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INTEGRATION OF PRODUCTS AND SERVICES - TOWARDS SYSTEM PROVIDER AND PERFORMANCE PARTNER

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1. Introduction

The Competitive edge of entity is to underpin the products and its enlarged knowledge-intensive business service offerings. This leads dramatically to increasing business complexity on all levels of the organization. The mechanism to survive in business, change the pattern of product and service offerings. It is no surprise that most complex features of the Universe, which proved reluctant to yield to the traditional methods of scientific investigation, should exist on our scale. The reason is that on smaller scales entities such as individual atoms behave in a relatively simple way in their one-to-one interactions, and that fascinating things are produced when many atoms are linked together in complicated and interesting ways, to make things like businesses.

We address in this article, the invisible requirements; and try to integrate the product and service management challenges when enterprise is in transition from physical product provider to system provider and performance partner. We provide in this article a methodology and computer toolset that will help to capture aspects of a business and analyze these to identify and compare options for meeting the business requirements. The toolset will have to provide task management support to users by helping them to perform service, product and enterprise modeling activities and guiding them through the toolset facilities.

We have successfully applied the toolset in the industry environment. Apart from its direct significance to the study, the methodology provides a profound insight into the nature of business world.

2. Business Transition from Machine Supplier to Value Partner

It has long been common practice to distinguish between data, information, and knowledge. Information is data arranged in meaningful patterns such that it is potentially useful for decision making. Knowledge is something that is believed, and is true, effective, and reliable. Knowledge is necessarily associated with an experiential context, and so is generally more valuable than information. Nevertheless, knowledge is much harder to assimilate, understand, transfer, and share than information.

Information theory is an objective (mind independent) entity. It travels immense of distances and records all data in detail. And three-dimensional-pictures moving or stand-still appear in nanoseconds, that a fast computer cannot handle even today; the brain-set in our human mammalian system in our body science. It can be generated or carried by messages (words, sentences, and pictures) or other products of cognizes (interpreters).

Communication theory focuses primarily on conditions involved in the generation and transmission of coded (linguistic) messages. When mixing these components into a technological format, in information and communication technology, we ignore elements that are not inserted into correct proposition as the chemists do. This miss-match we would always come across in our scientific missions cross-culturally like science-fictions.

Due to knowledge, information and communication, and their excitations in the product environment; industries are compressing themselves back to basic, instead of developing any new focused technology features or representations that would trap them to sustain. A sustainable growth of the business lies on services those corporations are offering though have no learned inserts. Today, the business is changing towards knowledge intensive and value critical over the life cycle. Products are increasingly embedding intelligent, therefore, the role of service and product architecture become more clinic and necessary (figure 1).

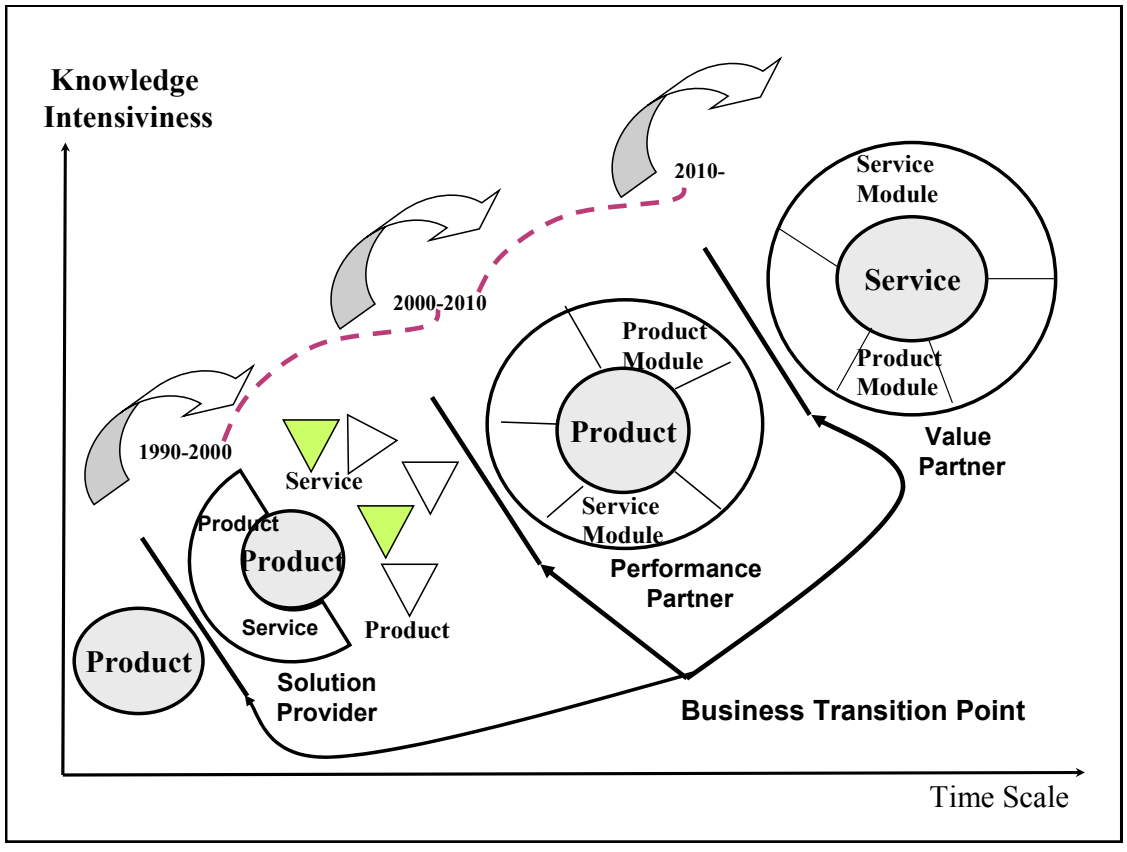

Figure 1: Business Transition Process from Machine Supplier towards Value Partner

The business model is changing completely when the percentage of services is increasing on a long run. The hardest transition emerges; when company and its value partners are changing on the road to performance partnerships. There exist several business transition points on that road and product and service integration creates the continuously changing

structure, the heart, for the enterprise. The entrepreneur is surrounded with a new business model that offers solution and dynamically forged other offerings to match the new situation. The new business level is achieving the intensity of higher knowledge, and the pattern of interactions between partnering aliens become service focused (figure 2).

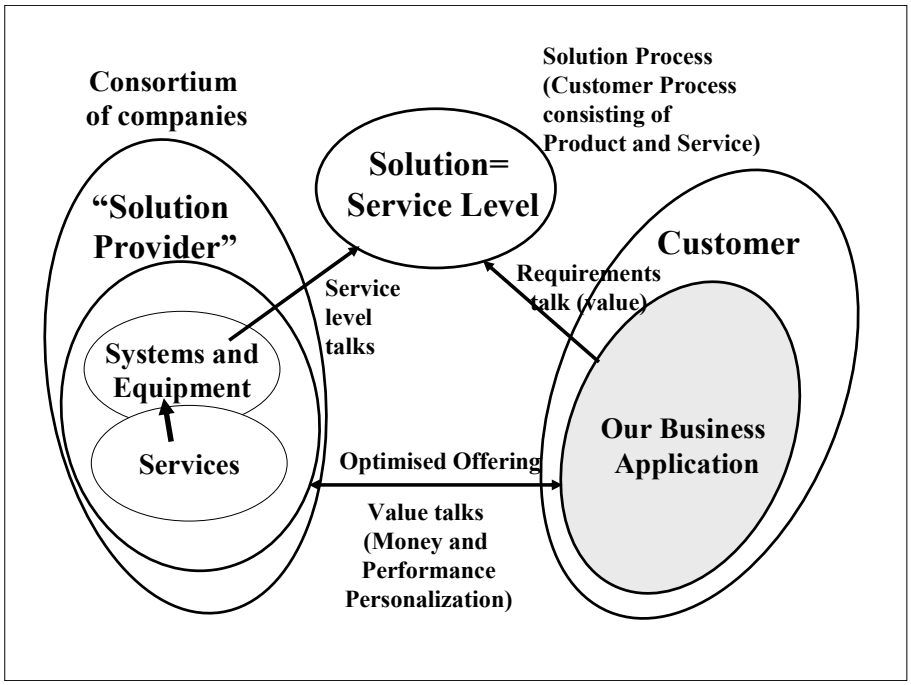

Figure 2: The role of service level improvement

To summarize, we come across with some excellent recent research works on specific features of system engineering requirements. However, do not exist, much theories or practical researches; on how to construct an adaptive system by integrating good theories. In this study, a number of theories and research results integrated as a system to view the new model based methodology to manage -

- Life cycle requirements (Customer and functional requirements), (several methodologies)
- Dependency management between various entities [1], [2]
- Solution architecture [3]
- Product/service/competence platforms [4]
- Configuration practices of various market segments by platform base [5]
- Life cycle innovation of product and service
- Complexity management (Several methodologies)

3. Existing Theories and Work

The product and service need to be defined. An engineer assumes when produced a technical product that the product is internally maintaining a service domain. On the other hand a service provider assumes that the concept consistently offering product and services. Both of them are misunderstanding; what is product and service. It is like fundamental laws [Coulomb's Law[1]] at states that the electric force of attraction or repulsion between two point charges in prepositional to the product of the distance between them. The force also depends

[1] Dictionary of Science [1988], University of Cambridge, UK

on the permittivity of the medium in which the charges are placed. If Q_1 and Q_2 are the point of charges a distance d apart, the force is –

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$$F = \frac{1}{4\pi\varepsilon}\frac{Q_1, Q_2}{d^2}$$

where ε is the permittivity of the medium

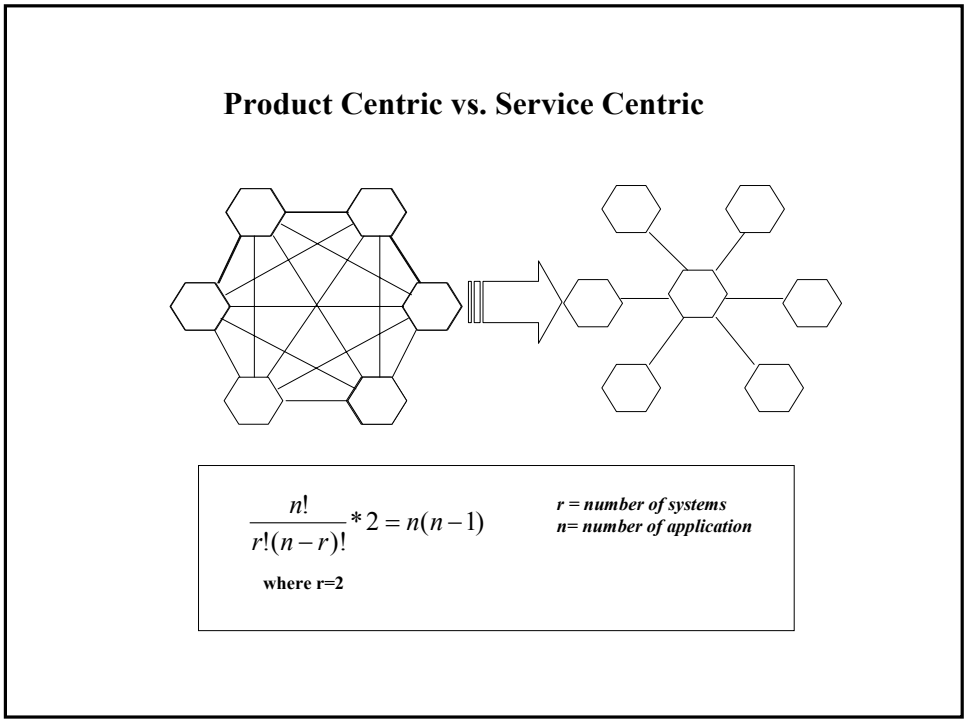

Figure 3: Product Centric vs. Service Centric

The force F is attractive for charges of opposite sign and repulsive for charges of the same sign. In this context, it is addressed that the Product and Service has scientifically attracted. They are treated or understood or both, as one and the same. It is possible to digests it either of the way, due to a purpose paradigm. It is further defined to understand the phenomenon in the form of molecular structure (figure 3).

To defend the consistency of Product and Service, we think of an emission strategy assessment. The ratio of the coefficient of absorption to the coefficient of emission is the same for all substances and depends for the total emission and also for the emission of any particular frequency. What we learn here is that when modeling Product and Service in a complexity environment, we have to dismantle them from each other and assemble them together again. When mirroring them, we are technically screening them in one entity while holding different so-called cash flow aspect in reality. This is why the dynamic approaches to carry them forward we refer at. This background is allowing us to make the business operational view. The business process and information models are structured where the requirements are scanned to set the metamodel workable mode, or say ebXML (Electronic Business Extensible Markup Language)- type (figure 4).

Product and Service Platform, when optimized, give opportunities to align the patterns from one perspective to another. Requirement and dependency threads the guidelines to form

metadata for operational systems[2]. This constructs an ontological framework for business management.

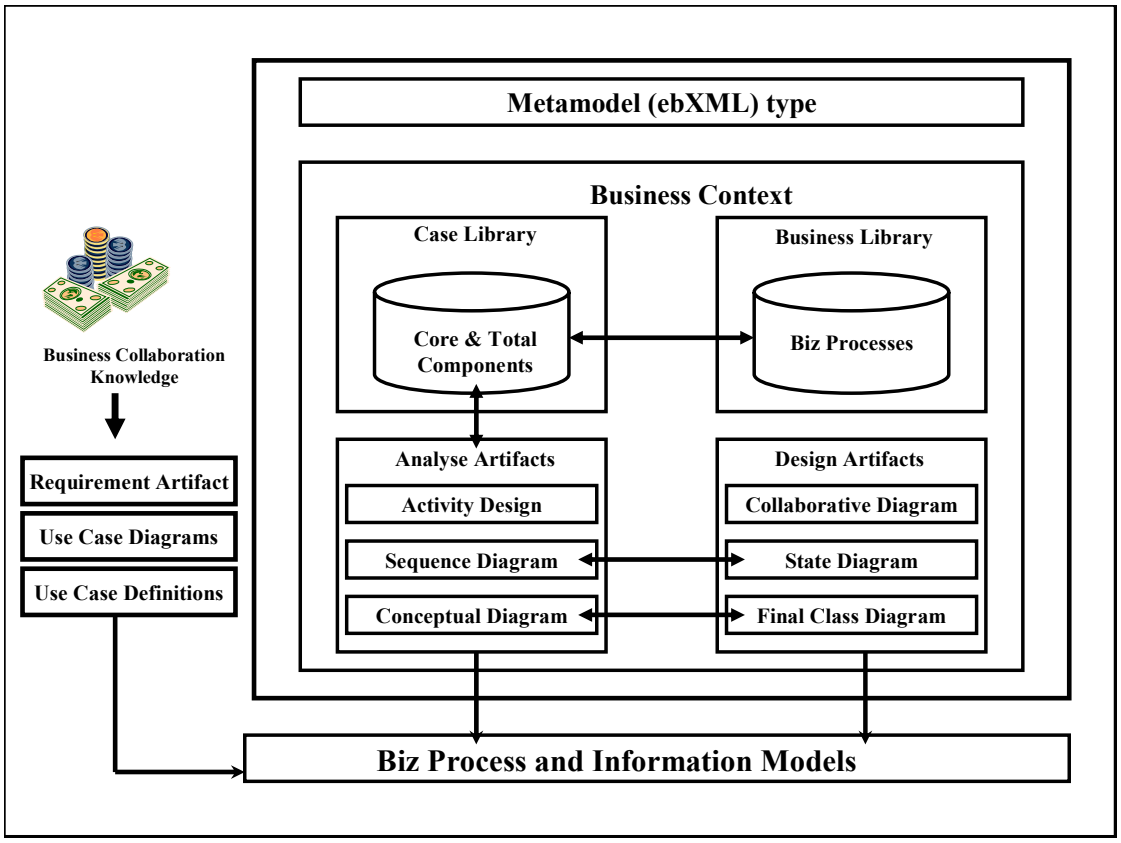

Figure 4 - Business Operation view through modeling

We face the need to construct a dynamic system to manage life cycle requirements, product and service features, operations and processes, interfaces and all dependencies to manage various challenges of life cycle business in dynamic environment. Salminen and Pillai [6] have made an assumption according to their research that adaptive systems are inherently non-linear. A natural approach to understand the behavior of adaptive systems is thus to use tools from the theory of nonlinear dynamical set-ups. This reveals that they have a very special structure. It is reasonable to assume that if the adaptation rate is small, the parameter estimates will change more slowly than the variables in a system. However nonlinear dynamics can be analyzed and performed when the command signal is periodical.

4. A practical insert on the State of Industrial Services

During last two years, there have been made feasibility studies on the state of Industrial Services in Finnish Industry. Studies were done by several research groups under one project, called BestServ. According to the feasibility study, it has been created common understanding about what industrial service is and how it interrelates with normal product businesses. Manufacturing companies position themselves differently in terms of customer intimacy through their Industrial Services offerings and operations. For practical reasons it was defined five different supplier positions or "roles" (figure 5), relative to the customer [7]:

[2] Systems are like Customer Relation Management (CRM), Product Data Management (PDM), Enterprise Resource Planning (ERP), and Supply Chain Management (SCM), etc.

- Machine supplier. The focus of the business relation is on delivering a piece of machinery or equipment that fits the customer's technical specification.
- Solution supplier. The focus of business is on delivery of a system, e.g. a production line, which usually is 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 expands 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 part 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 five supplier business models has its own "mindset". When a supplier aims to approach from one model to the next level, it faces tough challenges most on getting customer involved on that and also on developing its technical and business competencies to do that. The strategic positioning decision between supplier and customer is important and has to be prepared as thoroughly as any other strategic decision.

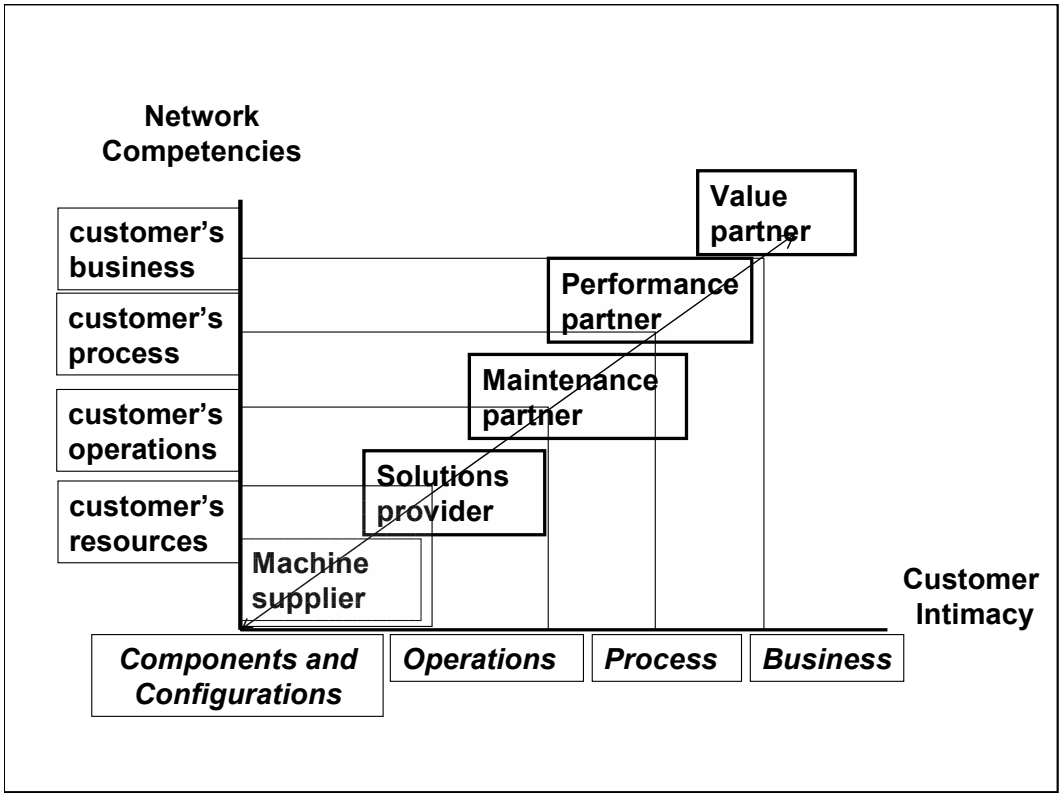

Figure 5: Business Model Analysis according Customer Intimacy [7]

The first two models focus the supplier's activities on the customer's investment decision and do not concentrate too much on supporting the life cycle of customer process. Solution supplier needs the ability to understand and interpret the customer's actual operations in its offering. Maintenance partner concentrates on professional maintenance management as continuous process. As pperformance partner, the supplier can have a responsibility on the actual daily performance of the customer process. When supplier is a value partner, it is involved in the customer's value generation, e.g. to producing optical cable in a cable factory at a given quality and price. The supplier has to have competence on customer's business. Level of knowledge and experience is increasing and creates competence for productive communication between partners of value network.

BestServ feasibility study showed that Industrial Services has been seen as a strategic intent to manage global competition and the evolution of current business models. This approach leads to the overall management of the customer offering through life cycles, from both a solution and a customer viewpoint. The main long term development areas figured out were:

- It is difficult to recognize the benefits of Industrial Services for customers and for all suppliers. The main challenge for this may be the lack of a shared value model of Industrial Services. The shared value model enables the discussion about the potential benefits and values to be captured by the services.
- Industrial Services are usually built like extended products based on the current product architectures and not on management of customer requirements and values. We need a customer-oriented solution architecture that integrates both product and service offering and enables efficient market segment management.
- It is difficult to determine an interoperable structure for Industrial Services to be integrated with product structure. This complicates the creation of new and innovative business models. Enterprises should have overall reference business models based on integrated structure of product and industrial services (earning logic, business strategy, organizational models etc.). The efficient development and use of reference models enables the continuous innovation of integrated offering over the life cycle of customer process and own business model.
- At the moment, many Industrial Services are traditionally oriented, while the need is for knowledge-intensive services (e.g. proactive maintenance, all kind of business consultation). The development of knowledge-intensive services requires a deep understanding of customer processes as well as the development of one's own competence. These require the reinventing of the customer offering and the related business model.
- Technological solutions (e.g. telecom, automation, operative systems) are mainly developed to support separate operations and processes. There is development challenge to manage the integration of separate technological solution**.** Continuous Industrial Service development requires parallel development of both business architecture and information and communication technology architecture.

During the survey we recognized that most of the companies needed to adapt their business according the paradigm shift from ownership to access and that potential sustainable growth of business lies in services created and captured. The framework of value transition means a transition from parts or machine supplier to value provider. Then the most essential factor is an adaptive business transition process.

A well understood and structured business model supporting business architecture is a very prime strategic tool when business is evolving according to the market requirements. The Solution architecture is at the compassion of business alignment. Solutions consist of integrated service and product elements. When there are reusable elements in the architecture

it is easier to build up new ones. Customer and functional requirements over the life cycle, product and service features, modules, components, and interfaces build the core structure of an enterprise solution structure.

A life-cycle business intelligence concept needs also to be created; to combine application knowledge and organizational knowledge in the value network, for life-cycle information management that could be based on ontology. An intelligent decision management system would be necessary to support the new or future development of product and services.

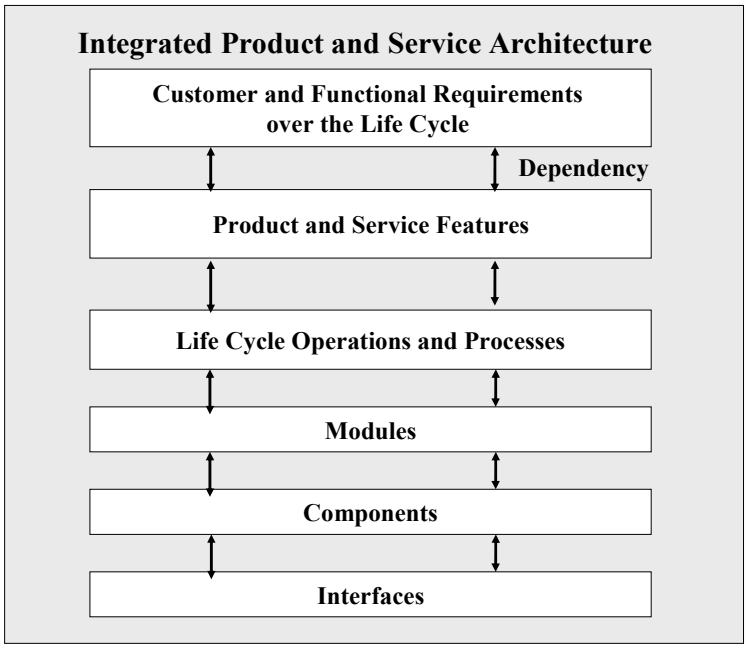

Figure 6: Definition of Solution Architecture for the Management of Life Cycle Business

Salminen &Pillai [3] have expressed the views as to how product and service can be organized in a systematic way, where the dependency is described at the product and service architectures. It is good to start by re-engineering the current product line and service line into modules and components: The goal of this phase is to recognize the most important elements to form a product and service platform. The intention is also to minimize the amount of components and restructure the product and service platform so that all the waste resulting from overlapping of components is limited. The goal is to reach up to a rationalized and optimized product and service platform with configured interfaces by interactions understood and determined. The intelligent product and service line offers the creation of this offering. These are practically done through the mechatronic approach with a layered model of mechanical and control structures and their interoperability domain processes and life cycle service processes. For this task, we frame the terminology constraints as in figure 7. It explains the utility terms for customer and functional requirements, product and service features, optimized modules, components including interfaces.

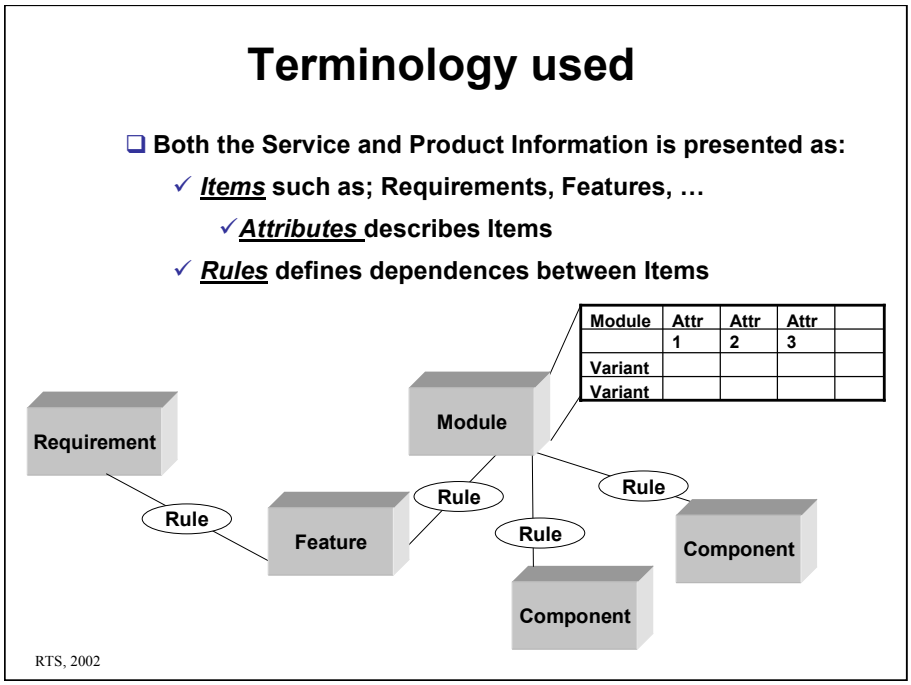

Figure 7: Terminology Definition

By the toolset it is possible to create dynamic system, which helps to integrate technology planning by unbundling and identifying technologies within the platforms, linking them in turn to technology road maps. Integrated development systems manage and iterate the platform elements. Product and service is organized in a systematic way, where the dependency is exploited in architecture. Platforms are key enablers for continuous introduction of product and service derivatives to multiple market segments. Furthermore the strategy is critical also when managing the complexity. We used in our one of the studies a tool called, Optiwise(TM)[3]. Product and service platforms are the foundation of derivative products/services. The platform assets consist of several physical and abstract varying items [3]. Platforms are essential in strategic product and service planning and management. This strategy performs in minimizing the complexity of the overall business. It is an object-oriented methodology. In using the toolset, it defines the re-usable solutions and models into the platforms.

The discipline of applying the model-based laws in a dynamic behavior such as explained above to describe the routers in the system become known in tracking and packing, while on process. The driving force behind such a dynamic system is as in figure 8. The system learns and complements the sequent, which is continuous. There is a snag with the iterative technique used to provide "solutions" in a situation like 'three-body' problems[4].

[3] Optiwise tool is owned by the Real Time Systems, Inc., USA [www.optiwise.com]
[4] We referred here is the laws of Newton.

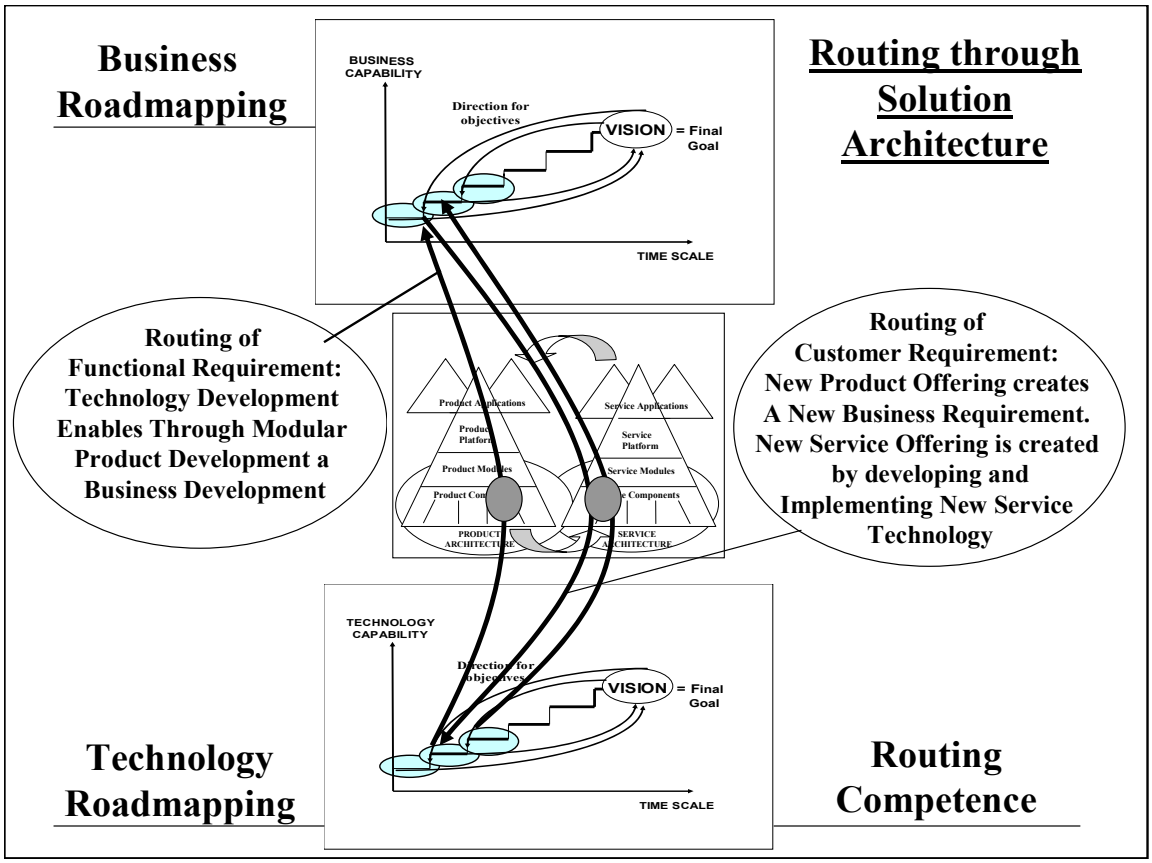

Figure 8: Requirement Routing through Integrated Solution Architecture and Platform

5. Model-Based Methodology: An implemented Case

We conduct a case study based on the above framework. The study executed with a telecom Portal Provider [3]. We have integrated dynamically the product and service concept into industrial reality. We used also above mentioned software tool. We modeled the portal provisioning live-data; while acquiring them at random, a number of unspecified customer requirements, and its new features. The following figures would explain the use of methodology and the software tool.

Figure 9 (an actual computer screen-shot) indicates the dependency of dismantled provision automation systems. The dependency; is further expanded with performance rules. The methodology of rule creation categorized as in figure 10.

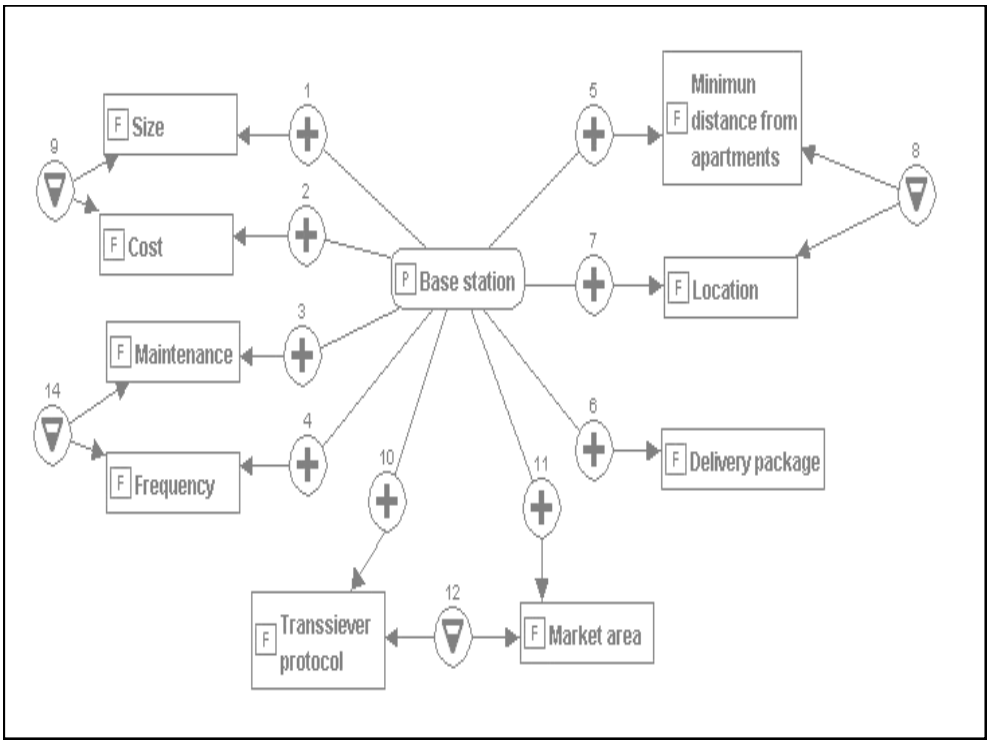

Figure 9: The dependency set-ups of a telecom Portal (A screen shot)

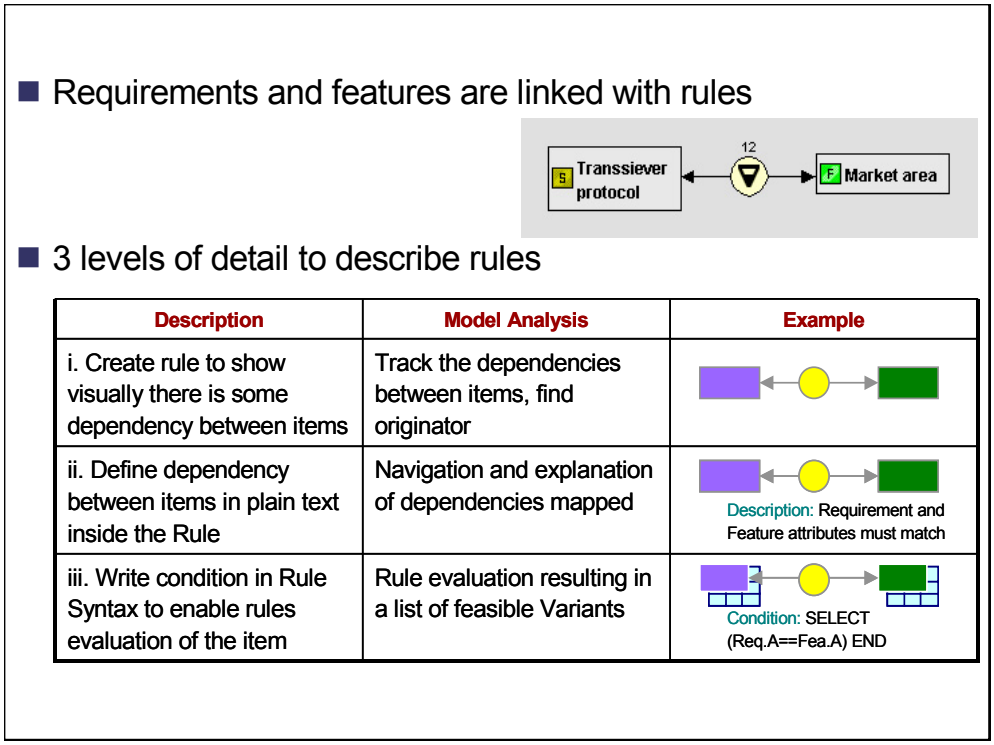

Figure 10: Rule Creation System

While considering the Life Cycle Challenge Management [3], LcC_{Mgt} of a Product and Service that in this case is invisible and faster than solid entity. Here as research team, we had problem to justify this concept in general. However, Life Cycle, is very short and fully packed with high technology. Here the challenge makes sense. Therefore, we made an

archive (Library) of requirement and used trajectory for tracking to build the "Backbone". The software tool is then applied to interpret and view the "Backbone". It is further scanned to pick up the required information from the archive to produce 3D-figures as to how a document or component is published or released collaboratively "looks-alive" before the decision portfolio. All these steps are drawn in following figures 11 through 13. While creating methodology, we scheduled an adaptive learning algorithm.

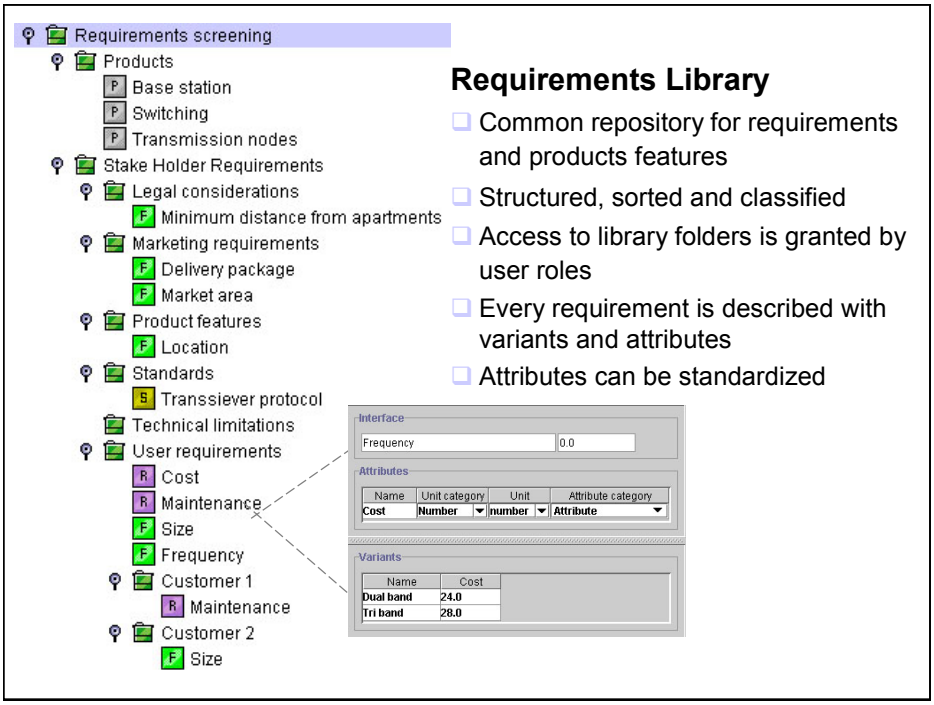

Figure 11: The use of Requirements Library

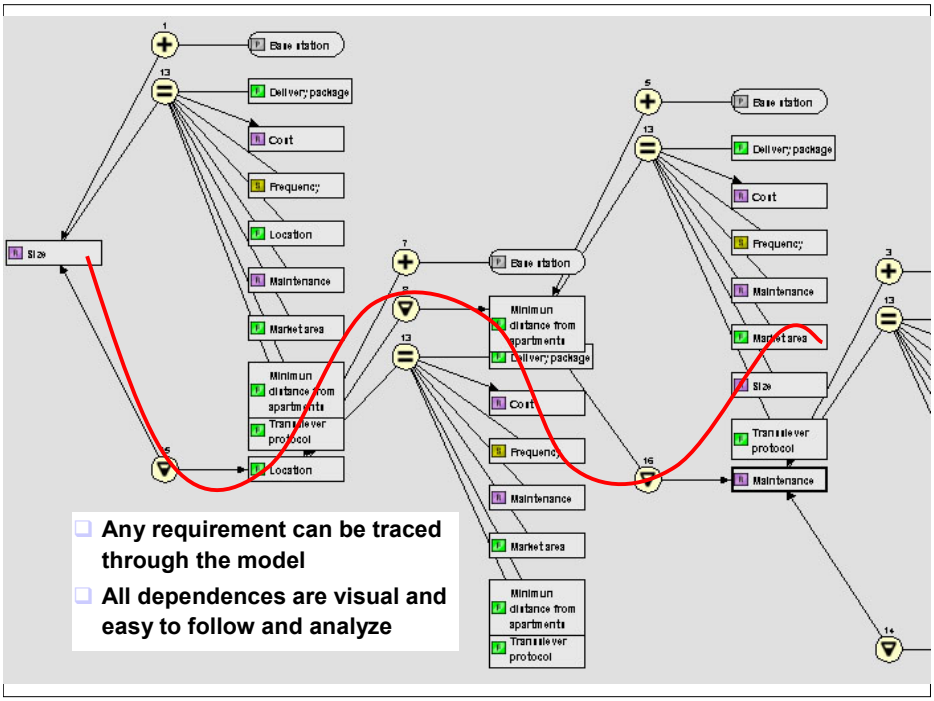

Figure 12: Tracking from the trajectory

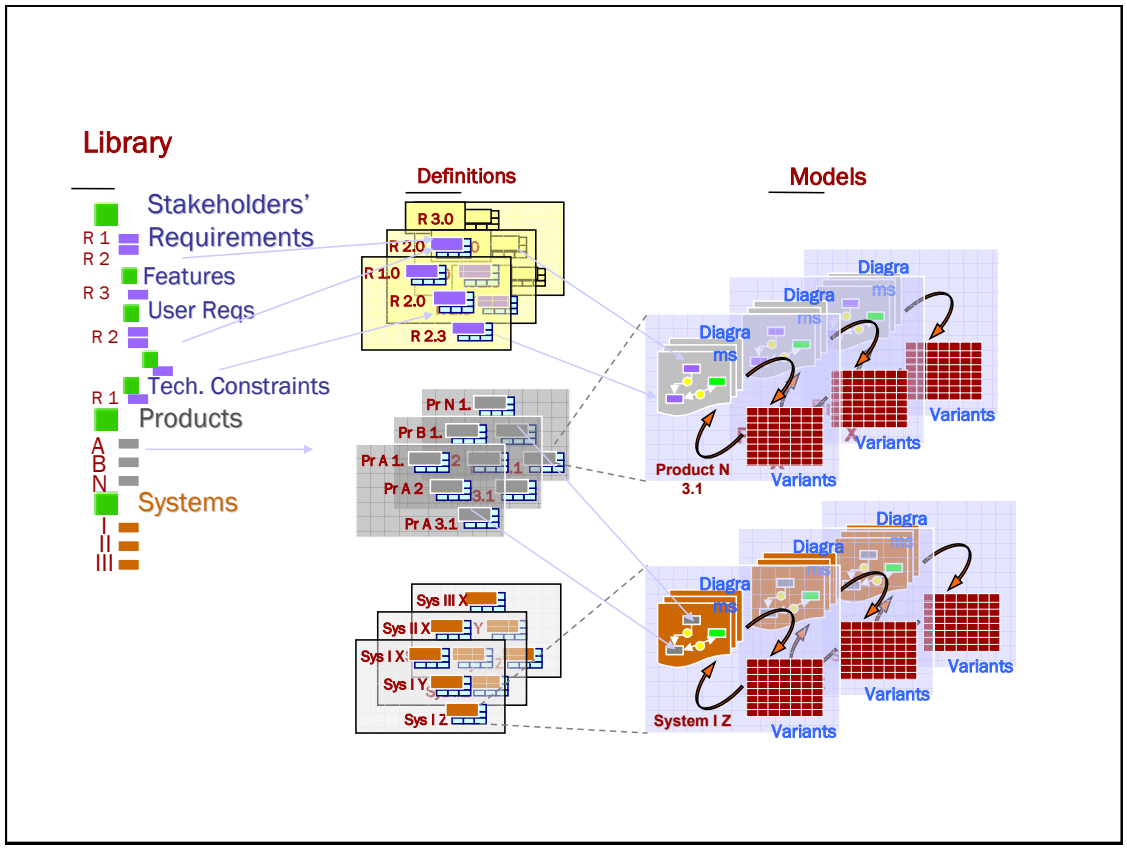

Figure 13: Summary of the methodology used.

6. Experimental Results

Integrating product and services into the new framework attract the industrial needs in fast growing technology areas. In the context of knowledge sharing we use the term ontology to mean a specification of a conceptualization. That is, ontology is a description of the concepts and relationships that can exist for an Agent or a community of Agents. When knowledge of a domain is represented in a declarative formalism, the set of objects (for example Service and Product) that can be represented is called the universe of discourse.

On the practical side we automated the workload of telecom provisioning system. The search engine and browser robot created on a semantic infrastructure. The piloting results calculated shown in Table 1 as actual representation of the telecom portal. This project was piloted in a team of 25 employees of Portal Provider. Immense number of Database processes is off-line Integrated and or deleted. Money value generated is simply to understand here as saving through workload of the pilot employees. Many numbers of files or documents had opened to trace a combination for certain class integration or add as default repositories. The result indicated that the traditional linear theory with product data management (Bill of Material) oriented implementation of product structuring become difficult and expensive. We stress here that the requirement has to be trapped prior to product versioning in its physical mode or *"invisible"* format. The experimental outcome is scheduled in Table 1 below:

Table 1: Experimental results of the Pilot study at an IT - Corporation

Experimental Results of a Telecom System

Item	Methodology Before Use	Methodology After Use	%-Time Saved	US $/1000 K Value Generated
Semi-automated Provisioning	Man-Power Employed mainly	Electronic Format-Model-Based	40% - Regular man-hour	500
SCADA-Integration	Databased in different Sources	Easy Integratti-on, no filtering, but models, In-terpretation and visualization	50% - man-hour	650
Customer Re-quirements	Manually Collected , data not used and sto-rage capacity large	Totally modeled, Integrated, Agent- Based-Browser access to view and in-tegration to Pro-duct Offering	80% - man- hour	750

On the other hand, a very small cause that escapes our notice determines a considerable effect that we cannot fail to see, and then we say that the effect is due to chance. The evaluation tool and tracking elements make the life easier when implemented the project.

The inspiration for this project came from the initiatives of an IT – Corporation of Finland, who failed in applying giant software that were expensive and difficult in piloting purposes. What we learned here is that most complex things in the known Universe are living creatures, such as ourselves. These complex systems are made from the most common raw materials known to exist. Those raw materials naturally assemble themselves into self-organizing systems, where simple underlying causes could produce surface complexity.

7. Conclusion

We were able to integrate two independent entities, namely, Product and Services. The mathematical framework allowed us in disintegrating them to see as separate and though they are sets and subsets. We pooled them back to track trajectory and fertilized, where knowledge, information, scattered and communication underpinned to speak the business language.

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