# A Systemic Approach for Designing Open Innovation Value Networks

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**Abstract:** The past two decades have seen a number of changes to the business and technological environment that have favored the rise of “open” collaborative innovation as alternative to the more traditional ”closed” models. The traditional view of innovation as a closed or proprietary system where new ideas are generated from an internal research group or an R&D department is being replaced by open innovation value networks in which enterprises collaborate in a variety of ways with third parties (including their competitors) to generate new or significantly improved products or services. In moving from “closed” to “open” innovation enterprises require; a new set of skills and tools to configure an open innovation value network, as well as, radical changes in their organizational structures in order to manage the complex web of relationships inherent in open innovation value networks. In this paper, we apply Systemic Enterprise Architecture Method (SEAM). SEAM offers a systemic conceptualization technique and a set of heuristics useful to analyze and design open innovation. In this paper, our method is illustrated with an example of open innovation in the computer industry. We show how enterprises can design open innovation value networks and identify the organizational structure required to better exploit the opportunities afforded by open innovation.

**Keywords:** coopetition; enterprise modeling; open innovation; systems approach; value network

## 1 Introduction

Innovation is described as the recombining of existing people, ideas and objects in novel ways (Hargadon, 2003). Open innovation is the purposive use of inflows of knowledge to accelerate internal innovation, or outflows of knowledge, to expand the markets for external use of innovation. Open innovation is a paradigm that assumes that firms can and should use external as well as internal ideas as they look to advance their technology(H. Chesbrough, Vanhaverbeke, & West, 2008). Open innovation is a new paradigm on the sources and uses of ideas. Valuable ideas can come from inside or outside the company and can go to market from inside or outside the company (H. W. Chesbrough, 2005) . This new paradigm requires organizations, and in particular the R&D departments within these organizations, to shift their focus from knowledge creation to knowledge brokering. There are implications for enterprises both in the processes of acquiring innovation from third parties, including their competitors (inbound innovation) and in generating ideas, products and other intellectual capital for third parties (outbound innovation).

It has been suggested that the open innovation is a useful paradigm for industrial R&D where there is an abundance of knowledge (H. Chesbrough, et al., 2008), as there is today, because open innovation is well placed to exploit this diffusion of knowledge. Haour (Haour, 2004), further describes the current trend of open innovation in terms of companies defining their 'innovation perimeter' just as the event of outsourcing redefined a businesses' production perimeter. Instead of restricting the research function exclusively to inventing new knowledge, good research practice also includes accessing and integrating external knowledge. Open innovation is becomes necessary as the pace of strategic change in companies outstrips the rhythm of basic research and companies need to access what the need, when they need it, either from inside the company or from external knowledge.

### *Typology of open innovation*

Some recent attempts have been made in the literature to give a typology of open innovation. From (H. W. Chesbrough, 2005), we can classify open innovation as inbound or outbound. In an inbound open innovation a firm sources knowledge from outside its organization. Inbound innovation falls into two categories:

- Appropriation of external knowledge: identifying, understanding, selecting from and connecting to the wealth of available external knowledge;
- Integration of external knowledge: integrating internal and external knowledge with internal competencies to form more complex combinations of knowledge.

Outbound innovation is defined as generating additional revenues and profits from selling research outputs to other firms for use in their own systems.

Elsewhere (H. Chesbrough, et al., 2008), West and Gallagher identify three models of innovation: proprietary, external and open. The proprietary model is also referred to as 'closed' or 'internal', where innovation is derived from a dedicated department (or departments) within the company. Their view of a truly open model encompasses proprietary and external innovation, as well as actively looking for the best ways to make profitable use of IP derived from within the company, even if this means spinning out ideas to external entities (outbound innovation) which may act as competition to the ‘parent’ company.

Haour refers to similar ‘spin out’ and ‘spin in’ types of innovation, as well as the concept of buying and selling of IP, in (Haour, 2004) where he refers to open innovation as ‘distributed’ innovation.

Companies should consider all of the above types of open innovation if they are to keep pace and support their business strategy. Open innovation also allows more flexibility but it is often difficult to determine the best partner for a particular open innovation and can be even more difficult to implement due to organizational constraints.

### *The need for a method to identify and configure innovation networks*

Redefining the company’s innovation perimeter (Haour, 2004) and the involvement of external partners such as customers, suppliers, competitors, research institutions, etc. in the innovation process have been recurrent themes in the open innovation research (H. Chesbrough, et al., 2008) (H. W. Chesbrough, 2005). So far, however, there has been little discussion about systemic approaches that can provide business managers with a clear understanding of the various strategic choices available for them to extend the innovation perimeter of their companies. Moreover business managers have preconceptions about who to cooperate with (partners, competitors, regulators, etc.) in the innovation process. This may prevent them from forming creative innovation networks. Hence the need for an environment scanning method, that enumerates all potential partners for an open innovation process regardless of their roles, is highlighted and a framework for configuring an *open innovation value network* is then required. We define an open innovation value network as a group of companies that collaborate to develop a new or a significantly improved product to the market.

Furthermore, an open innovation network may require companies to engage their competitors in their innovation process. In that case, they have a multifaceted inter-organizational relationship comprising cooperation and competition. This kind of relationship is called coopetition(A. M. Brandenburger & Nalebuff, 1995), (Adam M. Brandenburger & Nalebuff, 1997). It is undoubtedly a relation of a higher level of complexity compared to the one between non-competitors. The framework for configuring open innovation value networks should address such coopetitive networks.

### *Systemic Enterprise Architecture Modeling*

In this paper, we apply the Systemic Enterprise Architecture Modeling (SEAM) (Wegmann, 2003) to design open innovation value networks and the required corresponding organizational structure. The foundations of SEAM are in General Systems Thinking (GST) (Weinberg, 2001) and in RM-ODP (ISO, 1995). GST is the study of principles that are applicable to any kind of system. RM-ODP is a software engineering ISO standard that provides solid definitions for our concepts. SEAM has been applied for teaching (Wegmann, Regev, De la Cruz, Lê, & Rychkova, 2007) and consulting (Wegmann, Regev, & Loison, 2005) since 2001.

In SEAM’s we develop *enterprise models* to conceptualize a company and its environment. An enterprise model is a hierarchy of systems. The concept of system is generic and is independent of the nature of what is modelled. We define a system as a group of entities that interact for a certain purpose. Systems are defined by observers to illustrate something of interest for the observers. For example, a value network (system) is a set of companies perceived as interesting by a marketing person because the enterprises collaborate. An engineer might not see the same value network. In SEAM we define a number of systems: the market (system), the value segment (system), the value network (system), the company (system) and, possibly, the IT system. A market is a system composed of value segments; a value segment is a system made of value networks; a value network is a system made of companies; a company is a system made of employees and IT systems. Figure 1, depicts the hierarchy of systems in SEAM's enterprise models.

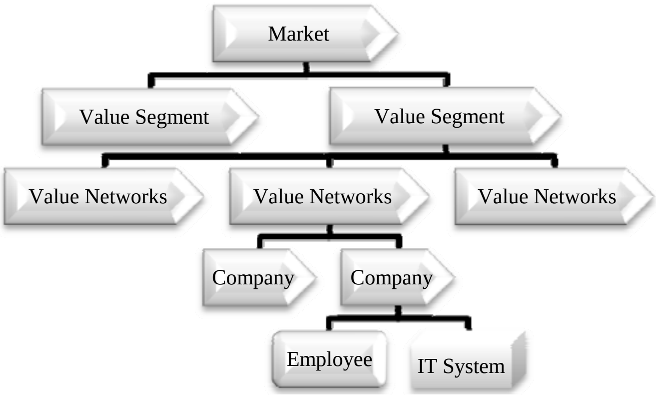


**Figure 1.** Hierarchy of systems in the SEAM enterprise model

SEAM as a systemic approach for designing open innovation value networks consists of four design steps.

Step 1 Developing enterprise models:

First we conceptualize the environment of the company of interest in an enterprise model. We augment the enterprise models by adding quantitative marketing concepts to illustrate the market share of a value network, company's the relative strategic significance (i.e. added value created by a company) in the value network and the customer migration between value segments.

Step 2 Identifying potential partnerships

We identify all the potential companies who can contribute to an open innovation project and develop various partnerships strategies can be developed accordingly.

Step 3 Assessing and selecting partnership strategies

At this step, we formulate the underlying goals and requirements of an open innovation project. The strategies identified in the step 2 are then assessed on the basis of how well they can satisfy the requirements and objectives.

Step 4 Configuring the open innovation value network

We finally configure the open innovation value network based on the dominant partnership strategy developed in step 3. Then, we present *a set of heuristics* to identify the organizational structure needed to better exploit the opportunities afforded by open innovation (in the case of partnering with competitors).

Figure 2, illustrates the steps in SEAM approach. The dashed line implies that this approach can be applied more than once and in the form of a cycle.

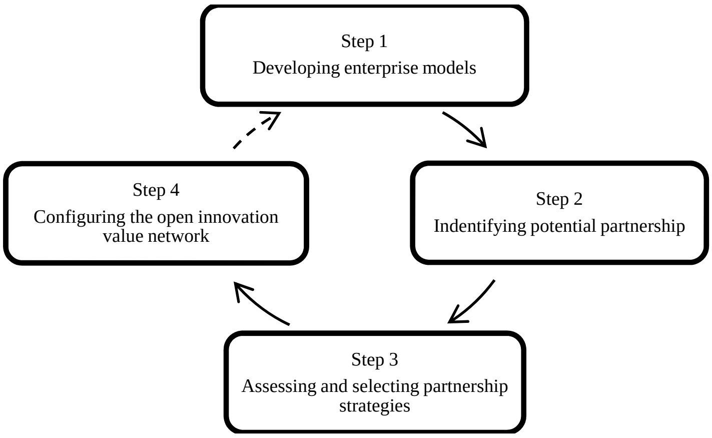


**Figure 2.** Design steps in SEAM approach

This paper is organized in the following way. In Section 2, we illustrate our approach by applying it to a case of open innovation (inbound open innovation) in the computer industry. Section 3 includes the related work and in Section 4, we present the conclusion and our future work.

## 2 Applying SEAM to open innovation in the PC industry: Open innovation gives birth to *PowerPC*

In this section we apply SEAM approach to the case of open innovation in the PC industry circa 1991. The case describes the development of PowerPC (Performance Optimized With Enhanced RISC Processor Chip) created by an alliance formed between Apple, IBM and Motorola, known as AIM alliance. This case[1] characterizes an inbound open innovation in which Apple appropriates the external knowledge in CPU design, as it moves towards a radical shift in its technology.

In 1990, Macintosh sales were eroding due to the increasing dominance of wintel based PCs (i.e. computers with Microsoft Windows operating system and Intel x86 CPU). This significant loss of market share was mainly due to the users' perception of Apple machines, in terms of performance and price. The high interdependence between Apple's hardware and its operating system (tightly coupled system architecture) had made it extremely difficult for Apple to implement changes in its machine. For instance, any

[1] The information on the case has mainly been collected from the book "Inside the PowerPC Revolution: The Inside Story Behind the Chips, Software, and Machines That Are Changing the Computer Industry" by Jeff Duntemann and Ron Pronk and interviews with a computer industry expert.

upgrade in the CPU (Motorola 680x0 processor) architecture would require a number a changes in the operating system (system 7) and as a consequence the applications by the third party developers needed to be modified or redesigned. On the contrary, the collaboration between Intel and Microsoft had led to a loosely coupled architecture in IBM PCs and compatibles. Hence, Intel could design and use faster chips without requiring Microsoft to redesign the operation systems. As a result, the users were able to notice a significant change in the speed and the performance of wintel based machines whenever they upgraded their machines (e.g. from machines with 386 processors to 486). Microprocessor designers believed that Motorola 680x0 processor was technologically superior to Intel's x86 architecture, and Macintosh machines outperformed wintel based PCs in particular for running graphic intensive applications. Wintel PC users, however, did not see any reason to switch from their machines with 66MHz Intel processors to Macintosh with a 40 MHz Motorola CPU that cost double the price of their machines. Surprisingly most of the wintel PC users had not even actually seen a Macintosh to date. So Apple had not managed to win the price/performance fight against Microsoft and Intel.

Having lost a significant share of the PC market, it was evident for Apple that nothing but a radical shift in technology could lead to its survival. This technological change would mean a faster chip with a highly scalable architecture that could support computers of any size without requiring changes in the operating system. In early 90's this description would be associated with Reduced Instruction Set Computer (RISC) CPU design that required a considerably high technological capability. Furthermore, Apple needed applications tailored to RISC architecture and instruction set. However, considering that Apple's market share percentage was dropping below ten, it was nearly impossible to convince the software developers to develop applications for the RISC-based Macs. Hence, in order to ensure the success of the new platform Apple needed to find a way to gain the support of software vendors. Finally, in order to change price perception of the users, Apple had to keep the costs of the new RISC-based Mac down. This could only be achieved by reaching high production volume which was geared to mass production capabilities. Knowing that it did not possess the required resources and the technical capability to develop the chip, Apple began looking out of the perimeter of its own organization to find partners to kick off an open innovation project.

### *Step 1 Developing enterprise models*

Figure 3 is a SEAM enterprise model of the computer industry in 1990. Enterprise models are developed on the basis of a number of underlying concepts. To ensure a better understanding of the approach we explain these concepts along with illustrating the case.

- Value Segments, value networks, companies

  SEAM enumerates all segments relevant for a company within which a company can create a value through its value network for the customers and its partners. Within the value segments we analyze how companies contribute to the product or service offered by the value network to the end users, we call these companies value segments.

In Figure 3, four value segments are visible in the computer market: Wintel based PCs, Macintosh, Workstation and Mainframe value segments. As our focus in this paper is on the personal computers we have shaded the Workstation and Mainframe value segments, a darker color means the further the value segment is to our focus area in the market. Within the Macintosh value segment, we can see that Apple and Motorola cooperate in a value network to offer the Macintosh to the end users.

- Cooperation and competition

  In SEAM, by default, companies within the same value network cooperate while companies in different value networks compete. Sometimes, however, companies within a value network compete.

  In Figure 3, IBM cooperates with Microsoft and Intel to provide the IBM PC to the end user. While, it competes with Compaq who is offering IBM PC compatibles to the market. By the same token, Intel is competing with AMD who clones Intel processors in the IBM PC compatibles. The two red arrows represent the intra-value network competition.

- Qualitative marketing information

  The share of the market captured by a value network is represented by the number of the end users. The size of the block arrows used to represent companies within value networks reflects the share of the company within its product market. End users can also migrate from one value segment to another.

  In Figure 3, The Wintel-based PCs have more end users as compared to Macintosh, and hence have captured most of the market share. The size of the block arrow representing Microsoft (company) reflects Microsoft's share in the OS market. Due to the success of the Wintel based platform, end users from Macintosh value segment were migrating to Wintel-base PC value segment Also mainframes were being replaced by Wintel based desktop PCs. These customer migrations are represented by dashed black lines.

*Step 2 Identifying potential partnership*

As the next step in the design process as illustrated in Figure 2, partnership strategies are developed. Apple can establish five different partnerships for developing its new CPU. The five potential partners are the manufacturers of CPU perceived as potentially relevant: Intel, AMD, Motorola, Sun and IBM. Each one corresponds to a different strategy. These strategies are represented by green solid lines in Figure 3.

*Step 3 Assessing and selecting the partnership strategies*

Apple's underlying goals for developing a partnership can be formulated as;

G1: A RISC architecture CPU

G2: Commitments from software vendors to develop applications
G3: Reducing the costs by reaching high production volumes (i.e. economies of scale)

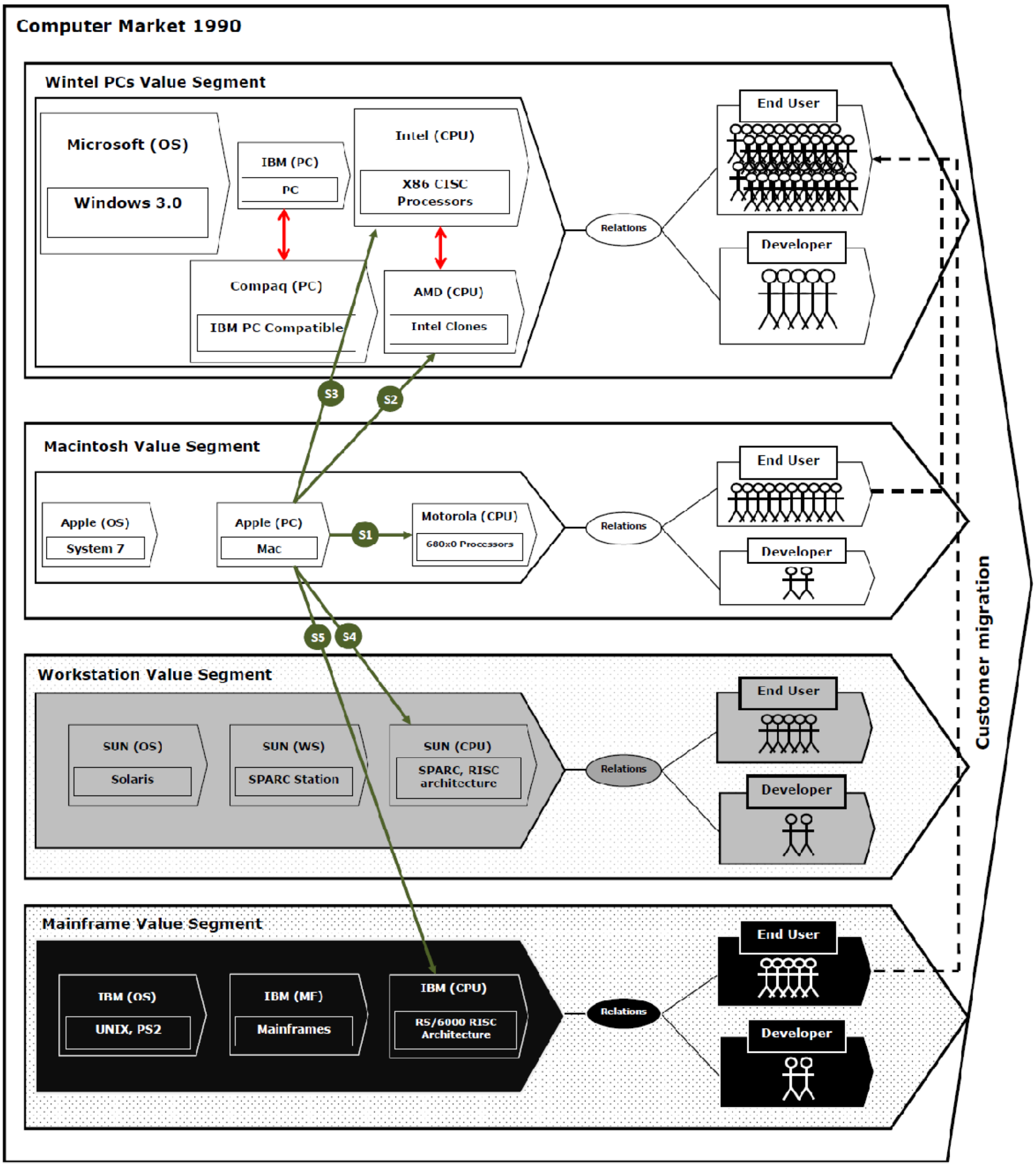


**Figure 3.** The enterprise model-1990

These goals can in turn be translated to the following requirements;

R1: Technological capability to develop RISC CPUs,
R2: Established brand to ensure software developers' support,
R3: Mass production capabilities

Potential partners are evaluated to check how they meet these requirements. Table 1, compares how well the identified strategies can satisfy Apple's requirements.

**Table 1** Assessing various partnership strategies based on the requirements

| | | **Partnership Strategies with CPU Manufacturers** | | | | |
|---|---|---|---|---|---|---|
| | | **S1** Motorola | **S2** AMD | **S3** Intel | **S4** SUN | **S5** IBM |
| **Apple's Requirement** | **R1**: Technological capability to develop single chip RISC CPUs | ++ | - | - | +++ | ++ |
| | **R2**: Established brand to ensure software developers' support | + | + | +++ | + | +++ |
| | **R3**: Mass production capabilities | ++ | +++ | ++++ | - | + |

In 1990, Intel and AMD were manufacturing CISC Architecture CPUs and hence did not have the required technological capability to develop RISC chips. The minus, (-) in (R1xS2) and (R1xS3), in Table 1 reflects this inability. However, SUN Microsystem, was already manufacturing a RISC instruction set architecture CPU called SPARC for its workstations, which was the closest match to Apple's required technological capability (R1 x S4). IBM servers and mainframes were manufactured with RS6000, a multichip RISC CPU (R1 x S5). However, it was clear to Apple that IBM had the design capability to create a single chip implementation of the R/S technology. Motorola was half way through the development of the RISC CPUs (R1xS1). From the brand perspective, Intel and IBM had established a prominent brand identity (R2 xS3) (R2xS5), but companies such as AMD, Motorola and SUN were not as well-known (R2xS1) (R2xS2) (R2xS4). Finally, Intel and AMD were leading the market, due to high sales volume of wintel based PCs which certainly meant that these companies were equipped with mass production capabilities). Whereas, as a result of the low demand (in terms of total units sold annually) for workstations and mainframes, both IBM and SUN did not need to produce high quantities of CPUs (R3xS4) (R3xS5). As Motorola was the sole provider of CPUs for Apple machines, it possessed relatively higher volume production capabilities compared to SUN and IBM (R3xS1).

As the comparative assessment of the partnership strategies suggests, the alternative that appears the best for Apple at that time would be to develop a partnership with Motorola and IBM. IBM had built a good image a in the software industry. IBM's RS/6000 gained quick market acceptance and support throughout the industry, despite the fact that it was brought to the market late. Hence, having IBM on board would enable

Apple to ensure support from software vendors for the RISC-based Macs. But would IBM collaborate with its head on rival in the PC market? IBM had lost a huge proportion of its market share to the wintel-based PC compatible manufacturers such as Compaq. In addition, as the desk top computer was becoming the dominant computation machine in the market the demand for IBM's mainframes was decreasing. So, IBM had plans to break the monopoly of Microsoft and Intel by forming an alliance with other players in the market. However, as IBM was manufacturing RS/6000 in small quantities for its mainframes, it lacked the volume production capabilities that Apple was looking for. Hence, involving Motorola who was equipped to manufacture chips in quantities would make sense. Moreover, Apple had made a huge investment on designing system boards for the next generation of Macs, and since the design was based on Motorola's existing 88100 chip, they did want to ensure that the new chips are 88100 compatible. More importantly both Motorola and IBM were open to collaborating with each other and were not rivals in the market, as they were active in different value segments.

### *Step 4 Configuring the open innovation value network and designing the organizational structure*

In the last step based on the, dominant partnership strategies specified in step 4, the open innovation value network is configured as Illustrated in Figure 4. The major challenge about establishing partnership strategies for an open innovation project is when a company has to collaborate with its rival. In the case of PPC, while Apple and IBM cooperate for chip development, they compete in the PC market. This hybrid strategy comprising cooperation and competition is called "coopetition" in the strategy literature. In SEAM, we conceptualize coopetition by the simultaneous existence of ***inter –value network competition linkage*** (i.e. competition between the companies that are not within the same value network) and ***intra-value network cooperation linkage*** (i.e. cooperation between the companies within the same value network) between two or more companies.

Based on (Carlin, et al., 1994) and (Dowling, Roering, Carlin, & Wisnieski, 1996) companies have two basic choices for dealing with this multifaceted inter-organizational relationship; avoidance or adaptation. If companies are to adapt themselves with the complexities inherent in coopetition they need to departmentalize or divisionalize their organizational structure so that different departments deal with different aspects of the multifaceted relationships. In some cases, companies separate cooperation and competition relationships by establishing a new department or subsidiary company. The solid black lines in Figure 4, conceptualize these organizational changes. These ***financial linkages*** represent that the companies belong to the same financial entity (for e.g. a company is a parent to or a subsidiary of another company) but work in different contextd or roles.

We apply these three kind of linkages to develop *a set of heuristic*s to design organizational structure of competing firms that collaborate in an open innovation project. In the case of coopetitive value networks, we claim, an organizational structure capable of accommodating the dynamics of coopetitive relationships should include the notion of financial dependency between at least one partner company within the open innovation value network and a company in the competing value network. As shown in Figure 4, in the case of PPC, two new companies were founded. IBM established Power Personal Systems to develop RISC-based PCs (IBM PPC), and IBM and Apple co-founded Taligent to develop an object oriented operating system to be used on future

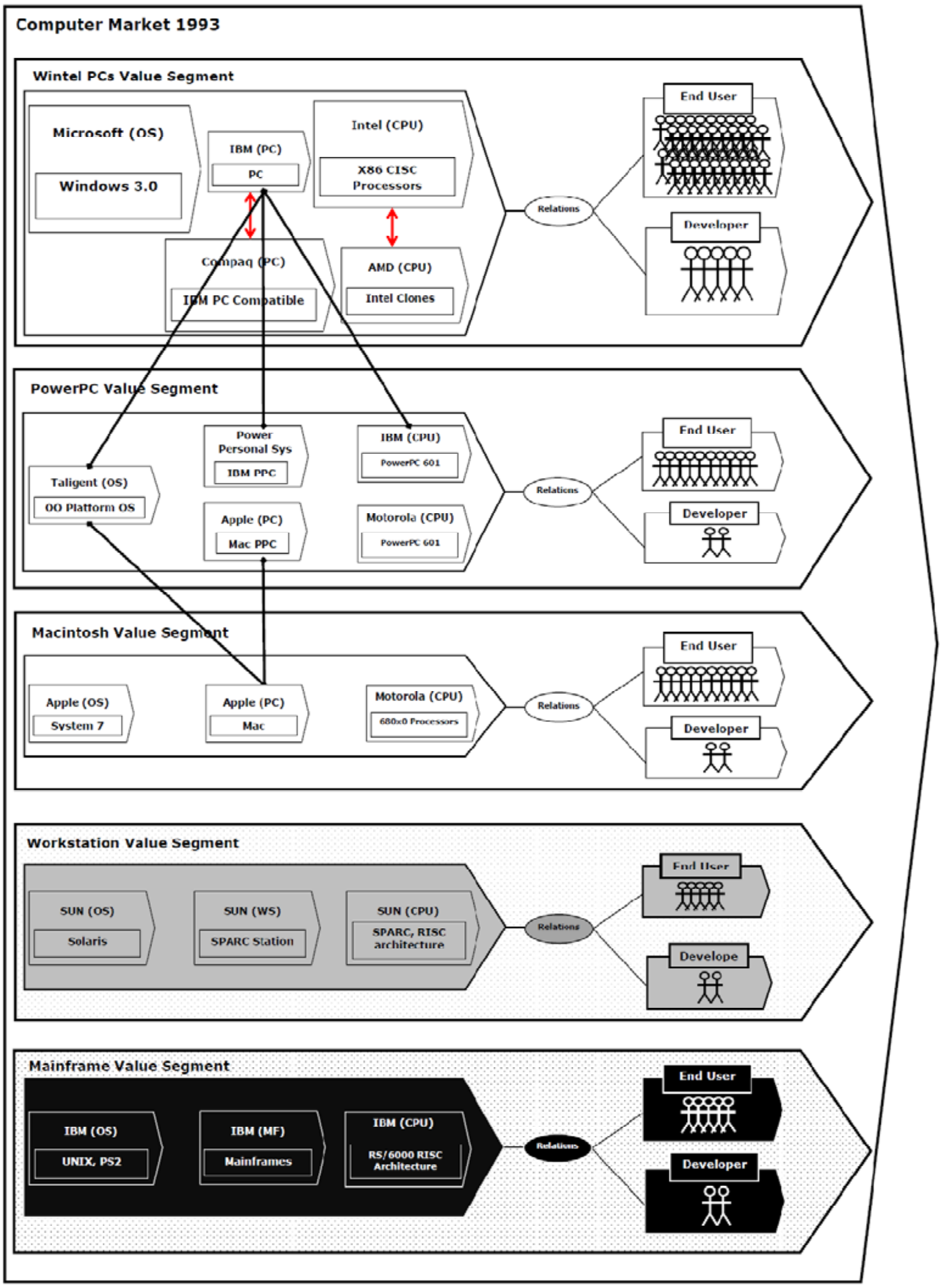


**Figure 4.** The enterprise model-1993

RISC-based Macs and IBM PCs. Apple also separated its efforts for developing RISC-based Macs (Mac PPC) by divisionalizing its PC operations(Duntemann & Pronk, 1994). The financial linkages in Figure 4 represent these ownership issues. Inter-value network competition linkage is between IBM (PC) with Apple (PC) (i.e. two companies with the same roles within two different value networks), Intra-value network cooperation is between Apple (PC) and IBM (CPU) (i.e. two companies within the same value network) and the financial dependency linkage is linking IBM (CPU) to IBM (PC) (i.e. the two companies belong to the same financial entity)1, hence IBM (PC) and Apple (PC) coopete. The cooperation linkages are shown by the fact that Taligent, PowerPersonal Systems, Apple, IBM and Motorola are in the same value network.

In a few years, Motorola stopped manufacturing its 680x0 CPUs, and Apple switched to RISC CPUS. IBM started to sell PPC to game box manufacturers. Playstation and Xbox still have PPC as their CPU.In 2006, Apple switched from PowerPC to Intel technology. This transition can be analyzed in a similar manner using SEAM.

## 3 Related Work

In (Haour, 2004) Hauers, presents a distributed approach for innovation consisting the following steps; Identification of the high impact offerings for a firm; selecting the most promising offering: seeking external technology to develop the selected products; developing the product by integrating internal and external contributions and, production and distribution of the product.

In (Dowling, et al., 1996), Dowling uses simple organizational charts to conceptualize coopetion , departmentalization and divisionalization.

## 4 Conclusions and Future Work

In this paper we proposed a systemic approach for designing open innovation value networks . Our approach consists of four steps, in which we systemically identify, assess and select open innovation partnership strategies and configure the open innovation value network. Three kinds of linkages (cooperation, competition, and financial) are defined to help structure the innovation value networks. We then explained the coopetitive open innovation value networks in which companies team up with their competitors to innovate and finally proposed a set of heuristics to identify the organizational structure that can accommodate the complexity of the inter-organizational relations within such value networks. Our future work will focus on applying our approach to other types of open innovation. We should also analyze the applicability for new businesses. Moreover, in the current phase of our research our approach is used to explain strategies, in our future work we will focus on discovering new strategies.

## 5 References

Brandenburger, A. M., & Nalebuff, B. J. (1995). The right game: Use game theory to shape strategy. *Harvard Business Review*, *73*, 57-57.

[1] The companies that start with the same name belong to the same financial entity. For the sake of simplicity and a better focus, we have shown the linkages relevant to the PPC value segment.

Brandenburger, A. M., & Nalebuff, B. J. (1997). *Co-Opetition : A Revolution Mindset That Combines Competition and Cooperation : The Game Theory Strategy That's Changing the Game of Business*: Broadway Business.

Carlin, B. A., Dowling, M. J., Roering, W. D., Wyman, J., Kalinoglou, J., & Clyburn, G. (1994). Sleeping with the enemy: Doing business with a competitor. *BUSINESS HORIZONS-BLOOMINGTON-, 37*, 9-9.

Chesbrough, H., Vanhaverbeke, W., & West, J. (2008). *Open Innovation: Researching a New Paradigm*: Oxford University Press, USA.

Chesbrough, H. W. (2005). *Open Innovation: The New Imperative for Creating And Profiting from Technology*: Harvard Business Press First Trade Paper Edition.

Dowling, M. J., Roering, W. D., Carlin, B. A., & Wisnieski, J. (1996). Multifaceted relationships under coopetition: description and theory. *Journal of Management Inquiry, 5*(2), 155.

Duntemann, J., & Pronk, R. (1994). *Inside the PowerPC Revolution: The Inside Story Behind the Chips, Software, and Machines That Are Changing the Computer Industry*: Coriolis Group Books.

Haour, G. (2004). *Resolving the Innovation Paradox: Enhancing Growth in Technology Companies*: Palgrave Macmillan illustrated edition.

Hargadon, A. (2003). *How Breakthroughs Happen: The Surprising Truth About How Companies Innovate*: Harvard Business Press.

ISO, I. T. U. (1995). ISO/IEC 10746-1, 2, 3, 4| ITU-T Recommendation X. 901, X. 902, X. 903, X. 904.“. *Open Distributed Processing-Reference Model, 98*.

Wegmann, A. (2003). Systemic Enterprise Architecture Methodology (SEAM), *SEAM). Published at the International Conference on Enterprise Information Systems 2003 (ICEIS 2003* (pp. 483-490).

Wegmann, A., Regev, G., De la Cruz, J. D., Lê, L. S., & Rychkova, I. (2007). Teaching Enterprise and Service-Oriented Architecture in Practice, *Proceedings of the Workshop on Trends in Enterprise Architecture Research (TEAR 2007)*.

Wegmann, A., Regev, G., & Loison, B. (2005). Business and IT Alignment with SEAM, *REBNITA/13th IEEE RE workshop, Paris*.

Weinberg, G. M. (2001). *An introduction to general systems thinking (silver anniversary ed.)*: Dorset House Publishing Co., Inc. New York, NY, USA.