Abstract

Manufacturing companies that are expanding their product offering to cover also lifecycle services in the customers' facilities are facing the increasing complexity and risk to execute continuous business transition. By mastering innovation over customer process life cycle it is possible to achieve leadership in life cycle business transition. Innovation is taking place in three dimensions, business, customer and life cycle innovation. Spiral innovation process over the three dimensions of this hybrid innovation enables new type of business transition with lower risk level. Business co evolution is taking place on boundaries of business models, networks and deliverables.

This article introduces new concept on hybrid innovation. Continuous, hybrid innovation based on management architecture is possible through continuous relationship with customer and customer process which supports life cycle learning and knowledge catching.

Keywords: Managing and Measuring of Innovation, Collaborative R&D for Innovation, Business Transition, Co-evolution, Networks and Clusters of Innovation, Open Innovation, Hybrid Innovation

1. Introduction

Industrial services, B-to-B services, are expected to have a high business potential for companies especially in traditional industries, such as manufacturing or real estate business. Companies need to develop new business models and activities especially in industries where product life cycles are long, and market mature. Thus, they need to broaden their business from manufacturing to service business to get new customers, to promote business of their current customers, and to find new market and new customers. Research on service business has so far concentrated mainly on traditional services, such as hotels, bank and insurance, or on business to consumers. Research on industrial services is so far rather limited. Therefore, there is a need for extensive research to explore business potential, development and benefits of industrial services. As a difference to traditional service, industrial service is strongly concentrating on value increase in customer process. Industrial service innovation (e.g. availability of performance services) over customer process life cycle is mostly executed by network of companies or individuals. That is the reason it needs distributed knowledge management of several customer processes and centralized management of service development. Service innovation needs open semantic infrastructure with metadata for collaboration.

Companies entering to service business are not only expanding the offering but also creating potential to innovate products, services and business processes. As an emergence they figure out a new set-up for creating customer value. Continuous relationship with customer and customer process supports life cycle learning, knowledge catching and continuous innovation. Innovation has to be understood in broader context. Increased degree of freedom of possible solutions enables serendipity. Innovation is also changing from closed to open. Openness requires network environment.

The hypothesis is that by mastering innovation over customer process life cycle it is possible to achieve leadership in life cycle business transition.

The objective of this article is to introduce a new concept on hybrid innovation. Innovation is taking place in three dimensions, business, customer and life cycle innovation. Continuous, spiral, innovation process enables new type of business evolution routing.

The results of this article have been created during collaborative industry and government funded projects “Modeling of Business Concepts when Productizing and Commercializing Competence, LIIMA” and Complexity Management of Life Cycle Business when Service and Product Portfolio is Developed as Enterprise Total Offering, LCB (Life Cycle Business). Nine case study companies (ABB Drives Corp., Kone Elevators Corp., Eltel Networks, Rocla Corp., TietoEnator Corp., Moventas Corp., AkerYards Corp., Metso Paper Corp.and Lassila&Tikanoja Corp.) and three research institutes (Lappeenranta University of Technology, Tampere University of Technology and Helsinki University of Technology) have participated on the project execution. That collaboration has developed an initial model to analyze a company’s status as a service provider during the life-cycle of a customer process.
New concepts have been developed based on research approaches of case analysis and grounded theory methodology [1]. It has been an iterative approach as target to achieve a solid industrial validation through the research project. The companies of various sizes and representing various business segments on manufacturing area participated on validation of concepts developed.

2. Relation to Existing Theory

It doesn’t exist exact earlier research on life cycle business transition by hybrid innovation but several earlier research approaches are dealing with sub areas of this research. In the following is introduced the theoretical background of the research approach.

Nonaka & Tageuchi [2] introduce that knowledge is created by flow of information and is anchored in the beliefs and commitment of its holder. Chesbrough, [3] declares innovation practices over the enterprise boundaries and in value networks by open innovation. In the open innovation model, the boundary between a firm and its surrounding environment is more porous; enabling innovation to move easily between the two. Miller and Langdon [4] introduce how to manage disruptive innovation by managing platform, product and process innovation in continuous cycles. Network dynamics forms the corner stones creating breeding environment [5] in new knowledge economy. The heart of innovation is the capability to learn, or generate and manage knowledge [6]. Meyer and Lehnerd [7] and Gawer and Cusumano [8] introduce platform thinking. Cagan and Vogel [9] introduce that value opportunity has to be structured by adaptive and integrated process. All Principles of mass customization of products and services [10] need to be applied in the adaptation of customers’ needs in life cycle business. Florida [11] introduce that diverse and open communities have compelled competitive advantage in stimulating creativity, generating innovations and increasing wealth and economic growth. McGrath [6] states, that the heart of innovation is the capability to learn, or generate and manage knowledge. Management of co-evolution in business needs management innovators [12].

Tang and Salminen [13] introduce the complexity management approach for the purpose of product and service management in continuous innovation. Both the product and service need to be defined in management architecture before they can be effectively used in configuration according customer and functional requirements [14]. Interoperation is supported by infrastructure model, which includes common semantics and semantics infrastructure [15]. That is important for the management of life cycle business over the customer process life cycle. It consists of customer and functional requirements over the life cycle, product and service features, life cycle functions and operations, modules and components and interfaces [16]. The integration of selected theoretical considerations has given an opportunity to create model of business innovation collaboration in open infrastructure and implementation framework. Salminen and Pillai [16] have introduced the integration concept and also tool to integrate service and product offering. Unlike in traditional capital business in the life cycle business the innovation is very much front-end process. Working closely with the customers and their processes create deep understanding of the customers’ value. This life-cycle knowledge is critical success factor for innovating new solutions and enables punctual innovation [17]. Tammela, Salminen and Laitinen [18] have introduced enlargement to the known theories and concentrated on product and life cycle management architecture as fundamental structure to support continuous innovation and business co-evolution.

In existing theory it can be found similar type of concept in human–machine interaction research called participatory design. Schuler [19] has introduced basic methodologies with principles and practices. Bdker [20] has concentrated on participatory IT design. In practical studies Collins [21] describes the transition from average to great company and the ways how you can fail in making that. Finally Wise and Baumgartner [22] and Davies [23] introduce the “going downstream” theory of this transition.

This article concentrates on enlargement of known knowledge and theories and own earlier research to introduce new concept of hybrid innovation based on management architecture in life cycle business.

3. Industrial Service Business Management and Life Cycle Consideration

The main question for service business strategy is the evolution of the customer’s business. This means the changes in the customer’s values that should be captured with the new service solutions. There are the different market trends (e.g. technology, market and society trends) that are changing business. Companies competing within the industrial service business market should track the potential and value of the benefits the customer may get from the services. Based on the expected values, the main concept of the service offering should be designed over the life cycle of customer process. In figure 1 is introduced various levels of industrial service business through which a technology company can enlarge the business from product-centric towards service and value centric [24].

Six different supplier positions or “roles”, relative to the customer, were defined:

- **Material, Component and Module Supplier.** The focus of the business is to take full responsibility on specific subsystem in the supplier network for main contractor.
- **Machine supplier.** The focus of the business relationship is on delivering a piece of machinery or equipment that fits the customer’s technical specification.
- **Solution provider.** The focus of business is on delivery of a system, e.g. a production line, which
is usually designed for the specific customer’s process and comprises a wider scope of supply than just one piece of equipment.

- **Maintenance partner.** The focus of business expansion to also include continued supplier involvement during the continuing life cycle of the delivery. This role adds contractual after-market elements, such as spares and consumables agreements, to the supplier-customer relationship.

- **Performance partner.** In this role the supplier is closely involved in operating the customer’s technical process by taking partial responsibility for the performance of the system, e.g. through availability warranties. This role requires the supplier to maintain at least a minimum of continuous on-site presence. The focus of the customer relationship is on securing the effective operation of the unit or production line.

- **Value partner.** The supplier is directly involved in the customer’s business, e.g. through ‘operate and maintain’ agreements, where the customer pays a pre-determined price for the actual output of the system. Both parties focus on profitable daily operations, and the supplier is responsible for the day-to-day operation of the plant or line.

Each of these six supplier business models has its own “mindset”. When a supplier aims to progress from one model to the next, it faces tough challenges, mostly in terms of getting the customer involved in this and developing its own technical and business competencies in order to advance. The strategic positioning decision between supplier and customer is important and has to be prepared as thoroughly as any other strategic decision.

The framework is based on idea that this enlargement takes place through providing different kind of lifecycle services for the product and to the customer, and through those services the technology company moves towards a service and value centric model. The problem in this type of business transition is that business model is changing dramatically when customer intimacy is increasing. The need for business networking is also increasing dramatically the more sophisticated and business related the service offering is. One enterprise has to manage several business models at the same time. As an example, a maintenance partner offers maintenance lifecycle services to support own products and application or the installed product base. The objective is to provide higher product availability through lowering down time or supporting the application by proactive maintenance. The proactive maintenance is enabled by knowledge of products and application and monitoring globally the same kind of applications over their life cycle. The costs of maintenance can also be often lowered compared to customer own maintenance function. On the other hand a performance partner offers process efficiency by taking care of some parts technical processes of the customer and ensuring high performance on these parts. The value creation takes place in collaboration with the customer and, thus, dense information exchange and joint processes are needed. The offering includes besides technical process availability on certain performance level, performance data, forecasts, and decision support aids.

On more sophisticated level, the industrial service influences on continuous increase in customer process performance. Then service provider is responsible also on innovation phase. Value partner represents a service centric business model. This is case when the value comes from operation of some equipment. In an extreme service example, the service would be to provide the desired outcome so that the customer does not even know what systems are used to produce the outcome, and even where the outcome is produced.

A well understood and structured business model supporting business architecture is a very important strategic tool when business is evolving according market requirements. Life-cycle innovation needs new approaches and leads to business-concept management. In future, it will be possible and essential to sell business models based on the available architectural structure of a company.

Knowledge intensive business is in continuous evolution. Life cycle challenges can be faced and competitive advantage achieved in knowledge communities [17]. Increasing share of the innovation process is taking place outside the single company. In the global scale the information is available anywhere when there is internet connection available. The community shares the same information at the same time. The question is how to integrate and synchronize knowledge, technology, competences and processes, especially when creating something new in networked environment over the life cycle of customer process.
The offering enrichment is usually achieved by providing particular knowledge to other companies down the supply chain, in order to increase the value in the customer processes or products. As a result, companies are moving closer to or even into the operations of their customers, what requires a different organization approach and “networked thinking”. A network in this sense consists of individuals and organizations with the resources they have, which are taking part in a process and thus interacting. This network perspective should already be implemented in the service development phase. Competition happens not only between single enterprises but between networks of businesses. The partners of value network have common responsibility on final customer process performance and its continuous development. Networked business means as well new ways for earning logics. Salminen and Pillai [16] have presented that the value and benefit for life cycle customer process have to be developed in collaboration with service partners. That benefit should also be showed to customer. When business ecosystem is further developed and requirement level is further increased, the trend for some partners in the network is to produce just industrial services which consist of service and products dynamically linked with each others.

The trend in networked industrial service delivering is that knowledge intensiveness is increasing. There is need for service production and for information and knowledge treatment and management. The critical success factor will be the capability to find and treat information and knowledge in changing environment for supporting own and customer life cycle processes.

Competition no longer takes place between companies but between networks. In an industrial network, all the members share the responsibility for the continual development and innovation of the services and competences offered. Industrial service is normally executed in the partnership of network businesses (availability and performance partnering) where partners in a value network search for collaborative value assessment in networked business environment. The value and benefits generated for the end-customer during the life cycle of the business activity must be created together and proven to the customer satisfaction. It is reached when customer process is running smoothly and efficiency increases quicker than with the competitors. Innovations will focus on continual improvement of a level of service. Consequently, the importance of interfaces and transparency is highlighted in corporate networks.

The idea is to produce value innovation (figure 2) through the analysis of the gaps recognized and tuned according the conditions and constrains. Value creation starts by first producing promise and perceived value during delivery time and as a result finally also service excellence in continuous cycle.

Industrial service is doing something on behalf of customer. If customer wants somebody to work for themselves, you have to do it better than customer can do it. That requires continuous increasing of excellence. If the target is a continuously excellence service it requires continuous innovation. You have to understand the life cycle requirements of customer process and produce continuous life cycle innovation to be able to produce continuously competitive and excellent services. The value opportunity classification is one of the main ways defining service and product attributes. It should be underlined the importance of design and other “soft issues”.

Emotional factors are strongly emphasized in industrial service business. Services have to be made so easy that they are easy to buy; visualization and high touch are important. The main experience gathered is that industrial service business is "just business as usual"; basic laws are same as in product business, but some aspects require perhaps more attention. It is important to understand and know the customer; all aspects of psychology of service experiences and needs, values and full revenue model. Service production is decentralized: process control and design are more challenging in the network of customer, partners, and subcontractors. Information management is as well wider in the network of customer, partners and subcontractors.

Service Excellence is produced through continuous value and emotion creation Soft things have to be measured first to be able to find correlation between profitability and “hard values”. It is caused by soft values to accomplish hard values.
4. Development of Business Structure

Life cycle business is based on long term relationship with customer, where new value is created continuously in partnership. This is typical approach in industrial service type of strategic partnership. Also manufacturing companies are looking for growth by providing life cycle services in their offering. Life cycle services are mostly targeting on customer asset management. Figure 3 illustrates the concept of business management of life cycle business. This concept is targeting for sustainable growth by managing customer process co-evolution and own business co-evolution when product and service offering is continuously changing.

Stepping to a new role in the customer’s business is a question of the business transition for the company. The company must adapt new value and operating model. In order to succeed there must be a Life Cycle Concept to guide the process. The concept is a strategic plan to implement the new business model. The Life Cycle Concept is management tool to control and lead the business transition.

Life Cycle Innovation is the mechanism that continuously renews the offering. The scope of the innovation is also expanding when climbing up from the role of machine supplier towards to performance and value partner. The product and services are in the scope of the solution provider, but by the services the whole business processes can be innovated. Unlike in traditional capital business in the life cycle business the innovation is very much front-end process. Working closely with the customers and their processes create deep understanding of the customers’ value. This life-cycle knowledge is critical success factor for innovating new solutions and enables punctual innovation [18].

The differences between capital and lifecycle business has led to two different business models. The companies that are running both businesses can make a substantial progress by integrating the information management together. The goal is to achieve not only better information management but also enhance dynamic interrelation between products and services enabling innovations based on customer value. The problem is that the business critical information and the business focus are different. There is a need for a management architecture that harmonizes the product and service modeling and provides a platform to transmit the lifecycle knowledge in network environment (Figure 4).

Figure 3. Three Phases of Life Cycle Business Management

Figure 4. Management architecture for Product and Service Life Cycle Business Management

Tammela, Salminen and Laitinen [18] introduce how management architecture coordinates the re-engineering of operations and processes and engineering of systems and system environment. It also guides and systematizes continuous platform content development, product modeling and instance management for lifecycle services.

The product management architecture is based on underlying elements that are harmonized and standardized business semantics, functional structures and interface definition. Using these elements any product or service, in the recognized class, can be semantically described and communicated through interface definition. The content is described as modules that can refer to the physical items, processes or information. Modules are reusable elements that have internal semantic description. Modules have three management layers: platforms, product model and product instance that form three different views to the module system. Figure 5 introduces the central role of
management architecture in business co-evolution and continuous life cycle innovation.

**Figure 5.** The framework of business co-evolution by the structures and semantics of management architecture

Life cycle business is knowledge intensive. Life cycle knowledge and information are key drivers for continuous business transition. Life cycle business management starts by developing Life Cycle Concept. That is a future roadmap through which to manage the offering according evolving technologies to satisfy customers’ existing and future expectations. There have to be management architecture for managing service and product in continuous customer application change and business transformation. Service and product have to be created, described, modelled and productized. After some time of use the created modelling becomes a heart of life cycle business, which is renewed by life cycle innovation.

In the following is introduced a framework to classify the different life cycle business models (figure 6) based on customer value and life cycle phase. In the business model on upper levels the integration of service and product is essential because of continuous analysis and increase of customer process performance.

The base for that are different services levels, which were identified in restudy of the collaborative project. Service levels identified are introduced in figure 6. Type of complexity is changing when customer value is increasing and business model is changing. Dependencies are increasing on upper levels and management of complexity is focusing on dependency management. Knowledge intensiveness is increasing as well on upper level business models.

**Figure 6.** Service Share Definition over the life cycle

During the research it was analysed over twenty manufacturing companies, which were approaching their business to various type of services. Mostly they had been creating services quite freely on various levels on figure 6 and without business structures to support the service management on global scale. Knowledge intensiveness increases quite dramatically when service offering on global scale is too diversified. In several cases analysed the knowledge management did explode and risk taken was not managed. This type of business situation was analysed to exceed on chaos and profitability decrease. Some of the businesses have come back from their business model of “Availability Business” to build business structures for the combined business model of “On Request Services with Spares and Wares”.

Service and product innovation on upper levels is in dynamic interrelationship. This enables leadership in life cycle innovation by focusing innovation scope on the particular customer value. In this article this phenomenon is called punctual innovation. Punctual innovation is taking place when existing customer’s process or application is changing. This causes re-organization and new creation of product and service elements according enhanced customer value in new business situation.

5. Hybrid Innovation

During industrial case studies it was recognised that innovation have to be understood more broadly, when business is in continuous transition. The possible forms of new business are dominated by the state of existing business with executed business model. New solutions are often restricted by used networks and offered deliverables. It limits the magnitude of taking advantage of new opportunities and possible change in business ecosystem. Innovation and reconfiguration enlarge business space where new customer value and competitive advantage can be found.
In figure 7 is introduced a new concept of hybrid innovation, where business space is determined by three axes: Business Innovation, Customer Innovation and Life Cycle Innovation [25]. Business innovation covers new opportunities to create new dominant design and make transition to new business model. Customer innovation builds continuously better market fit according customer value. Life cycle innovation happens over the life cycle of customer process and fit into the changing life cycle requirements. Learning occur according gathered life cycle knowledge. Business innovation is enabling radical changes in dominant designs whereas the nature of customer innovation is more incremental. Life cycle innovation is continuous and should be punctual. Punctual open innovation focuses the network partners to the right development activities by routing and converting customer requirements for value and innovation network.

The purpose of management architecture is to reduce complexity in business, networks and structure of deliverables in the boundaries. It also forms the set-up of value in business space.

Spiral innovation process cumulates the knowledge and routes it through the network partners. This is taking place in open semantic infrastructure enabling open innovation. Semantics enables outside connections and exchange of knowledge through interfaces in each of the boundaries. It also routes the knowledge and competence over various types of innovation. One new spiral cycle increases the business space to be used in transition.

Continuous spiral process of business, customer and life cycle innovation support business evolution dynamics. Spiral process gets direction continuously through life cycle concept and makes business re-engineering, system re-engineering and changes offering structure based on management architecture (figure 8).

![Figure 8. Leadership for business transition by hybrid innovation](image)

It is impossible to manage the business transition without having entities on middle circle:

- Life cycle concept directing the transition,
- Practices and processes of business re-engineering
- Practices and processes of system definition and engineering and
- Management architecture on updating structural change.

Manufacturing companies entering into service business undergo a stepwise transition process from equipment-based to more customer-oriented. Methods and structures supporting the business need to be adapted to a new situation. A company, willing to run profitable business in industrial context, needs to master its business transition at three levels: 1) the strategic level and strategic insights, 2) structural level and 3) operational level. Three levels
of management are illustrated in (Figure 9). When amount of product and services are increasing, the offering management and the relation between the products and services become more complex. In order to reduce complexity the main focus is to define business structures that are able to handle the products and services. There need to be structural elements to cover product and service life cycle management and support the continuous change of the life cycle business. During strategic business aligning it should be recognized on which level of business model in figure 6. Then it is important to understand if the new value customer is requiring leads the company to a business model on upper level. It is important that there exist suitable business structures or they area developed to support the business model implemented (figure 9). If business structures are missing or they are not developed and new value service is delivered, it is obvious that there are problems in life time service proposition. That can influence as well in decreasing of business profitability.

![Figure 8. Performance Measuring System Enabling Business Transition](image)

6. Findings During Research Phase and Industrial Validation

The frameworks explained in chapters 3, 4 and 5 have been created in close cooperation with real business cases by learning from theoretical studies, integrating theories together and tuning them to be implemented in practical industrial studies. Then it has been learned from case study implementations and re-engineered the theories and frameworks by grounded theory more suitable for industrial large scale implementation. During this process it has been gathered also some practical experiences which is introduced in the following.

Manufacturing companies have faced difficulties in managing services as part of the business. For example there is a great need for strategic cooperation between customer and provider network. Competence is distributed in networks and it contains a lot of tacit knowledge. The need to manage tacit knowledge was recognized but not the methods to use it in innovation leadership. Semantic infrastructure is mostly missing because most of the structures are not identified and benefited in business, competence and offering co-evolution. There is a need to define a life cycle concept in every company. It forms the basis for life cycle business in continuous transition. Life cycle concept is the basis for various types of life cycles: customer relationship, customer process, product and service offering.

During industrial validation studies it was recognized that the role of service innovations is heavily increasing. That brings the business processes in the scope of innovation. Life cycle innovation happens mostly in value and innovation networks. Open innovation in networks has not been well understood as an opportunity to increase competitive power. The enabling structures for...
innovation have not been created yet. Services as an example are described and modeled for the sales purposes but lack of supporting innovation and operations. Network innovation is difficult to carry out because of the missing structure on semantic infrastructure. Performance measuring system should support idea creation and innovation in collaborative environment. Innovativeness oriented indicators have very seldom been used in industrial service business.

Systematic management of business models is recognized as a part of innovation. However business management concentrates on management of products and service deliveries. Customer and functional requirements are not systematically managed over the life cycle. This restricts innovation on business models. That means that business transition is difficult to execute in continuously changing life cycle business. Performance indicators should capture the need for business transition and help in formulating the objectives for continuous change. It is essential to understand the changes in business models when moving towards higher customer value in life cycle business as shown in figure. The scope of innovation covers also business processes as well as customer deliverables. Third party services and products bring the need for managing of competencies. It is essential to understand the changes in business models when moving towards higher customer value in life cycle business as shown in figure 8. The scope of innovation covers also business processes as well as customer deliverables. Third party services and products bring the need for managing of competencies.

Industrial innovation has concentrated mostly on customer fit or completely new innovation based on new technology but not so much on continuous life cycle type of innovation. Performance measuring indicators have not been implemented yet on that type of approaches although business transition is difficult to manage without innovation based measuring system. In industry there were not found any management structures for punctual innovation. That is the reason this research ended up in introducing a new concept of hybrid innovation. This concept needs still more research and industrial validation.

7. Conclusions

In this article has been introduced the concept of leadership in business transition by business, customer and life cycle innovation on hybrid way. Life cycle business requires structures which reduce the complexity in order to manage business transition. Leadership in business transition enables simultaneous innovation of customer solutions and new business. Continuous, hybrid innovation based on management architecture is possible through continuous relationship with customer and customer process which supports life cycle learning and knowledge catching.

The introduced concept can be used in achieving leadership in creation of competitive advantage in networked industrial service business environment.

9. References


