system or at least a framework together with aggregated Grid resource-oriented services that enable Solution Providers to develop working and practical software products, which are utilisable for the end user.

Together with the Network Operator, the Grid Operator plays a major role within the Akogrimo business model, since it provides the bridge between the mobile world and the technological implementation (in this scenario the Mobile Grid).

Input	Value Added	Output
Resources provided by the Grid Resource Provider	Operation of the Grid in the form of a Platform offering aggregated services and a development platform	Development and operational Grid Platform for Solution Providers as well as its subsidiary Solution Service Providers.

Table 8: Input, Value Added, and Output of a Network Operator

Figure 11: Value Network Relationship of a Grid Operator

3.2.2.3.1. Grid Service Aggregator

The provision of resources or services to the Virtual Organisation might be sufficient for some Virtual Organisation driven by simple workflows or collaboration requirements. However in more complex settings the spontaneous composition of individual services to more complex services is one of the major innovations of Service Oriented Architectures. A Grid Service Aggregator might not necessarily own resources or services himself but only act as an intermediate between the service consumer and service providers taking over the responsibility for orchestrating them to a complex service.

Input	Value Added	Output
Grid Resource Providers' input, especially those from Grid Resource/Service Providers	Combination of Grid resource-oriented services to more complex Grid services.	Complex services that can even be tight to the customer's need or provide a standard solution for a particular application domain.

Table 9: Input, Value Added, and Output of a Network Operator

3.2.2.3.2. Grid Operator in a tighter sense

Beside the provision of application services a set of infrastructure services need to be available in order to establish, operate and manage a Virtual Organisation. Furthermore services for registering and publishing available services and providing mechanisms to detect them based on semantically enriched queries need to be supported.

Input	Value Added	Output
Dependency on Grid Resource/Service Providers and Grid Service Aggregators Needs and requirements of a virtual organisation's users	Publishing of Grid services Detection services for users of Grid services Distribution of policies for the use of Grid services	Supporting infrastructure that enables the service providers to deliver their services to each other as well as to service consumers

Table 10: Input, Value Added, and Output of a Network Operator

3.2.2.4. Device Provider (DP)

The Device provider will provide the user with several devices, such as Mobile Phones, PDAs and PCs. Devices are made intelligent and flexible by means of modular engineering platforms and middleware. Intel has started to develop hard and firmware for Mobile phones (Xscale processor). The Java community and Microsoft dominate engineering and middleware. Intel and SUN agreed to cooperate on Xscale and Java; a cooperation that will make us look forward to get for example Nokia Phones with GPS, WLAN, Java and an application programming interface with location based functionality. Software vendors are working on solutions to make their products independent from a devices' access preference, and p2p client vendors are that forefront of this development.

Input	Value Added	Output
Mobile device.	Enhancing of senses for mobile devices; Intelligent Decision Support.	Mobile device for the end user.

Table 11: Input, Value Added, and Output of a Device Provider

The value added regarding device in Akogrimo project is the following:

- *Enhancement of Senses for mobile devices.* Mobile devices are rather weak in performing computing intensive actions. This has to be done through the use of the high performance computing capabilities that are assigned mainly to base stations. The enhancement of senses mainly corresponds to optimizing:
  - Pictures, videos and stereo sound analyse
  - Ad hoc access to information of other cooperation mobile devices of the team

- *Intelligent Decision Support*: Mobile units collect and process information locally. However, they are also capable of providing information to the central base which can process it to perform simulations of the situation, extract useful information and statistics and finally propose actions to support decisions for the proactive handling of the emergency situation. The movement of the crisis team over the terrain, positioning of key-personnel at specific points, as well as classification of the risk are some of the decisions that will be supported by the system.

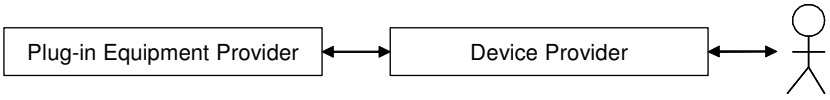

Figure 12: Value Network Relationship of a Device Provider

3.2.2.5. Plug-in Equipment Provider (PIEP)

Plug-in is a program module that adds functionality to a Web browser (or, in general, any other program). On the Web, plug-ins let Web browsers display data such as VRML scenes, real-time video, or multimedia data inline with the HTML document. Plugins, when available, are accessed through HTML EMBED or OBJECT elements.

Input	Value Added	Output
Mobile device.	Functionality to the user mobile device.	Enhanced Mobile device.

Table 12: Input, Value Added, and Output of a Plug-in Equipment Provider

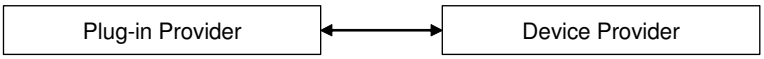

Figure 13: Value Network Relationship of a Plug-in Equipment Provider

3.2.2.6. Local Resource Provider (LRP)

The Local Resource Provider authority determines the value of resources within their administrative purview. This resource valuation can be used as a mechanism to attract or deter external users by utilizing the laws of supply and demand. Submitted jobs must contain enough resource requirement information to allow local resource allocation software to determine the cost of the local resources that will be consumed by the job.

The local authority will decide for their administrative purview if they will require a remote user to have a local account to utilize local resources. If local resources are provided to remote users without local accounts/accounting, the local resource provider must provide full accounting of each resource used and the costs charged for each resource for the job. This accounting can be performed immediately or later when the accounting software is run (or upon request from the requesting site).

Input	Value Added	Output
User query.	Remote access for user jobs on foreign resources without an account.	Result report.

Table 13: Input, Value Added, and Output of a Local Resource Provider

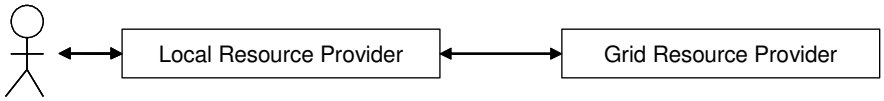

Figure 14: Value Network Relationship of a Local Resource Provider

3.2.3. Solution Provider (SP)

The main role of the solution provider is the development and distribution of applications/services supporting the end user with solutions in a special domain exploiting the possibilities of the Mobile Grid Platform. Some examples of services are: e-health, e-learning, crisis management, etc.

Solution service providers constitute a sub-group of solution providers that support solution providers with applications and services. Solution service providers are expected to become an important alternative, not only for small companies with low budget, but also for larger companies as a form of outsourcing. The main idea is that external solution service providers can offer their services to operators and application providers. Some samples of these services could be: video-conferencing, e-mail, search engines, search algorithms, routing services, analysis, others.

Input	Value Added	Output
Grid Platform Solution Services Contents Mobile Services	Input integration.	Solution for the end user.

Table 14: Input, Value Added, and Output of a Solution Provider

As it is shown in Figure 15, the Inputs to Applications Providers are:

- *Grid Platform*. This platform is sold/rent to the Solution Provider to build a solution that is ready to put its solution on top.
- *Solution Services Provider*. Make an available add-on solution for the Solution Provider
- *Content Provider*. Management of content (information and knowledge in a certain domain) and provision to the Solution Provider.
- *Mobile Services*. That is the Mobile Portal or Access Portal. The End User connects to this portal to access the solution.

The Output from Solution Providers is the solution for the end user.

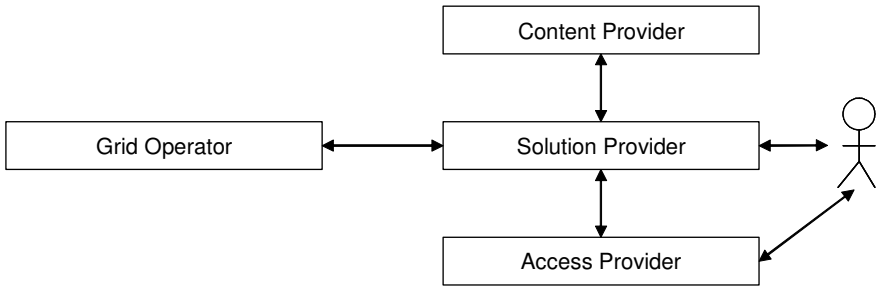

Figure 15: Value Network Relationship of a Solution Provider

3.2.4. Content Provider (CP)

Participants in the value chain perform a well-defined role, taking inputs from upstream participants, adding value, and then delivering their output to a downstream contributor.

Currently, the mobile network operators generate a major part of their revenue from voice services and a very small part comes from data services such as SMS. Whereas some data services such as SMS have been growing rapidly, other experiments such as WAP have not found widespread customer acceptance. During the next decade it is anticipated that the gross revenues for voice services will remain stagnant and that the expansion of the mobile industry will be driven by mobile data and it is projected that by the year 2008 the mobile data services will constitute more about 60% of the total revenue of Mobile network operators. The mobile content market is changing. Once at the heart of the value chain, mobile operators have found themselves being squeezed out of the equation, and finding it harder and harder to avoid being pushed into a position of merely providing the data transport between providers and their customers.

For growth to materialize, the industry needs to build increased network capacity and functionality as well as applications and services. The criticality of mobile content is driven home by the fact that the ARPU (average revenue per user) from voice services is declining and mobile carriers need to generate alternate sources of revenue. A good example is Mobile Service Provider - NTT DoCoMo's service named i-Mode. About 39 million i- Mode users spend money on subscription based i-Mode sites. DoCoMo collects these fees as part of the monthly phone bill, takes 9% commission and passes the rest to the site's publishers.

On the other hand Content aggregators are threatened with extinction by the fact that major brands and operators are tending to deal directly in order to get content to consumers devices. With the value of some of the truly global brands being far in excess of that of the equivalent operator brands, multinationals have found that they can leverage their extremely loyal customer base to pry users away from operators. They are putting in place the business models to develop their own white-label branded portals and vitally establish their own billing relationships with customers. In turn, operators are looking to develop their own content, either through in-house expertise, or through outsourcing, in an effort to minimise the impact of being sidelined by these developments. In addition to this, mega-brands are not satisfied with just taking a slice of the revenue from their content, they want to provide voice services as well, further reducing operator revenues.

The following groups participate in the m-commerce value chain:

- *Content creators* develop new content, product or services such as News, database information sources, products, and entertainment
- *Content aggregators.* Content syndication and enhancement, content development, and hosting. They basically package the work for distribution purposes.
- *Content distributors.* Content fulfilment and optimization services, synchronization services, assurance, and security services

Each of these definitions is rather fluid in the sense that some extremely large players - like AOL Time Warner - may actually have divisions that perform several of these functions.

Input	Value Added	Output
Needs of Solution Service Providers Any information being relevant	3 stages of Value Addition : - Content Creation - Content Aggregation - Content Distribution	Final Ready to deliver content to the User via the Access Provider

Table 15: Input, Value Added, and Output of a Content Provider

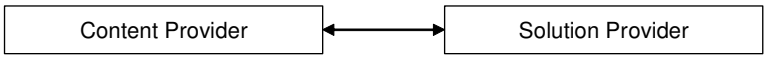

Figure 16: Value Network Relationship of a Content Provider

3.2.4.1. Content Creator

Content Creators aim to incorporate mobile technology into services that surround private and business customers. The objective is to create and provide content services to major network operators. There are a different variety of Web and Mobile content that is on offer. These services vary from news to financial transactions to entertainment, games, ring tones and database information. Content originators own copyrights to the material they create and license and distribute it either directly to carriers and portal companies themselves or in partnership with a middleman.

Entertainment content must also be accessible across device types. Companies such as Indiqu create wireless content, and in some cases, take content developed for other media and make it wireless-ready. Music content is a typical media conversion example. Transaction content ranges from stock quotes to auction bids. For example, at eBay, users can track auction progress and change their bid wherever they are. Database content typically includes reference materials such as restaurant guides like Zagat.com, maps like those provided by MapQuest, and white pages.

3.2.4.2. Content Aggregator

Content aggregators function as middlemen between the content originators and the distributors. Aggregators license local, regional, national, and global content from its creators and focus on the packaging and customizing aspects for use by specific devices and networks. Aggregators (or mobile applications infrastructure provider) provide value to the content originators by negotiating intricate and time-consuming distribution deals with individual carriers, resulting in wider content distribution. As they are also connected to all Mobile Network Operators and create an infrastructure for the carriers, content aggregators create turnkey mobile data applications by combining content from numerous sources and integrating it into a single interface.

For example, i3 Mobile takes information from approximately sixty-five different content providers and uses its proprietary XML-based servers to pull out and format the personalized content subscribers have requested. It then distributes this content to the subscriber's mobile device through a carrier's network. Currently, the company works with twenty-seven carriers. While aggregators such as i3 Mobile emphasize the broad availability of content, other aggregators such as SmartServ Online bundle content together solely to drive transaction processing.

3.2.4.3. Content Distributor

To generate revenues, content aggregators must deliver the content they provide through new distribution channels. Content distributors provide the aggregators with the ability to publish

their content on different networks, devices, and operating systems. Distributors support and develop applications for a wide variety of wireless protocols. Examples include cHTML and WAP applications, which use different programming standards to enable mobile devices to display Internet-based information. The content distributor InfoSpace (that has direct relationships with wireless network operators) provides the aggregator companies with access to the wireless network operators and portals it uses to distribute content. In addition, their technology can also provide digital content providers with the means to repackage their content for delivery through a wide variety of wireless data protocols such as SMS applications, WAP, microbrowser applications, and various voice applications.

Content distributors also offer content delivery services, which help to enrich the end user's wireless experience. Content delivery capabilities include: Synchronization services that enable data transfers over unreliable networks and Optimization services, which compress data and thus speed the delivery to users in a bandwidth-constrained environment. Mobile content distribution is proven to be a rapidly growing source of revenue and a powerful marketing tool to mobile network operators. It is designed and packaged to enable fast mass distribution of content using different distribution channels (SMS, MMS, E-mail). Some of the features of services that a content distributor includes:

- Data collection from content providers and aggregators ·
- Push content distribution
- Pull content distribution
- Asynchronous data collection
- Location based services integration
- Content charging
- Access screens for content providers

3.2.5. Access Provider (AP)

Providing access may have different notions depending on the current viewing angle at this role. Different outlines of how to integrate access providers into a value network are thinkable which the following short scenario shall visualize.

The role of an access provider embraces all activities that are targeted at brokering between different

- Organisational entities involved in an electronic workflow (from a virtual organisation's viewpoint),
- Resources that communicate and exchange information (from a Grid services viewpoint) and
- Identifiable users - ranging from individuals to organisations of larger extent - and available network infrastructure (from a network viewpoint).

The above presented structuring implies a broad and complex task portfolio which changes from the viewpoint or layer that has the focus on: Looking at the network infrastructure layer, an access provider could be regarded to be closely related to a network service provider as described in section 3.2.1.3. Access providers in fact primarily place a communications infrastructure at the disposal and secondly grant or deny access to this infrastructure to a certain user.

However, an access provider does not only make the communications infrastructure available. There is more to consider. An access provider has to decide whether to allow access to the

network, but also to Grid services and resources and finally – on the virtual organisation's level – the access provider determines whom to integrate in a business process.

A small scenario as shown in Figure 17 shall outline the above stated in a more comprehensive way. Consider an individual that is an active customer to the mobile communication services offered by a company called MobCom. This customer now would like to profit from an e-health service by running a locally installed application on his mobile device. The service itself is provided by a specialized service provider, thus the MobCom customer attempts to take the role of a service user or service consumer. Consequently, the customer is labelled with the term user in Figure 17. MobCom, the application provider and the service provider stand in a mutual relation of trust, symbolized by the usage of a green arrowed line between the two administrational domains. This basically means that MobCom and the service provider both are members of the same virtual organisation – they have either once concluded a direct contractual agreement or they are both included in the virtual organisation by means of a central entity, in this scenario the application provider that administers the virtual organisation. The consequence of this trust relation between two organisations lies in the mutual acknowledgement of authentication information.

Thinking of the usual case in which a user accesses his home network – MobCom in this scenario, symbolized by an arrow labelled with 1 – the user first has to authenticate oneself in order to be granted access. MobCom registers successfully authenticated users in its own systems with a set of according event data, such as:

- User@MobCom, authenticated on date X at time Y by means of a valid PIN
- Furthermore, a security token is calculated out of this data set.

As the user in this scenario is not primarily interested in network access only, but in consuming a (mobile Grid) service that is accessible through his mobile device, it has to be decided in a second step which workflow or business process has to be instantiated and executed according to the user's request and if the user actually is allowed to call for this process. This decision is taken by the application provider. But before doing so, the application provider needs to verify the user's identity which can be achieved by sending the earlier mentioned security token with the service request. Therewith, the application provider can poll the user's authentication status that first applies to MobCom's domain, but due to the mutual trust relation, the application provider accepts authentication information from MobCom for its own domain as well.

The same holds for the respective trust relation between MobCom and the service provider or between the service provider and the application provider: Thus authentication within a virtual organisation only has to be done once. However, another scheme applies when it comes to authorizing a user. Authorization at this stage of the scenario would mean to allow or to refuse the user to consume the requested e-health service. Several configurations are imaginable, but let's think within this scenario of the following arrangement:

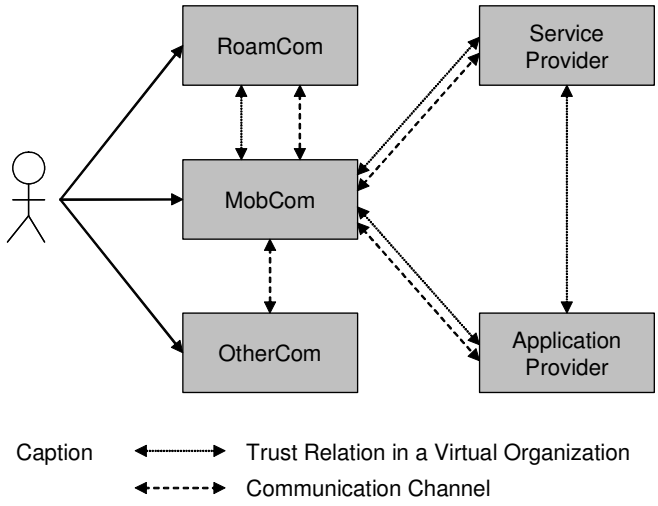

Figure 17: Access Scenario

When MobCom routes the service request to the application provider it automatically attaches the user's profile to the request. Therein, generic information about the user such as the preferred language is contained. It also may include the services a user is subscribed to. The application provider thereon may take the submitted user profile or its own user profile (if there is any) into account for authorizing a user for the requested and identified process to be started. If the user is authorized the corresponding business process is executed and monitored for what the service provider with its resources is bound into the workflow.

In this first alternative, all mentioned entities, the user, the service provider and the application provider were connected through MobCom's communication infrastructure. But what happens when the user is abroad, logged into RoamCom's network (reflected by the arrow, labelled with 2), but still would like to consume the same e-health service? As indicated by the green arrowed line between MobCom and RoamCom in Figure 17, both companies share a trust relation, so they both can be members of the virtual organisation. In this configuration, not much has to be adjusted from the simpler first case. The user authenticates with the same identity as it would do by a direct MobCom network access procedure. However, as the user does not dispose of an active contractual relationship with RoamCom, the user cannot be authenticated for the RoamCom domain in the first place, but an authentication request will be transferred to MobCom. If MobCom in turn will authenticate a user, traffic simply will be routed through RoamCom's infrastructure.

More changes have to be taken into account when the user tries to access the e-health service through a network that is interconnected with MobCom's infrastructure, but does not dispose of a trust relation within the virtual organisation. This case is reflected in Figure 17 by an arrow labelled with 3. In this configuration, network access will only be granted if the user is an active customer of OtherCom. The service request still will be routed to MobCom and the user may be authenticated or not depending on the respective authentication credentials transmitted. It also is imaginable that only the application provider will be able in this specific case to authenticate a user.

Whereas within the virtual organisation, service level agreements will be concluded and the entity's adherence to them will be supervised, agreed quality of service parameters will not apply to data that is routed through OtherCom's communication facilities. As a consequence, the requested e-health service may be accessed, but in a best-effort manner only as the virtual organisation will not be able to guarantee the service to be provided from end to end in a desired quality.

Input	Value Added	Output
Authentication information User service profile Application/service specific data in the form of a service request	Achieving a transparent usage of the network as a communication means for authenticated and authorized users in order to consume Grid services that are part of an appropriate business process. The transparent aggregation of data, content, services and resources while executing and surveying a business process.	Authentication status information Authorization status information Initiation of a business process if a user is correctly authenticated and authorized.

Table 16: Input, Value Added, and Output of an Access Provider

As explained in the previous section, the role of an access provider may differ from configuration to configuration. It furthermore includes different steps depending on the viewing angle at it. Access provision on network level for example deals with other tasks than access provision does on a Grid services or virtual organisation level. Overall, access provision consists of two main activities:

- Authentication and
- Authorization

While the first is done on network level already, authorization has to be achieved for requested Grid services and Grid resources respectively, and in the end for a whole business process to be executed.

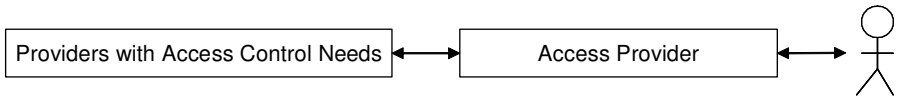

Figure 18: Value Network Relationship of an Access Provider

3.2.6. Payment Clearing Provider (PCP) and Payment Provider (PP)

In a commercial environment, payment for service usage and payment clearing automatically obtains the status of a key issue to be solved. Therefore, both payment providers and payment clearing providers take a central support role in service provision.

Before starting to define what a payment provider and a payment clearing provider might be and which respective role within the value chain they might receive, a clear understanding of different payment- and clearing-related terms as well as the underlying financial process has to be gained.

Whenever a resource in a business-oriented mobile Grid solution is consumed by a Grid service, the service consuming entity will have to compensate the service provider in a monetary way. In a Grid environment based on the concepts of outsourcing and concentrating on core competencies, resources and services are the central objects of interest. In a potentially multi-tiered hierarchy of service providers, a service provider sells a specific service to a service consumer. The latter in turn, probably will take on a higher hierarchy level again the role of a service provider, by including in its very own offered service bought and self-produced services. This scheme easily is extensible to a wide range of hierarchy levels.

Services produced by the service provider's own hand depend on the need for appropriate resources. Thus, a service provider – independently on which hierarchy level it finds itself – has to find appropriate metrics and functions that directly or indirectly reflect the cost structure of a service provider's resources. Furthermore, purchase information about externally provided services have to be gained. While resource costs can usually be regarded as invariable or slowly variable from a short-term view, prices for external services may change on short notice. However, this depends highly on the number of potential (external, lower level) service providers and the respective influence factors on their resources.

The whole system has to be regarded as one of high dynamicity as a service provider probably first will be involved in a competitive negotiation phase where its offered conditions (by means of a proposed service level agreement) have to prevail against alternative offers. Again, this holds for both, negotiations between a service consumer and a service provider as well as negotiations between the same service provider and its potential range of suppliers.

In the end, a service provider has to conduct a price calculation, taking into consideration its resources' costs, (probably only estimated) prices of purchased services, assumptions about its own services' market chances (such as the service consumer's willingness to pay) and the desired margin to be achieved, allowing a long-time survival for example for further investments.

After having shortly outlined the financial processes in a Grid environment, the focus shall now be led back to the monetary compensation for a consumed service. The monetary flow for service usage is referred to as payment in financial terms. A service consumer shows outgoing payments whereas a service provider would speak of an incoming payment. Payments will consist in most cases of electronic financial flows only as in a mobile Grid environment electronic workflows on a organisational level and web services based Grid services on the Grid level are the central objects of interest. Considering as well the fact that money in its form of the universal intermediary can only be issued by accredited trusted institutions, the involvement of a separate role dealing with financial transactions appears to be quite reasonable.

Payment providers, thus highly specialized and interconnected institutions focusing on asset management as well as the secure exchange of payments, will take care – upon request or automatically – of all financial transactions, be it incoming or outgoing flows for and from their customers, service consumers and service providers respectively.

However, in a dynamic and potentially large virtual organisation with a high number of service requesters and service providers that might be integrated in an ad-hoc manner, the mere amount of single payments runs the risk of becoming unmanageable. Furthermore, every payment finally transferred will cause costs which leads to the conclusion that an effective and scalable solution has to be found in order to handle payments. That's where payment clearing providers come into play. Potentially on every hierarchic level, an entity can be placed that settles the different incoming and outgoing payments. Settlement of payments basically means to charge payments against other payments in order to reach a net balance (positive or negative signed). Payment clearing providers thus will in a first step collect charging information for the domain it is responsible for by assigning the information to logic containers, accounts so to speak, and then in a second step the accounted financial information will be settled in planned intervals. The resulting balance value is afterwards transferred to the payment provider which in turn awaits and accounts incoming payments as they have been billed (in case of a positively signed value) or arranges the respective payment (in case of a negatively signed value).

Input	Value Added	Output
Financial transaction data (in form of a request for an incoming or an outgoing payment)	Secure and reliable exchange of monetary values across administrational domains Accounting incoming and outgoing payments	Financial transaction status data

Table 17: Input, Value Added, and Output of a Payment Provider

Input	Value Added	Output
Financial transaction data: To be collected and accounted financial data	Settlement of payments Offering centralized services in a financial administrational domain (allowing for example single-bill solutions for customers) Aggregate different payment providers' systems	Presentment of balanced accounts (Electronic) bill presentment

Table 18: Input, Value Added, and Output of a Payment Clearing Provider

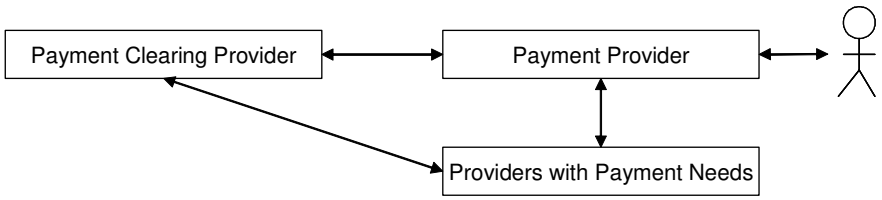

Figure 19: Value Network Relationship of Payment Clearing and Payment Providers

3.3. Analysis of the Value Network by Economic Theories

For the analysis of the participants of the value network in Figure 5 according to the transaction cost theory and the principal agent theory it is necessary to consider three different dimensions:

- *Criteria of the economic theories*. Each of the main criteria for the transaction cost theory and the principal agent theory have to be considered.
- *The participants in the value network*. Each participant has to be examined regarding its relationships towards its direct partners in the value network.
- *Chronological shift*. According to chapter 1 Mobile Grid Services have still to prove their acceptance and subsequent success. For this reason it is necessary to consider the situation as it is today (without Mobile Grid Services) and as it will be in future (after the implementation of Mobile Grid Services).

3.3.1. Criteria of the Economic Theories

Each participant in the value chain will be analyzed according to the following criteria:

Theory	Analysis Criteria		Description
Transaction Cost Theory	Uncertainty		Deficiency of rationality of each participant.
	Asset Specificity		Specificity of machines, knowledge etc.
	Frequency of Transactions		Costs from specialized governance included.
	Control Archetypes	Arm's Length Control	Featuring outcome control based on market-derived standards or predefined contractual provisions.
		Machine Control	Administrative control based on codification of behaviour or predefined performance targets.
		Exploratory Control	Working from converging insights that accrue and spread during the process.
		Boundary Control	Proscriptive in nature, emphasizing actions to be avoided.
	Costs	Search and Information Costs	Costs from discovering who it are that one wishes to deal with.
		Bargaining and Decision Costs	Costs from conducting negotiations leading up to bargain and draw a contract.
		Policing and Enforcement Costs	Costs from inspections needed to make sure that the terms of the contract are observed.
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	Before signing a contract there are lot of uncertainness for both sides. Principal has to find a way out to screen potentials of the agent.
		Hidden Action and Information	Asymmetry of information is the problem in the post-signature phase of a contract.
		Hidden Intention	Problems caused by intentions of the agent.
	Incentives		For a right behaviour of the agent.
General Criteria	Marginal Contribution to the Final Product		Related to the different resources in the value network.
	Conflict of Interests		Between two resource exchangers.

Table 19: Criteria for Analyzing Participants of a Value Networks

3.3.2. Results of the Analysis

In the following sections the values of the economic theories' attributes are given. They are the result of internal workshops at the University of Hohenheim and want to give indications for each participant in the Value Network regarding its current situation an its future.

For that reason the main business partners of each participant were identified according to its description in chapter 3.3.1. All business partners are referenced by a certain abbreviation given in squared brackets. The values for all criteria are proposed from the participant focused in the particular section.

3.3.2.1. Network Equipment Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[NO] Low	[NO] Increased
	Asset Specificity		Increased	Increased
	Frequency of Transactions		[NO] Few projects, medium number of services	[NO] Few projects, medium number of services
	Control Archetypes	Arm's Length Control	[NO] No	[NO] No
		Machine Control	[NO] Yes	[NO] Yes
		Exploratory Control	[NO] No	[NO] No
		Boundary Control	[NO] No	[NO] No
	Costs	Search and Information Costs	[NO] No	[NO] No
		Bargaining and Decision Costs	[NO] Normal	[NO] Increased
		Policing and Enforcement Costs	[NO] (Maintenance)	[NO] Increased as more infrastructure to maintained
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[NO] Low	[NO] Increased
		Hidden Action and Information	[NO] Low	[NO] Low
		Hidden Intention	[NO] No	[NO] No
	Incentives		[NO] No	[NO] No
General Criteria	Marginal Contribution to the Final Product		[NO] Increased as high availability	[NO] Increased as high availability
	Conflict of Interests		No	No

Table 20: Economical Analysis of a Network Equipment Provider

Today most of the indicators discussed in section 2.3 are rather low. In future most of them will increase. Consequently network equipment providers' business could be taken by network operators even if the probability is not very high.

3.3.2.2. Network Operator

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[User] Normal [NEP] Normal	[User] Increased [NEP] Increased
	Asset Specificity		Increased	Increased
	Frequency of Transactions		[User] Often [NEP] Seldom [NSP] Seldom	[User] More often [NEP] Seldom [NSP] Seldom
	Control Archetypes	Arm's Length Control	[NEP] Yes	
		Machine Control		
		Exploratory Control		
		Boundary Control	[NSP] Yes	[NEP] Yes [NSP] Yes
	Costs	Search and Information Costs	[User] Increased [NEP] Low [NSP] Low	[User] Increased [NEP] Low [NSP] Increased
		Bargaining and Decision Costs	[NEP] Normal [NSP] Increased	[NEP] Increased [NSP] Increased
		Policing and Enforcement Costs	[NSP](Maintenance)	[NSP] (Maintenance)
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[NEP] Low [NSP] Medium	[NEP] Low [NSP] Medium
		Hidden Action and Information	[NEP] Low [NSP] Medium	[NEP] Low [NSP] Increased
		Hidden Intention	[NEP] Low [NSP] Medium	[NEP] Low [NSP] Increased
	Incentives		[NSP] Yes	[NSP] Decreased
General Criteria	Marginal Contribution to the Final Product		Increased as high availability	Increased as high availability
	Conflict of Interests		[NO] No	[NO] No

Table 21: Economical Analysis of a Network Operator

Considering the network operator's relationship towards the network equipment provider today most of the indicators discussed in section 2.3 are rather low. In future some of them will be increased. Consequently network equipment providers' business could be taken by network operators, but there is no high probability.

Considering its relationship towards a network service provider today most of the indicators discussed in section 2.3 are rather increased. This situation will slightly increase. For this reason the work of network operators and network service providers could be integrated if there is no clear differentiation.

3.3.2.3. Network Service Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[User] Normal [NEP] Normal	[User] Increased [GRP] Increased
	Asset Specificity		Low	Medium (Mobile Grid expertise)
	Frequency of Transactions		[User] Often [NO] Regularly	[User] Decreased [NEP] Stays equal [GRP] Regular
	Control Archetypes	Arm's Length Control	[NO] Yes	
		Machine Control		[NO] Yes
		Exploratory Control	[User] Yes	
		Boundary Control		[GRP] Yes
	Costs	Search and Information Costs	[User] Increased [NO] Low	[NO] Low [GRP] Increased
		Bargaining and Decision Costs	[NO] Low [GRP] Increased	
		Policing and Enforcement Costs		[GRP] Increased
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[NO] Medium	[NO] Increased [GRP] Low
		Hidden Action and Information	[NO] Low	[NO] Low [GRP] Medium
		Hidden Intention	[NO] Low	[NO] Low [GRP] Medium
	Incentives			[GRP] Yes
General Criteria	Marginal Contribution to the Final Product		Low as low need of availability	Even Lower as lower need of availability
	Conflict of Interests		[NO] Yes	[NO] Yes [GRP] Yes

Table 22: Economical Analysis of a Network Operator

Even if the indicators discussed in section 2.3 are low there could be an integration of network service providers and network operators. If they do not clearly differentiate their businesses there could be heavy conflicts of interests as especially their particular asset specificity seems to be low. The situation towards grid resource providers seems to be comparably if their assets are not very different.

3.3.2.4. Grid Equipment Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[GRP] Low	[GRP] Low
	Asset Specificity		Rather High	Rather High
	Frequency of Transactions		[GRP] Low	[GRP] Low
	Control Archetypes	Arm's Length Control		
		Machine Control	[GRP] Yes	[GRP] Yes
		Exploratory Control		
		Boundary Control		
	Costs	Search and Information Costs	[GRP] Low	[GRP] Low
		Bargaining and Decision Costs	[GRP] Low	[GRP] Increased
		Policing and Enforcement Costs	[GRP] Low	[GRP] Low
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[GRP] No	[GRP] Increased
		Hidden Action and Information	[GRP] No	[GRP] Increased
		Hidden Intention	[GRP] No	[GRP] Increased
	Incentives		[GRP] No	[GRP] Increased
General Criteria	Marginal Contribution to the Final Product		Importance of availability	Importance of availability increased
	Conflict of Interests		[GRP] No	[GRP] Probably

Table 23: Economical Analysis of a Grid Equipment Provider

Grid equipment providers and grid resource providers currently do not have serious conflicts as they are quite specialized. In future they could have more conflicts. Furthermore information asymmetry will increase. For that reason their businesses could integrate if one of them has the adequate potential.

3.3.2.5. Grid Resource Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[GEP] No [GO] Low	[GEP] No [GO] Increased
	Asset Specificity		[GEP] Low [GO] Low	[GEP] Lower [GO] Lower
	Frequency of Transactions		[GEP] Low [GO] Increased	[GEP] Low [GO] More increased
	Control Archetypes	Arm's Length Control	[GEP] Yes [GO] Yes	[GEP] Yes
		Machine Control		
		Exploratory Control		[GO] Yes
		Boundary Control		
	Costs	Search and Information Costs	[GEP] Increased [GO] Medium	[GEP] Even higher [GO] Increased
		Bargaining and Decision Costs	[GEP] Low [GO] Low	[GEP] Low [GO] Increased
		Policing and Enforcement Costs	[GEP] Increased [GO] No	[GEP] Increased [GO] No
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[GEP] Yes [GO] No	[GEP] Yes [GO] No
		Hidden Action and Information	[GEP] Low [GO] Medium	[GEP] Low [GO] Increased
		Hidden Intention	[GEP] Low [GO] Medium	[GEP] Increased [GO] Low
	Incentives		[GEP] Yes [GO] No	[GEP] Yes [GO] Yes
General Criteria	Marginal Contribution to the Final Product		Low because of infrastructure	Low because of infrastructure
	Conflict of Interests		[GEP] Medium [GO] Low	[GEP] Increased [GO] Increased

Table 24: Economical Analysis of a Grid Resource Provider

The indicators of section 2.3 are rather low considering grid resources providers' relationships towards grid equipment providers. In future there could be more information asymmetry and conflicts could rise. Consequently the grid resource provider could be interested in integrating or at least controlling grid equipment providers' business.

Business relationships towards grid operators also will become more difficult. It can not be precluded that grid operators do not try and get heavy control of their grid resource providers and vice versa.

3.3.2.6. Grid Operator

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[GRP] Low [SP] Increased	[GRP] Increased [SP] Less increased
	Asset Specificity		[GRP] Low [SP] Medium	[GRP] Increased [SP] Increased
	Frequency of Transactions		[GRP] Increased [SP] Medium	[GRP] Even higher [SP] Increased
	Control Archetypes	Arm's Length Control	[GRP] Yes	[SP] Yes
		Machine Control		
		Exploratory Control	[SP] Yes	
		Boundary Control		[GRP] Yes
	Costs	Search and Information Costs	[GRP] Increased [SP] Increased	[GRP] Even higher [SP] Decreased
		Bargaining and Decision Costs	[GRP] Low [SP] Increased	[GRP] Even Lower [SP] Low
		Policing and Enforcement Costs	[GRP] Increased [SP] Low	[GRP] Decreased [SP] Increased
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[GRP] Increased [SP] Increased	[GRP] Decreased [SP] Low
		Hidden Action and Information	[GRP] Increased [SP] Increased	[GRP] Medium [SP] Low
		Hidden Intention	[GRP] Increased [SP] Increased	[GRP] Medium [SP] Low
	Incentives		[GRP] Increased [SP] Low	[GRP] Medium [SP] Medium
General Criteria	Marginal Contribution to the Final Product		Low even availability is important	Low even availability is important
	Conflict of Interests		[GRP] Increased [SP] Increased	[GRP] Medium [SP] Low

Table 25: Economical Analysis of a Grid Operator

The relationship between grid operators and grid resource providers is already quite tensed today. It has to be expected that some grid resource providers will try and become grid operators. After Mobile Grid Services have become very common the will probably be a clear border between grid operators and grid resource providers.

The relationship with solution providers is also quite difficult today as there is no clearly defined forecast for the interaction between grid operators and solution providers.

3.3.2.7. Device Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[User] Low [PIEP] Low	[User] Increased [PIEP] Low
	Asset Specificity		Increased	Increased
	Frequency of Transactions		[User] Quite low [PIEP] Quite low	[User] Increased [PIEP] Increased
	Control Archetypes	Arm's Length Control		
		Machine Control	[User] Yes [PIEP] Yes	[PIEP] Yes
		Exploratory Control		
		Boundary Control		[User] Yes
	Costs	Search and Information Costs	[User] Increased [PIEP] Medium	[User] Increased [PIEP] Lower
		Bargaining and Decision Costs	[User] Low [PIEP] Medium	[User] Low [PIEP] Increased
		Policing and Enforcement Costs	[User] Low [PIEP] Increased	[User] Low [PIEP] Medium
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[User] No [PIEP] No	[User] No [PIEP] No
		Hidden Action and Information	[User] No [PIEP] Low	[User] No [PIEP] Low
		Hidden Intention	[User] No [PIEP] Increased	[User] No [PIEP] Increased
	Incentives		[User] Increased [PIEP] Increased	[User] Medium [PIEP] Decreased
General Criteria	Marginal Contribution to the Final Product		Infrastructure Role	Infrastructure Role
	Conflict of Interests		[User] No [PIEP] No	[User] No [PIEP] Yes

Table 26: Economical Analysis of a Device Provider

The relationship between device providers and the plug-in equipment providers today is quite well-known as such business interactions already exist in the telecommunication sector. In future in cannot be excluded that there will be more and more conflicts between the partners as it is not known how they will develop their market power.

3.3.2.8. Plug-in Equipment Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[DP] Low	[DP] Increased
	Asset Specificity		Low	Low
	Frequency of Transactions		[DP] Low	[DP] Low
	Control Archetypes	Arm's Length Control	[DP] Yes	
		Machine Control		
		Exploratory Control		[DP] Yes
		Boundary Control		
	Costs	Search and Information Costs	[DP] Low	[DP] Low
		Bargaining and Decision Costs	[DP] Increased	[DP] Increased
		Policing and Enforcement Costs	[DP] No	[DP] No
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[DP] Increased	[DP] Increased
		Hidden Action and Information	[DP] No	[DP] No
		Hidden Intention	[DP] No	[DP] No
	Incentives		[DP] Low	[DP] Higher
General Criteria	Marginal Contribution to the Final Product		More increased than [DP]	More increased than [DP]
	Conflict of Interests		[DP] Yes	[DP] Yes

Table 27: Economical Analysis of a Plug-in Equipment Provider

As there will be more and more different mobile grid devices the market will be more and more uncertain for plug-in equipment providers. For this reason it could be possible that they try and expand their business activities towards the device providers. Consequently conflicts could appear and maybe plug-in providers are bought in by device providers.

3.3.2.9. Local Resource Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		Existence of Local Resource Providers depends on the existence of the Mobile Grid	[User] Rather low [GRP] Increased
	Asset Specificity			[User] Increased [GRP] Rather low
	Frequency of Transactions			[User] Increased [GRP] Increased
	Control Archetypes	Arm's Length Control		
		Machine Control		[User] Yes
		Exploratory Control		[GRP] Yes
		Boundary Control		
	Costs	Search and Information Costs		[User] Low [GRP] Low
		Bargaining and Decision Costs		[User] Low [GRP] Increased
		Policing and Enforcement Costs		[User] Low [GRP] No
Principal Agent Theory	Information Asymmetry	Hidden Characteristics		[User] No [GRP] No
		Hidden Action and Information		[User] Rather high [GRP] Increased
		Hidden Intention		[User] No [GRP] No
	Incentives			[User] Medium [GRP] Increased
General Criteria	Marginal Contribution to the Final Product			Service provision on infrastructure level
	Conflict of Interests			[User] No [GRP] Increased

Table 28: Economical Analysis of a Local Resource Provider

After Mobile Grid Services are really widespread local resource providers continuously have to pay attention that they are not substituted by other local resource providers coming from the large number of grid resource providers. Nevertheless the role itself is expected survive because of the mobile aspect.

3.3.2.10. Solution Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[User] Increased [GO] Increased [CP] Low	[User] little decreased [GO] Decreased [CP] Medium
	Asset Specificity		Increased	Further increased compared to [User] and [CP]
	Frequency of Transactions		[User] Low [GO] Low [CP] Increased	[User] Increased [GO] Medium [CP] Increased
	Control Archetypes	Arm's Length Control		
		Machine Control	[CP] Yes	[GO] Yes
		Exploratory Control		[User] Yes
		Boundary Control	[User] Yes	[CP] Yes
	Costs	Search and Information Costs	[User] Increased [GO] Low [CP] Increased	[User] Low [GO] Low [CP] Increased
		Bargaining and Decision Costs	[User] Increased [CP] Increased	[User] Low [CP] More increased
		Policing and Enforcement Costs	[User] Low [CP] Increased	[User] little increased [CP] Increased
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[CP] Low [GO] Increased	[CP] Low [GO] Low
		Hidden Action and Information	[CP] Low [GO] Increased	[CP] Low [GO] Increased
		Hidden Intention	[User] Increased [CP] Normal	[User] More increased [CP] Decreased
	Incentives		[User] Normal [CP] Low	[User] Low [CP] Increased
General Criteria	Marginal Contribution to the Final Product		Increased	More Increased
	Conflict of Interests		[GO] ([CP])	

Table 29: Economical Analysis of a Solution Provider

Currently grid operators could try and become solution providers because as far as today there is no market for Mobile Grid Services that is really established. After Mobile Grid Services have been introduced it will be possible that there is a clear specialization between solution providers and grid operators.

Content providers think about providing their contents directly to the user today instead of selling them to solution providers. For this reason they could tend towards becoming solution providers themselves. In future the specialization will be clearer. Consequently there will be content providers that are quite specialized on certain subjects as well as solution providers using their content.

3.3.2.11. Content Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[SP] Low	[SP] Little increased
	Asset Specificity		[SP] Low	[SP] Decreased
	Frequency of Transactions		[SP] Increased	[SP] More increased
	Control Archetypes	Arm's Length Control	[SP] Yes	[SP] Yes
		Machine Control		
		Exploratory Control	([SP] Yes)	
		Boundary Control		
	Costs	Search and Information Costs	[SP] Low	[SP] Low
		Bargaining and Decision Costs	[SP] Low because of weak position	[SP] Low because of specialization
		Policing and Enforcement Costs	[SP] Increased	[SP] Increased
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[SP] Increased	[SP] Stays equal
		Hidden Action and Information	[SP] Increased	[SP] Stays equal
		Hidden Intention		
	Incentives		[SP] Increased	[SP] Low
General Criteria	Marginal Contribution to the Final Product		Increased because of importance	Stays proportionally equal
	Conflict of Interests		[SP] Normal	[SP] Low

Table 30: Economical Analysis of a Content Provider

Today content providers consider their possibilities to become solution providers themselves because Mobile Grid Services could offer new business opportunities for them. After the introduction of Mobile Grid Services the differentiation between content providers and solution providers will be clearly defined again.

3.3.2.12. Access Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[All] Low	[All] Low
	Asset Specificity		[All] Increased	[All] More increased
	Frequency of Transactions		[All] Increased	[All] More increased
	Control Archetypes	Arm's Length Control		
		Machine Control	[All] Yes	[All] Yes
		Exploratory Control		
		Boundary Control		
	Costs	Search and Information Costs	[All] Low	[All] Low
		Bargaining and Decision Costs		
		Policing and Enforcement Costs	[All] Quite increased	[All] Quite increased
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[All] Yes	[All] Yes
		Hidden Action and Information	[All] Increased	[All] Stays equal
		Hidden Intention	[All] Yes	[All] Yes
	Incentives		[All] Yes	[All] Yes, but decreased
General Criteria	Marginal Contribution to the Final Product		Increased with regard to reliability	Stays equal with regard to reliability
	Conflict of Interests		[All] Yes	[All] More increased

[All] … All roles, except Equipment Providers.

Table 31: Economical Analysis of a Access Provider

Access providers offer their services to all participants in the value network. With their service they help their clients saving complexity costs. Nevertheless there will be more participants in the value network that try and offer their own access concepts either besides their usual services or as new access providers. Consequently the number of conflicts of interests will increase. But as complexity of access management is high enough access providers will survive.

3.3.2.13. Payment Clearing Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[All] Low	[All] Low
	Asset Specificity		Increased	Increased
	Frequency of Transactions		[All] Increased	[All] Increased
	Control Archetypes	Arm's Length Control		
		Machine Control	[All] Yes	[All] Yes
		Exploratory Control		
		Boundary Control		
	Costs	Search and Information Costs	[PP] Low [Rest] Low [User] No	[PP] Low [Rest] Low [User] No
		Bargaining and Decision Costs	[All] Low	[All] Low
		Policing and Enforcement Costs	[All] Relatively high	[All] Relatively high
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[All] Increased	[All] Increased
		Hidden Action and Information	[All] Increased	[All] Increased
		Hidden Intention	[All] No	[All] No
	Incentives		[All] No	[All] No
General Criteri	Marginal Contribution to the Final Product		No	No
	Conflict of Interests		[All] No	[All] No

Table 32: Economical Analysis of a Payment Clearing Provider

For payment clearing providers the introduction of mobile grid services will partly change the platform they are working on, but it will not change their business itself. For that reason they will persist and probably have to optimize their transaction processes.

3.3.2.14. Payment Provider

Theory	Analysis Criteria		Before Mobile Grid	After Mobile Grid
Transaction Cost Theory	Uncertainty		[All] Low	[All] Low
	Asset Specificity		Increased	Increased
	Frequency of Transactions		[All] Increased	[All] Increased
	Control Archetypes	Arm's Length Control		
		Machine Control	[All] Yes	[All] Yes
		Exploratory Control		
		Boundary Control		
	Costs	Search and Information Costs	[PCP] Increased [Rest] Medium [User] Medium	[PCP] Increased [Rest] Increased [User] Increased
		Bargaining and Decision Costs	[PCP] Increased [Rest] Low [User] No	[PCP] Increased [Rest] Lower [User] No
		Policing and Enforcement Costs	[PCP] No [Rest] Medium [User] No	[PCP] No [Rest] Medium [User] No
Principal Agent Theory	Information Asymmetry	Hidden Characteristics	[All] Yes	[All] Yes
		Hidden Action and Information	[All] Yes	[All] Yes
		Hidden Intention	[All] No	[All] No
	Incentives		[All] Medium [PCP] No	[All] Increased [PCP] No
General Criteri	Marginal Contribution to the Final Product		[All] No	[All] No
	Conflict of Interests		[All] No	[All] No

Table 33: Economical Analysis of a Payment Provider

For payment providers the introduction of mobile grid services will partly change the platform they are working on, but it will not change their business itself. For that reason they will persist and probably have to optimize their transaction processes.

3.4. Conclusions

In chapter 3 the participating roles of a Mobile Grid Value Network are described according to their role in a value network and their dyadic relationships. The dyadic relationships were described in detail in chapter 3.3.2.

It can be stated that there is a certain probability that in the area of network and grid operations there could be some role mergers. Furthermore solution providers and content providers as well as device providers and plug-in equipment providers will have to redefine their particular differentiations. Access providers will always have to compete with challenging low price and low quality access providers whereas business will only marginally change for payment clearing providers and payment providers.

4. Value Network for Mobile Grid Service Providers

The following scenarios are considered in order to find out which participants in the value chain play an important role in generating added value for each scenario. The results will be important for activity 7 "Demonstration Trials" in order to identify adequate institutions that are prepared to test Akogrimo's results.

4.1. E-Health Scenario

In this scenario, a Spanish architect is abroad on a business trip and suddenly during his travels feels an acute pain in the left side of his chest. He uses his mobile phone to call for assistance and transmit his cardiological data with the help of the special ECG equipment integrated into his mobile phone.

As soon as the architect starts transmitting information, a virtual environment is immediately constructed in the emergency control centre. In this environment, all information needed for the optimum care of the patient is processed and made available to all relevant persons involved.

To begin with, the patient's immediate location is automatically identified. Based on this, the navigation system determines which ambulance service can reach the patient the fastest and an ambulance is despatched as soon as possible to attend to the patient's preliminary needs. Simultaneously, an emergency patient record is created. This record contains all emergency relevant information of the patient's medical history and is translated to the local language if necessary. Based on the historical data and the current available data an initial diagnostic report is compiled by a Grid Service. These findings are made available to paramedics on their way to the patient.

Taking into account the immediate diagnosis, the distance to travel and available bed space an appropriate hospital is chosen, where a doctor and other hospital staff is already on alert and on standby to attend to the patient as soon as he arrives.

Medical equipment for patient monitoring is harnessed and language is preset automatically. Consequently, any symptoms and findings captured during the examination and treatment are stored within the emergency record thus facilitating an improvement in diagnosis and documentation also for future references.

The hospital's casualty unit is prepared for the incoming patient's medical records. As demonstrated, Mobile Grid technologies offer the possibilities of bringing together and employing the necessary information, resources, participants as well as the required knowledge directly at the scene of any emergency.

4.1.1. Heart Monitoring and Emergency Service (HMES) Example

In this section, first the case of a German enterprise is given which already offers services that are very comparable to those planned to be provided via the Akogrimo Platform. Consequently the value added by Mobile Grid Services can be shown.

4.1.1.1. Case Study Vitaphone

Vitaphone is a German enterprise offering mobile devices for people who suffer from heart diseases. In a case of emergency they are able to call Vitaphone's service centre with a single keystroke on their mobile device.

- *Vitaphone Services 7 x 24 hours.* At the push of a button the patient is always and at once connected to the Vitaphone Service Centre.
- *Identification of the caller.* The patient is personally addressed and his electronic healthcare record automatically gets opened.
- *Medical competence.* In the Vitaphone Service Centre there are physicians as well as other qualified medical specialists at the patient's disposal.
- *ECG always and everywhere.* The patient can always record his ECG on his own and send it to the Vitaphone Service Centre.
- *Documentation.* There is a very detailed documentation of patient data that are relevant for diagnostic or therapeutic purposes, for example by event recording in the case of acute events.
- *Information for the patient's general practitioner.* The ECG that is recorded via the Vitaphone Service Centre is forwarded to the patient's general practitioner.
- *Exact localization.* By means of the integrated Global Positioning System (GPS) the caller can exactly be localized anywhere and everywhere in Germany. In case of an emergency the nearest emergency control centre is called by the Vitaphone Service Centre in order to save time.
- *Disease management.* In the context of the disease management program individual services can be provided by the Vitaphone Service Centre, for example for health insurance companies.

Today Vitaphone is still providing many services (e. g. cardiologists with special medical skills) on its own. Furthermore many services have not been integrated in a completely digital way. For this reason the Vitaphone cases only shows some steps towards mobile Grid but it has to be further developed.

4.1.1.2. The Grid Solution

In this section a scenario is given where the Vitaphone case is systematically enhanced by Grid services. First the course of actions is outlined in order to identify all the participants in the scenario in chapter 4.1.1.3. Furthermore it has to be clear that the emergency call is directly triggered by a permanent heart monitoring service after having identified any aberration is identified.

- Infrastructure
  - Mobile network operator (GSM net)
  - Cryptography services
  - Billing systems
- Emergency call
  - Mobile phone e. g. by mobile phone sellers with various selling channels
  - Mobile phone emergency call add-on by an engineering service

- ECG
  - Mobile phone heart signal measurement infrastructure by an engineering service
  - Adequate data transfer bandwidth
- Patient Identification in the Grid
  - Trust centre managing the access rights according to the patient's opinion
  - Voluntarily provided patient record with emergency data
- Localization of the Patient via a geographical service
  - Trust centre managing the access rights according to the patient's opinion
  - Geographic localization service
- Call of emergency control centre
  - Directory of rescue control centres
- Identification of the nearest Emergency Car
  - Emergency car on service with adequate infrastructure
  - Geographical localization service
- Identification of the nearest Hospital specialized on heart attacks
  - Hospital with adequate infrastructure and sufficient capacities
  - Geographical localization service
- Initial Diagnosis by Diagnosis service
  - Evidence based medicine infrastructure that is on service
  - Knowledge and experience based medicine infrastructure that is on service
- Resolution of linguistic problems by a translation service
  - Real-time translation services that are on service
- Patient health records are ordered from Spain and from Germany and sent to the doctor and to the ambulance car which is already on its way to the patient
  - Further information on the patient's anamnesis from his doctors
  - Confidential messaging service
- Doctor gives further analysis concerning the patient health records to the ambulance car
  - Medical advices to the rescue assistants
- The patient is treated and transported to the hospital
- Further medical data is sent from the ambulance car to the hospital
  - Patient's bio-signal values
  - Drug information
- Patient arrives at the hospital
  - All the Grid services are dislocated

4.1.2. Analysis of the Participants

Service integrators

- Emergency control centre

Shared service providers: factory type business strategies

- Enterprises as resellers for their managers
- Mobile phone seller
- Evidence and experience based medicine information provider
- Medical heart attack specialist (doctor)
- Engineering services for heart signal sensors
- Engineering services for communication software

Exclusive service providers: specialist type business strategies

- Patient record storage provider
- Emergency car provider
- Hospital
- Translation service for medical information
- Cryptography service provider
- Trust centre
- Geographic localization service provider
- Messaging service provider

4.1.3. Value Network of the HMES Example

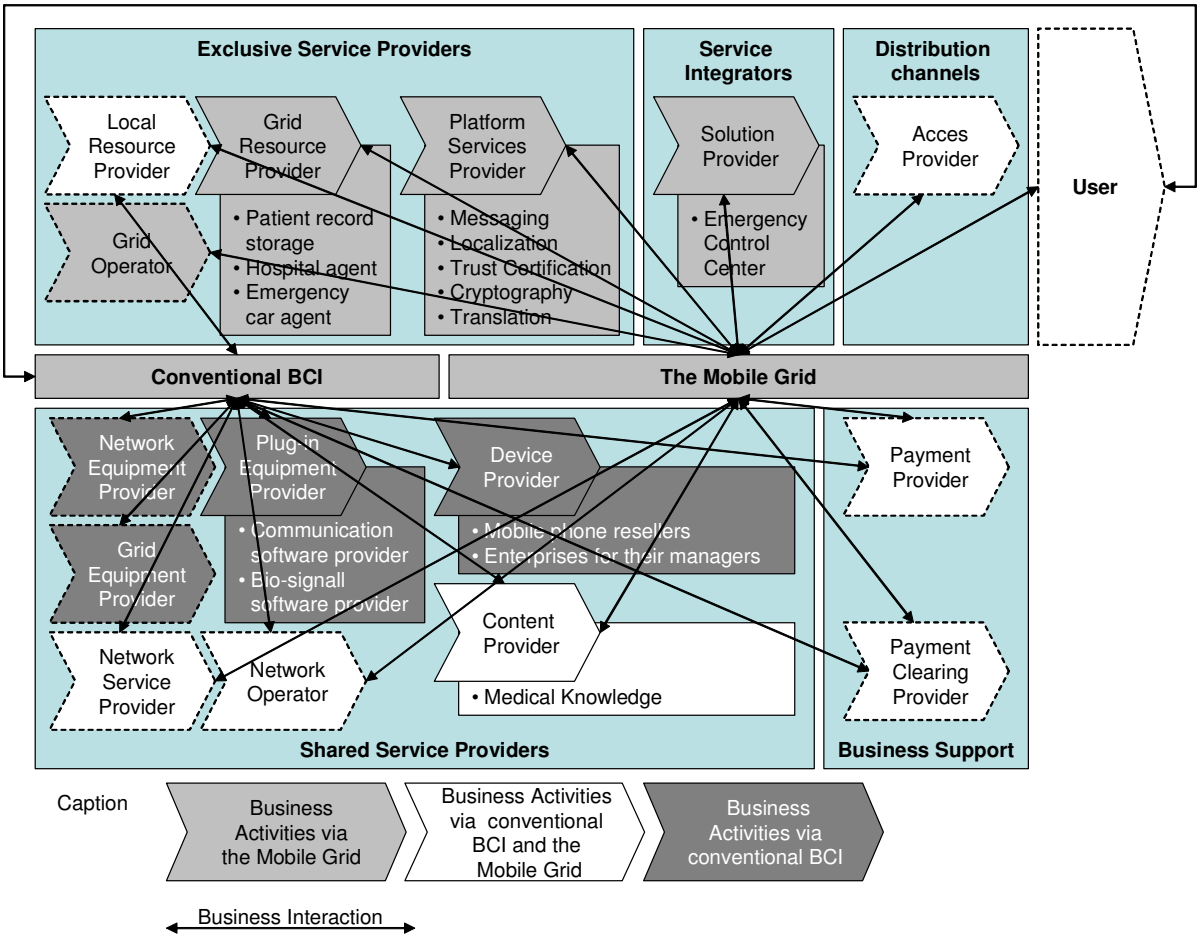

Figure 20: Value Network of the HMES Example

4.1.4. Analysis from the Economic Theory View

Transaction Cost Theory

From the economic point of view, transaction costs can be reduced by using Mobile Grid Services in the e-health scenario. For example patient data are directly available when the emergency service centre is called after a heart attack. Furthermore neither time nor money has to be spent on looking for an adequate hospital or the nearest emergency car. Finally medical knowledge for analyzing the ECG is always available. Consequently not so many medical advisors are needed in the scenario.

Principal Agent Theory

In this scenario the emergency control centre represents the role of the principal that is controlling its agents. Of course some of the agents need to keep certain information asymmetries in order to be justified compared to the control centre.

Summary

Considering the indicators for the degree of integration of the value network given in section 2.4 it can be stated that there is not much uncertainty in the scenario because more and more people suffer from heart diseases, there are certain information asymmetries but they are not exceptionally high. Most of the participants maintain quite specific assets. Nevertheless it is not

difficult to relate marginal contributions of the different resources to the final value and there is quite high alignment of interests between the resource exchangers.

Consequently there will be a combined solution of very integrated areas of the value network and such that are rather fragmented. It will depend on the reliability of the Mobile Grid as well as the agents whether many partners will be involved or the principal integrates most of the services as Vitaphone does today.

4.2. E-Learning Scenario

The general description of the scenario is given in Work Package 2.3, D - 2.3.2: "Jane and Luisa belong to 'Greek civilization' group travelling to Greek amphitheatres, museums, archaeological finds and to fetch data by means of cameras and registers available in their PDA. Before they leave, the 'Greek civilization' teacher starts a Field Trip Grid service (FT) and shares it with all the project's students. The FT will be useful to provide all discovery supports during their trips. During the travel by train to Athena, Jane and Luisa connect their PDA to the WAN and access to the portal of the e-Learning platform after being identified in the system. In according to the two students context and to the project planning, it's inferred that Luisa have to visit the Parthenos and Erechtheum temple in order to analyze thoroughly Doric, Ionic and Corinthian architectural systems (Greek orders), while Jane have to visit the Archaeological Museum of Piraeus in order to analyze some archaeological finds. They use their PDA to make researches and studies of the arguments and by using semantic based Grid service searching and location capability they get the information about others students group with affinity to their work and belonging to different Grid enabled virtual learning organization in order to share their experience.

Arriving at Athena and connected again to the e-Learning platform by a local network, Luisa takes photos and videos clips and uses the FT of Grid for storing data in a multimedia repository Grid service and giving them explainable information (indexed automatically and transmitted by mobile device using appropriate metadata standards, in account with user profile and his context information), while Jane takes notes speaking her PDA microphone and communicates them to FT orchestrating speech to text. The FT, together with semantic tool for text and images interpretation and other tools for knowledge management (virtualized as Grid services), will analyze all the given information comparing content produced by the two students and other groups correlated with the same study activities, and formalize, in an ontology based knowledge representation, the knowledge about the evolution of Greece architectures.

At the end of the day all the students working in the field trip project access to e-Learning platform for consolidating the knowledge acquired. For instance, by the data provided by Jane, Luisa and other students group as well as by other sources (e.g. Web), Jane can deepen her archaeological knowledge by performing a simulation by means of her laptop (her PDA video is unable to visualize 3D data) to reconstruct the real physiognomy of Parthenon temple during the 400 BC. Moreover, all the students can use the PDA speech recognition capability for sending commands to the search engine as means to retrieve the information and for their visualization. During these sessions they consult digital libraries (provided by different organizations) for finding new information or for checking some hypothesis done and/or evaluations made about the provenience of discovered objects and, eventually, teachers or experts on the field can be involved in private (e.g. by means of mail, calls, private chat, etc.) or public (e.g. by means of public mail, phone conferences, forums, public chats, etc.) discussions to orient the various point of views."

4.2.1. Field Trip Example

In this section it is described how the e-learning scenario will take place:

- Connection to the archaeological e-Learning Portal
  - E-Learning Portal
  - Laptop
  - University LAN
- Instantiation of a Field Trip Grid Service
  - Field Trip Grid Service
- Negotiation of the communication infrastructure
  - PDA
  - Local Network Service
- Personal knowledge improvement
  - Electronic project studies and researches
  - Information retrieval
  - Request formalization
  - Data indexes
- Expert discussion
  - Personal index
  - Meeting service
  - Relevance identification service
- Simulation
  - Simulation service

4.2.2. Analysis of the Participants

Distribution Channels

- Portal provider

Service integrators

- Field Trip Grid Service provider

Shared service providers: factory type business strategies

- Laptop provider
- PDA provider
- Electronic project studies and researches provider
- Expert index provider

Exclusive service providers: specialist type business strategies

- Request formalization provider

- Relevance identification service
- Simulation service

Business service infrastructure

- University LAN provider
- Local Network Service provider
- Information retrieval provider
- Data indexes
- Meeting service

4.2.3. Value Network of the Field Trip Example

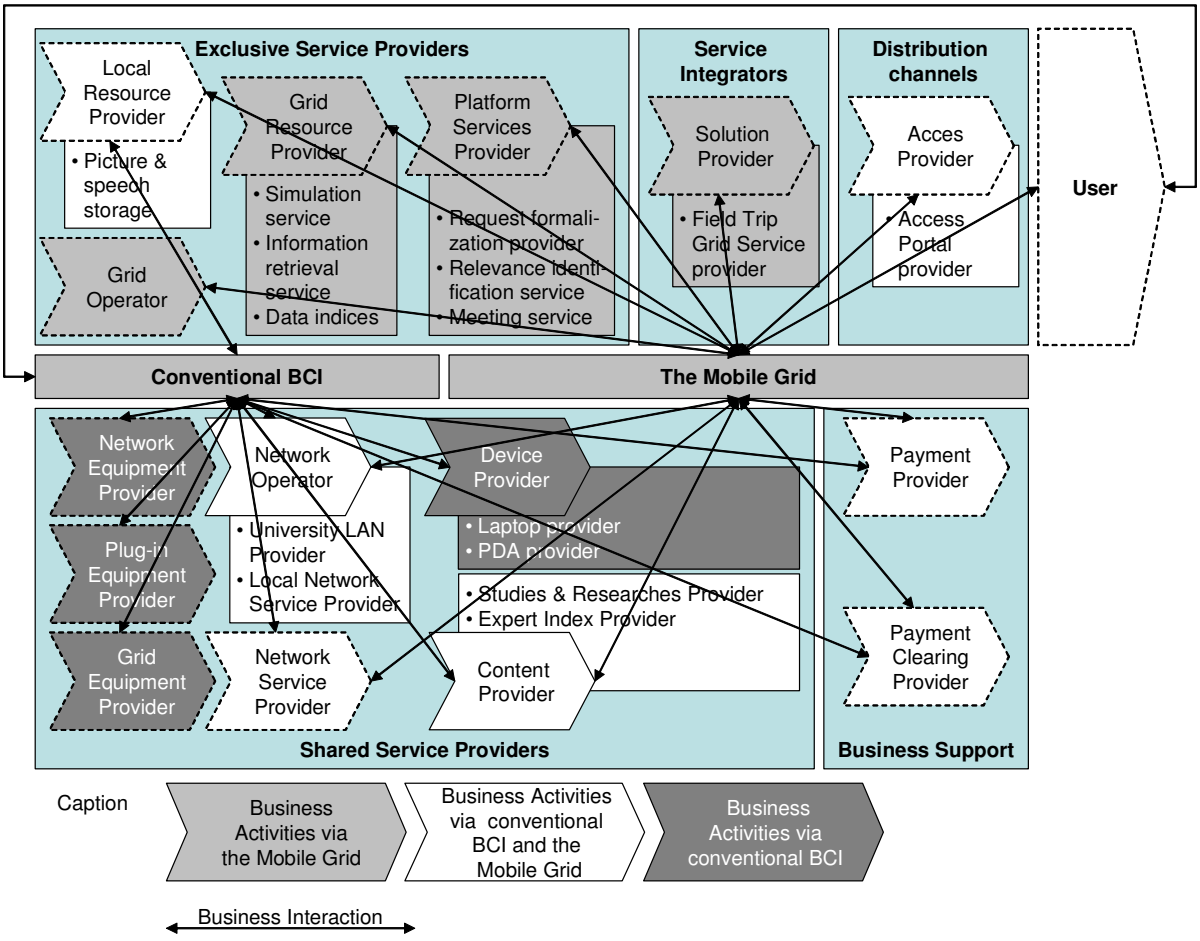

Figure 21: Value Network of the e-Learning Example

4.2.4. Analysis from the Economic Theory View

Transaction Cost Theory

Compared to conventional e-learning scenarios transaction costs can be reduced by using Mobile Grid Services. For example the student's do not have to take photos with low resolution, but send them directly to their local resource provider which forwards them to the Grid. In the Grid computation power can be used to analyze the pictures, to start knowledge base retrievals, and to

redeliver aggregated information. Furthermore virtual meetings with different persons are possible.

Principal Agent Theory

Most of the transactions between the different services are controlled by the Field Trip Grid Service Provider which is in the role of principal. Because the information provided and needed by the user is much more complex the agents do not have to keep as much information asymmetries as in the e-health scenario. Nevertheless it can not be excluded that there are big information asymmetries between the agents in order to survive economically.

Summary

Considering the indicators for the degree of integration of the value network given in section 2.4 it can be stated that there is not much uncertainty in the scenario because more and more people are using remote and location-based information services that are supported by high computing power. There are certain information asymmetries between the agents but not adversely the principal because of the complexity of each service. Most of the participants maintain quite specific knowledge assets whereas their technology is not extraordinarily specific. It is not very easy to relate marginal contributions of the different resources to the final value as in the e-health scenario because it has to be found out how much the user would be prepared to pay for a single service. This information can change continuously. Finally there the alignment of interests must not be very high if each of the providers delivers its services to non-Grid markets.

Consequently there will also be a combined solution of very integrated areas of the value network and such that are rather fragmented. The success of the scenario will highly depend on the capability of the principal to coordinate and to integrate all the services offered by its agents. Otherwise the agents can easily be imagined that the agents will sell their services in other value networks.

5. The Akogrimo Consolidated Value Network

The considerations in chapter 3 and chapter 4 show that adding value in the mobile Grid case is accomplished within complex networks of different roles. Mobile Grid Services still have to be considered as a vision with much uncertainty as it could be shown in chapter 3.3.2.

For this reason and because of many concurrent interactions all value networks that have been shown in this paper did not include any process logic. In this section it is tried to provide a consolidated value network including some information on its process logic. Basic elements therefore can be found in D2.1.1, D2.2.1 and D6.3.1 as well as in a proposal from TID which will be introduced here.

5.1. TID Value Network Proposal

The following value network for traditional Grid services was proposed by TID. That is why the original nomenclature was retained.

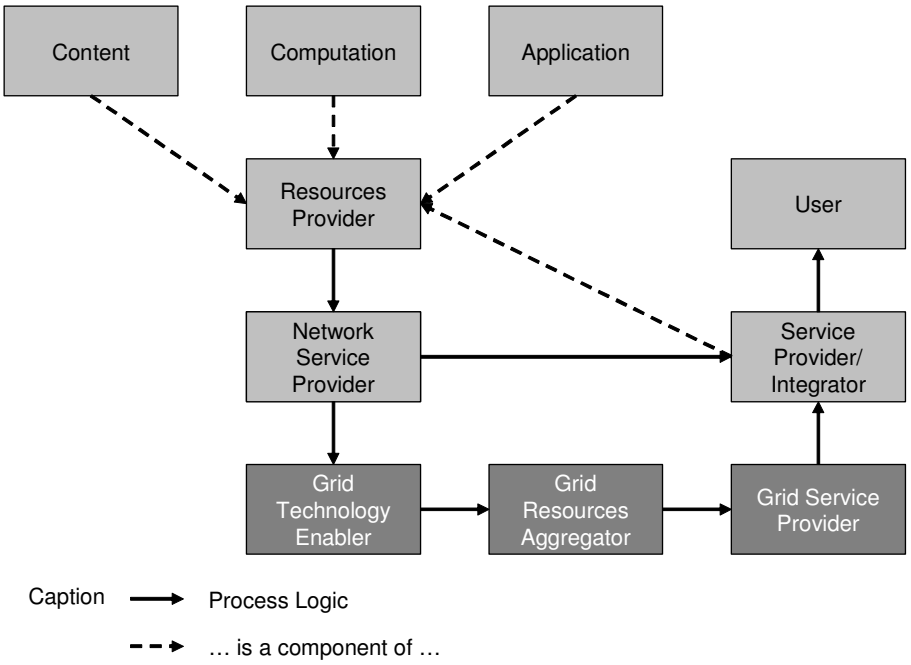

Figure 22: TID Value Network Proposal

In Figure 22 the Resource Provider includes the content, applications and computation capabilities provision. The Network Service Provider links all these disseminated resources. The whole Grid Technology Provision can be subdivided into three different functions: the Grid Technology Enabler, the Grid Resources Aggregator and the Grid Service Provider. The Grid Technology Enabler provides to the Resources Provider the capacity of being able to offer the available resources. The Grid Resource Aggregator would act as a market so that Grid resources and Grid service providers meet. Finally, the Grid Service Provider would build basic services over these resources, hiding the complexity of managing these distributed resources to other Services Providers, who would build more complex services based on the basic ones.

The conventional as well as the Grid-enabled value chains can be derived from the schema in Figure 22, as depicted in Figure 23:

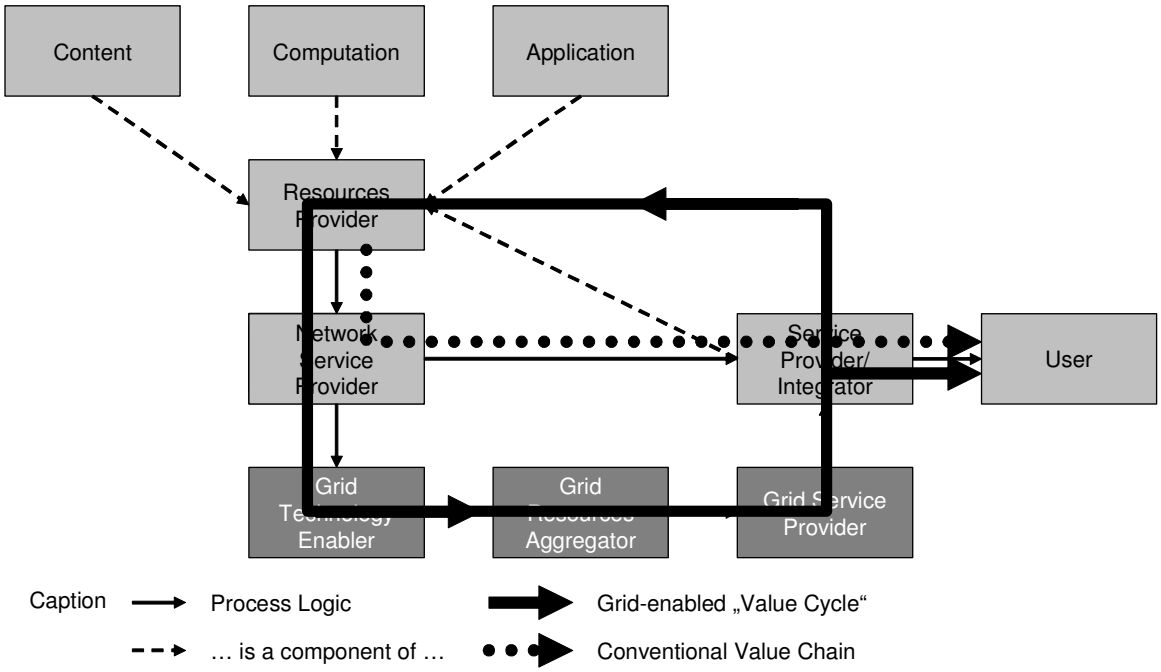

Figure 23: Conventional and Grid-Enabled Value Chains

For a Grid service scenario, the closed line is followed. The integrated service can be used by the User or can be considered as a new resource element, which starts the cycle again. A conventional non-Grid service scenario is represented by the dotted path. The main difference is that with Grid technology more resources would be available and would be used more efficiently.

A possible extension of the previous model could take into account the mobile essence of the Akogrimo Service, with the corresponding necessary roles. To do that, it would be necessary to split the Network Service Provider role, highlighting the presence of a Mobile Access network Provider. Other roles that could be added would be related with the provisioning of physical equipment, such as access devices for the end user, computation resources for the Resources Provider and network equipment for the Network Service Provider. Notwithstanding, this more detailed view would introduce more complexity, as more relations would be possible.

5.2. Proposal of a Consolidated Value Network

Considering the results of chapter 3 and 4 the following role interactions can be identified from a service point of view.

		Service Consumers														
		AP	CP	DP	GEP	GO	GRP	LRP	NEP	NO	NSP	PCP	PIEP	PP	SP	User
Service Offerers	AP															
	CP															
	DP															
	GEP															
	GO															
	GRP															
	LRP															
	NEP															
	NO															
	NSP															
	PCP															
	PIEP															
	PP															
	SP															
	User															

Table 34: Role Interactions

In Table 35 it is tried to build a diagonal in order to identify a certain process logic order for the participants in the value network according to their dyadic interactions.

		Service Consumers														
		NEP	NO	NSP	GEP	LRP	GRP	GO	CP	SP	PIEP	DP	User	AP	PCP	PP
Service Offerers	NEP															
	NO															
	NSP															
	GEP															
	LRP															
	GRP															
	GO															
	CP															
	SP															
	PIEP															
	DP															
	User															
	AP															
	PCP															
	PP															

Table 35: Role Interactions

The black fields in Table 35 show an ideal diagonal while the grey fields show a certain suboptimal diagonal. According to the result shown in Table 35 a value network including process logic can be proposed in Figure 24.

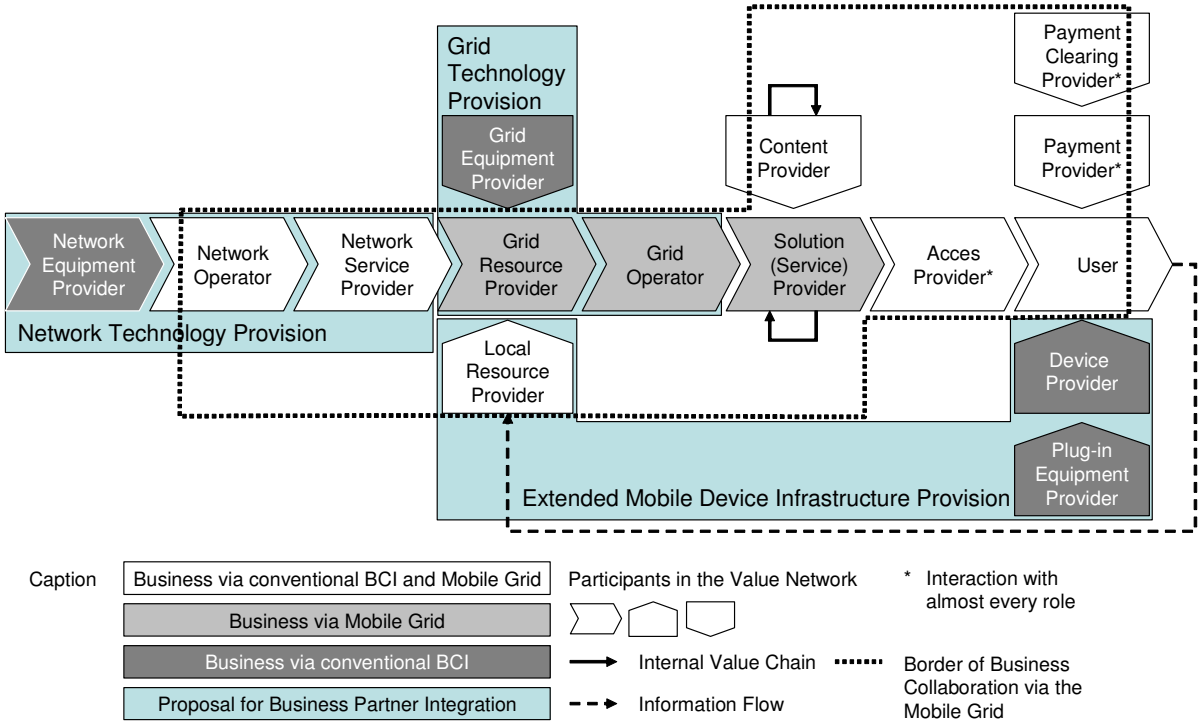

Figure 24: Proposed Value Network with Process Logic

Figure 24 shows the participants and roles respectively providing network technology as well as those providing Grid technology. Furthermore there are roles providing extended mobile devices infrastructure, and payment services. It can be seen that Grid operations base on Network services. Grid operations are the basis for user-oriented solutions. Further participants acting via the Grid platform offer access or payment services. Hardware infrastructure is only delivered via conventional business collaboration infrastructures.Figure 24 corresponds to the value network proposed by TID in chapter 5.1 if the differences are transparently explained:

- Some role names have to be mapped in order to have a common terminology (Table 36).
- The role "Application" can be integrated into the Solution (Service) Provider which has close contact to the user. The same applies to the role "Content" which is comparable to the "Content Provider" that provides content to the Solution (Service) Provider.
- The "Value Cycle" shown in Figure 23 can also be found in Figure 24. However the user is integrated into this cycle as he could always provide personal information (cf. HMES example).

TID Value Network	Consolidated Value Network	Comments
Content	Content Provider	
Computation	Grid Resource Provider	Computation power is interpreted as a Grid Resource.
Application	Solution (Service) Provider	Solutions consist of applications and subsidiary services.
Resources Provider	-	
Grid Technology Enabler	Grid Equipment Provider	Grid equipment mainly consists of technological products.
Grid Resources Aggregator	Grid Resource Provider	Aggregated Grid resources are provided by several providers.
Grid Service Provider	Grid Operator	Grid services are offered by the Grid Operator.
Service Provider/Integrator	Solution (Service) Provider	Solutions consist of applications and subsidiary services.

Table 36: Mapping of Roles of the TID and the Consolidated Value Network

Together with the considerations of section 3.3.2 and further insights as described in chapter 6 Figure 24 offers a certain basis for further consolidations towards a consolidated value chain as well as the basis for a more enhanced and sophisticated business model framework.

6. Summary and Conclusion

Starting from today's inter-organisational value chains the deliverable discussed Porter's generic approach of value chains that was enhanced in chapter 2.2 by focusing on a more detailed value network model in order to examine more complex value adding structures.

Furthermore other approaches were introduced which are able to explain the preconditions of successful Grid services. Consequently consolidated knowledge about economic interrelations regarding supply and value network structures respectively, as well as competitive advantages, enterprises' attitudes and market structures was provided.

Afterwards the very generic analytical approaches for describing value networks and economic interrelationships between their participants were adapted to the Mobile Grid Services' situation. Furthermore the specific roles were described and analyzed according to the economic theories.

Then the analytical approaches were used in the cases of two scenarios considered in the Akogrimo project in order to deliver some clues for Work Package 7 by identifying the main participants of the scenarios. Finally a proposal for a consolidated value network for Mobile Grid Services was presented which was not reduced to a "consolidated value chain" yet, because of temporal reasons. In order to provide a valid "consolidated value chain" further research still has to be done as outlined in the following paragraphs.

The Mobile Grid Value Network has been analyzed from a theoretical point of view so far and first conclusions on the development of the value network could be given. Now it would be necessary to continue with an empirical study asking an adequate number telecommunication and grid providing companies for their future business models from the Mobile Grid perspective. For this reason it would be necessary to get answers from the companies' strategic management. On this basis the value network proposed so far could be further consolidated on a good empirical basis.

On the other hand the chair Information Systems II of the University of Hohenheim is going to cooperate with SAP which will provide its integration platform (SAP Netweaver), its hospital information system software as well as its "Advanced Planning and Optimizer" (SAP APO) to be hosted via the department in Hohenheim. Furthermore there will be co-operations with the Alcatel SEL Foundation which is part of a provider of network infrastructure as well as mobile devices, iSoft (hospital information system), and Vitaphone (mentioned in the E-Health Scenario in section 4.1). These co-operations offer the possibility to implement the E-Health Scenario in close co-operation with leading players in the European hardware and software industry.

Apart from this, first co-operations between the chair "Information Systems II" and two large mobile telecommunication companies that do not belong to the Akogrimo consortium but that are very dominant in the German market. The co-operations have been started in order to examine business models that deal with many of the aspects that are also relevant in the Mobile Grid context.

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Annex A. Examples of conventional Grid Research Projects and their Value Networks

A.1. Grid-Enabled Medical Simulation Services (GEMSS)

Further information of the project can be found at http://www.gemss.de, especially in the following document: http://www.gemss.de/Deliverables/D6.3b.pdf.

GEMSS was a two and a half year project which started in September 2002.

An interoperable, innovative Grid-Middleware for medical service applications was developed which gives medical practitioners and researchers the opportunity to access simulation and image processing services for improved pre-operative planning and near real-time surgical support.

The main goal was to provide end-users of the medical community with advanced tools at their workplaces with access through easy-to-use interfaces.

Different medical sectors and applications respectively were targeted:

- Maxillo-facial surgery simulation: a virtual pre-operative planning space
- Neuro-surgery support: prediction of the brain-shift during neuro-surgery
- Radio-surgery simulation: improved treatment planning for cancer destruction
- Inhaled drug delivery simulation: virtual drug delivery to the lung
- Cardio-vascular system simulation: simulation of the entire cardio-vascular system for improved treatment plans and surgical procedures
- Advanced Medical Image Reconstruction

Project participants:

- C&C Research Laboratories, NEC Europe Ltd., Germany (co-ordinating partner)
- Max-Planck Institute of Cognitive Neuroscience, Leipzig, Germany
- AEA Technology Engineering Software, U.K.
- CRID, Research Centre for Computer and Law, University of Namur, Belgium
- IT-Innovation, University of Southampton, U.K.
- Department of Medical Physics and Clinical Eng., University of Sheffield, U.K.
- Institute for Software Science, University of Vienna, Austria
- IDAC Ireland Ltd., Ireland
- ASD Advanced Simulation & Design GmbH, Germany
- Institute for Biomedical Engineering and Physics, University of Vienna, Austria
- Sheffield Teaching Hospitals NHS Trust, U.K. (subcontractor)

GEMSS Grid-middleware is a service oriented infrastructure for the secure and lawful provision of medical application services based on web service technologies.

A.1.1. How it works

Infrastructure:

- GEMSS-Client: Application client code and GUI with access to the GEMSS-server via a transport and messaging layer that resides in a component manager
- GEMSS-Server: provides the Grid service provision framework
- Service Oriented Architecture
  - Client (user who has a job to run) accesses service provider (people who support the Grid servers that can run Grid jobs)
  - Certificate authority (third party who provides certificate authentification after appropriate identity check)
  - Service registry (registry holding a list of service providers and the services they support)

Three step process to job execution:

- Initial business step: accounts are opened and payment details are fixed
- Quality of service and negotiation step: QoS and price are negotiated and agreed
- Contract is in place and job can be submitted and executed

Medical service applications:

- Have different Grid requirements concerning computation time, memory usage, …
- Address different medical areas

A.1.2. Example workflow for Facial surgery using Maxillo-facial surgery simulation

- Patient comes to specialist (surgeon) after referral from his practitioner (our assumption)
- CT images are taken of the patient
- Image data is converted into a format understood by the tools
- Surface mesh of the bone is generated
- The surgeon interactively specifies bone cuts and displacements on the surface mesh (virtual osteotomy)
- Creation of a 3 D finite element Model (FEM) of the problem
- The FEM-problem is solved by a simulation code (carried out on a remote high-performance computing platform)
- Results are visualized and interpreted by the surgeon
- Surgeon operates the patient adequate to the virtual solution (our assumption)

A.1.3. Participants in case of the Facial Surgery using Maxillo-facial surgery simulation

The participation of the following participants is assumed:

Distribution Channels

- Vendors of the applications

Service Integrators

- Grid service provider

Shared service providers

- CT device provider
- Patient record storage provider
- Hospital
- Translation service for medical information
- Specialist (doctor/surgeon)

Exclusive service providers

- Engineering services for CT images
- Engineering services for surgery instruments
- Engineering service for Interfaces, EAI

Business service infrastructure

- Cryptography service provider
- Messaging service provider
- Simulation service provider

A.2. Agent Mediated Grid Services in e-Learning

More detailed information on the project is provided by http://research.ac.upc.edu/clag/cy_lane-goal_grid_service_conference.ppt.

In this project an agent-based Grid service in e-Learning was developed. The vision of what learning will become according to the paper mentioned above is:

- "Alice in Wonderland". Computer based agents assist learners in diverse ways.
- "Ubiquitous learning". Embedded agents in handheld wireless devices and in real objects i.e. "intelligent" objects.

A.2.1. How it works

Infrastructure (bottom-up architecture)

- Provider applications
- Grid services

- Marketing service agents
- Information service centre
- Service agents
- Consumer applications
- End users

A.2.2. Example workflow

The following workflow can be assumed:

- End user ("learner") starts the process by sending a request to the service using his application
- The service is hosted by the service agents
- Upon reception of the request, negotiation are initiated (by the marketing service agents)
- The learner gets prepared and his/her learning path is generated before the actual learning process starts
- During the learning process the learner will be tutored according to his/her learning part.
- "Learning objects" are delivered to the end user.
- The courseware servers in the Grid environment provide the learning objects to the service.

A.2.3. Participants

The following participants can be assumed:

Distribution channels, provided by:

- Vendors of the applications
- Mobile phone sellers

Service Integrators

- Grid service provider

Shared service providers

- Network provider
- E-Learning specialists

Exclusive service providers

- Engineering service for agents, agent-platforms
- Engineering service for communication software

Business service infrastructure:

- Cryptography service provider
- Messaging service provider

A.3. Distributed Aircraft Maintenance System (DAME)

More detailed information on the project is provided by [8]

DAME is a pilot project involving Rolls-Royce, Data Systems and Solutions, and other commercial and academic partners in the UK. It is about a novel application domain for Grid technologies, namely the development of an improved computer-based fault diagnosis and prognostic (DP) capability and the integration of that capability with a predictive maintenance system.

Diagnosis and prognostic Systems

- are data centric,
- typically require complex interactions,
- are often distributed
- need to provide supporting or qualifying evidence for the DP offered
- can be safety or business critical

Challenges of the DAME project:

- the type of data captured by QUOTE primarily involves real-valued variables monitored over time (up to 1 GB per flight)
- in order to detect features and analyze the type of data produced by the engine, advanced pattern-matching and data-mining methods must be developed
- DP processes will require a collaboration among a number of diverse actors within the stakeholder organizations

A.3.1. How it works

To adress the challenges, the DAME system developed a number of core functional services and tools:

- Engine Data Service: this service controls the interactions between the on-engine monitoring system QUOTE and its communications to the ground station
- Data Storage and Mining Service: consists of the AURA pattern-matching engine system (Grid Version: AURA-G)
- Engine Modelling Service: takes parameters from flight data and runs models of the engine
- Case-Based Reasoning Service: this tool uses case-based reasoning to improve the knowledge base and captures fault DP methods in a procedural way
- Maintenance Interface Service: organizes all interactions with stakeholders beeing involved in taking remidial actions and response to a DP

A.3.2. Example workflow for DAME

- Operation starts by using the QUOTE system to identify abnormal vibration data
- If the detected abnormal data can not be classified locally by the QUOTE system, sensor data are passed to the ground-based diagnostic system and storage facility

- Simultaneously the system reports the possible abnormality to interested stakeholders; a search against the archived fleet engine data is performed (vast data-mining activity is done by AURA-G)
- If similar abnormal events are found, then any supporting information relating to these events can be recovered (e.g. maintenance steps, remedial corrective actions)
- If similar events are not detected or more processing for fault identification is needed, further detailed analysis of the data can be performed by using a number of computer-intensive signal analysis modules available within the DAME portal (Grid service creates new instantiations of the modules on a set of registered computers)
- Diagnostic process is completed with distribution of DP results to the appropriate airline and the relevant stakeholders

A.3.3. Participants in case of DAME

The following participants can be assumed:

Distribution Channels

- Vendors of the applications

Service Integrators

- Grid service provider
- System owner/operator

Shared service providers

- Airport
- Engine data storage provider

Exclusive service providers:

- Engineering services for sensors
- Engineering services for aircrafts
- Engineering services for diagnostic software
- Data mining service provider
- Simulation service provider

A.4. The World-Wide Telescope

More detailed information about the project can be found in [9].

The Virtual Observatory – sometimes also called the World-Wide Telescope – is under construction in many countries. It seeks to provide portals, protocols and standards that unify the world's astronomy archives into a giant database containing all astronomy literature, images, raw data, derived datasets and simulation data – integrated as a single intelligent telescope.

A.4.1. How it works

The emerging infrastructure themes are the following:

- Archives. They store text, images and raw data in blobs or files and store schematized data in relational databases; they provide data mining tools for easy search and subsetting of the data; they contain metadata about their contents.
- Web services. The archives provide web service interfaces for on-demand queries and a file transfer service for answers.
- Registries and portals. Each archive declares its services with one or more registries; all registries record what kind of information the archive provides; all registries will be used by portals which serve to answer user queries by integrating data from many archives

A.4.2. Example workflow

The following example workflow can be assumed:

- User requests information using his portal
- Portal uses registries for selection of adequate archives
- Request is sent to archives where data packages will be computed (e.g. data mining, subsetting of data)
- Data packages are send back to portals
- Portal integrates data from many archives

A.4.3. Participants

The following participants in the value network can be assumed:

Distribution Channels

- Astronomical community

Service Integrators

- Grid service provider

Shared service providers:

- Astronomical device provider (e. g. telescopes)
- Archive provider
- Scientific institutions
- Scientists, students, … (as portal user)

Exclusive service providers

- Engineering services for astronomical Grid services
- Data mining service provider
- Simulation service provider