

**UNDERSTANDING THE HEALTH OF TECHNOLOGICAL ECOSYSTEMS:
THE CASE OF PROFESSIONAL OPEN SOURCE SOFTWARE**

by

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(Under the direction of Marie-Claude Boudreau)

ABSTRACT

The value attainable from information systems investments requires the contributions of not only vendors and customers, but also an interdependent network of skilled professionals and organizations. This is especially salient for open source software, as the contributions are predominantly voluntary. In this study, an ecosystems metaphor is applied from the fields of ecology and human ecology to develop an understanding of the relationships and capital flows that enable the health and sustainability of these technological networks. A healthy ecosystem is defined as one in which the members are able to achieve sufficient returns to both satisfy their needs and encourage continued contributions. Using a case study of particular incidents occurring within professional open source ecosystems, this study attempts to identify the generative mechanisms, antecedent factors, and structural means by which ecosystem health evolves despite the myriad stresses they experience. The data collection via interviews, field observations, and archival data focuses on the circulation, transformation, and accumulation of capital associated with the response to these stresses. In so doing, this research develops a more complete means of assessing not only the health, but also the potential value of participating in these ecosystems.

INDEX WORDS: Ecosystems, ecosystem health, resilience, open source software, capital

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DEDICATION

I dedicate this paper to my sons, for whom I wish the very best as they pursue their goals and dreams as they go through life.

I also dedicate this paper to my wife, who had the forethought, tolerance, and patience to give up a part of her career and a city she loved to follow me to Georgia and allow me to pursue this new path and the new life we hope to experience together as a family.

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	vi
LIST OF FIGURES.....	vii
CHAPTER	
1.0: INTRODUCTION.....	1
2.0: THEORETICAL BACKGROUND AND LITERATURE REVIEW.....	4
3.0: METHODOLOGY.....	43
4.0 MCOMP CASE ANALYSIS.....	63
5.0 BCOMP EPISODE ANALYSIS.....	157
6.0 CROSS-SITE ANALYSIS.....	205
7.0 DISCUSSION.....	245
BIBLIOGRAPHY.....	260
APPENDICES.....	269

LIST OF TABLES

Table 1: Capital Typology.....	17
Table 2: Summary of Interview Data.....	55
Table 3: Data Comparison Display.....	59
Table 4: Capital Observations – MComp Founding.....	70
Table 5: Capital Observations – TCorp Failure.....	78
Table 6: Capital Observations – MComp Group Founding.....	88
Table 7: Capital Observation – Bill Coleman hiring.....	96
Table 8: Capital Observations – RDT Defection.....	108
Table 9: Capital Observations – Acquisition of GSoft.....	121
Table 10: Capital Observations – VC Funding.....	130
Table 11: Capital Observations – CWare Acquisition.....	138
Table 12: Capital Observations – Acquisition by OpenSoft.....	149
Table 13: MComp Mechanisms By Episode.....	154
Table 14: Mechanisms by Capital Interactions.....	156
Table 15: BComp Episode Listing and Typology.....	158
Table 16: Capital Observations - BComp Founding.....	165
Table 17: Capital Observations – BComp Website and White Paper.....	172
Table 18: Capital Observations – Todd Mayweather joining BComp.....	178
Table 19: Capital Observations – BComp VC Funding.....	185
Table 20: Capital Observations – BComp Acquisition of JSoft.....	199
Table 21: Mechanisms by Episode.....	202
Table 22: Mechanisms by Capital Interaction.....	204
Table 23: Economic Capital observed in the present study.....	208
Table 24: Structural Social Capital observed in the present study.....	209
Table 25: Cognitive Social Capital observed in the present study.....	209
Table 26: Relational Social Capital observed in the present study.....	210
Table 27: Human Capital observed in the present study.....	211
Table 28: Procedural Organizational Capital observed in the present study.....	212
Table 29: Referential Organizational Capital observed in the present study.....	212
Table 30: Codified Knowledge - Organizational Capital observed in the present study.....	213
Table 31: Symbolic Capital observed in the present study.....	213
Table 32: Classification of Mechanisms.....	220
Table 33: Summary of Events by Mechanism Table.....	238
Table 34: BComp Mechanisms by Episode.....	241
Table 35: MComp Mechanisms by Episode.....	242
Table 36: BComp Episodes by Capital Effects.....	243
Table 37: MComp Episodes by Capital Effects	244

LIST OF FIGURES

Figure 1: Barnard –Simon Equilibrium.....	8
Figure 2: Conceptual Framework of Ecosystem Health.....	11
Figure 3: MComp Download History by Month (with smoothed average).....	25
Figure 4: Realist Explanation Framework.....	44
Figure 5: Phases of Change in Ecosystem Health (negative change).....	47
Figure 6: Explanatory Case Study Methodology (adapted from Fisher, Ziviani 2004).....	51
Figure 7: Capital Flow Diagram – MComp Founding	73
Figure 8: Capital Flow Diagram – TCorp Failure.....	80
Figure 9: Capital Flow Diagram – MComp Group founded.....	91
Figure 10: MComp Bookings by year, 2002-2006.....	94
Figure 11: Capital Flow Diagram – Bill Coleman Hiring.....	98
Figure 12: MComp Download History by Month (with smoothed average).....	103
Figure 13: Capital Flow Diagram – Rival Development Team	112
Figure 14: Capital Flow Diagram –GSoft Acquisition.....	123
Figure 15: Capital Flow Diagram – MComp Group Venture Capital Funding.....	132
Figure 16: Capital Flow Diagram – CWare Acquisition by BigWare.....	139
Figure 17: MComp Direct Sales Model.....	145
Figure 18: Capital Flow Diagram – OpenSoft Acquisition.....	151
Figure 19: Capital Flow Diagram – BComp Founding.....	168
Figure 20: Capital Flow Diagram – BComp Whitepaper / Website deployment.....	174
Figure 21: Capital Flow Diagram – Todd Mayweather joining BComp.....	179
Figure 22: Capital Flow Diagram – BComp VC Funding.....	187
Figure 23: Download history – KSoft and JSoft.....	198
Figure 24: Capital Flow Diagram – BComp Acquisition of JSoft.....	201
Figure 25: Episode Progression for BComp.....	203
Figure 26: Barnard Simon Theory of Organizational Equilibrium.....	249

1.0: INTRODUCTION

Advances in Internet and communications technologies have enabled the emergence of a pervasive network economy that allows for increased interconnections between vendors, suppliers, customers, and other stakeholders from across the globe . Gone are the days when exchange partners were limited to individual dyadic relationships and locally proximate markets. Instead, communities of exchange partners can easily arrange and complete relatively complex transactions whether they are located in the same region or on different continents, often without the need for equally complex contractual agreements. This is especially common for transactions involving technological innovations, for which operational and commercial viability often depends on the contributions of networks of organizations . Each member of these collectivities depends on the other members' capacities to contribute sufficient resources so that the desired benefits are attainable. As such, the value of information technology investments are sustainable to the extent that both vendor and customer can continue to attract and support a network of skilled professionals and organizations motivated to provide the necessary innovation, support, training, and other services. Customers who deploy technology products and/or platforms that fail to attract a thriving ecosystem or whose ecosystem deteriorates (e.g. IBM's mainframe customers) are increasingly faced with declining availability of skills, increasing operating costs, and/or lower levels of innovation .

Several terms have been used to describe similar collectivities, such as interorganizational relationships, communities, and networks . In this paper, I describe the social systems surrounding a given complementary set of technological innovations as *ecosystems*, a metaphor that is becoming increasingly popular for practitioner and academic uses . Despite its

emerging popularity, the term is often applied in ways that fail to take advantage of the full benefits afforded by the metaphor.

As conceptualized in ecology, the focus of an ecosystem is not only on the set of dyadic relationships or exchanges in a given network, but on a more holistic view of the collective structure, operations, and strategies employed by the members of the ecosystem for their mutual benefit. Although the members typically act in their own interests, the interdependence which results from these actions must both maximize the benefits generated and enable each member to appropriate their maximum expected proportion of these benefits (Van de Ven 2005). Unhealthy ecosystems are those that fail to meet these requirements, particularly with respect to satisfying the necessary returns to each member. Analogously from ecology, the concept of ecosystem health is multidimensional, encompassing the organization, vigor, and resilience of the underlying ecosystem . Similar sets of concepts have been applied specifically to strategic management in business ecosystems and to population studies of social systems in general (Hawley 1986), but not in much depth. Other studies have examined ‘health’ in terms of the trust among members . There has been little research focusing on the health of these social systems in terms of the sustained capital flows among the members.

Whereas the underlying concepts are applicable to a wide spectrum of business ecosystems, the specific context for this research is open source software ecosystem. As an integral component of the deployment of any computing platform, software requires the participation of a wide range of participants and crosses the technology spectrum. Within the software industry, open source software is becoming an increasingly common part of the enterprise information technology infrastructure for many organizations. Researchers have initiated studies into several different aspects of the OSS phenomenon, including individual

developer motivation , economic aspects , software development and engineering efforts , business strategy and organizational structure . However, there have been comparatively few studies that have taken a broad look at the entire open source ecosystem despite pronouncements that the quality of the resultant software reflects the health, maturity, and stability of the community that surrounds it .

This study examines the health of professional open source software ecosystems using a case-study methodology. Specifically, I will identify the generative mechanisms within the ecosystem that influence the ability of these ecosystems to survive despite the myriad stresses they experience. The application of this framework will enable researchers and practitioners to evaluate the sustainability of open source ecosystems as a precursor for assessing the long-term appropriability of capital. Because of their clear value proposition, the quality of their products and services, and their recent gains in the software industry, professional OSS firms and their ecosystems will likely be an increasingly significant part of the IS deployments of the future , making them an ideal context to investigate.

2.0: THEORETICAL BACKGROUND AND LITERATURE REVIEW

2.1 Ecosystems

This research leans on several theory bases. The first originates in the field of ecology itself,¹ from which the ecosystem (and ecosystem health) concepts have been borrowed. This is supported by later research in human ecology² and management. Appendix A shows several alternative definitions for ‘ecosystem’ from these disciplines.

Ecosystem theorizing in ecology began as researchers realized the importance of the relationship between a community of living units and the abiotic, or nonliving, units and environment in which they existed . As the concept matured, it included theorizing on the flow of energy as well as materials . An ecosystem can be defined in a number of ways (see Table 1). However, at its core, an ecosystem “involves the circulation, transformation, and accumulation of energy and matter through the medium of living things and their activities” . This definition includes the flow of materials and energy among the various living and non-living components such as water, air, soil . As a metaphor, ecosystems provide a rich, informal term that allows stakeholders to easily view their roles in a holistic view of a given network of relationships.

Parallel to the development of the ecosystem concept as a tool for understanding ecological systems, a similar concept was being developed in the field of human ecology. An offshoot of sociology, human ecology was introduced as a means for investigating the symbiotic relationships within a community of humans. The ecosystem concept was ported over from ecology, particularly from the study of plant communities , to employ many of the spatial and

¹ See Golley (1993) for an excellent historical discussion of the ecosystem concept.

² Including the work of Otis Duncan (1964), Amos Hawley (1950, 1986), and others.

organizational concerns of bio-ecological systems to investigate ways that human populations attempted to sustain their existence in a specific environment. In human ecology, an ecosystem is defined in terms of the units, relations, and functions that comprise it . Units are the entities that exist in the environment under investigation. Relations refer to the interdependencies between the units, while functions are those activities that produce materials, distribute them among the various units, and coordinate the other functions to ensure sustenance and efficiency.

Conceptually, three different senses of the term ‘ecosystem’ have been identified . In the first, ecosystems are defined as a *domain* containing a number of units (or species) that provide a number of functions in support of their existence and those of the units which share the domain of interest. These units must interact with the abiotic, or nonliving, components of the domain and the environment surrounding and encompassing the domain itself. In the second conceptualization, ecosystems exist as a *theory* that describes and explains the flow of matter and energy in these ecosystems . This includes systems modeling and field studies of a specific system in order to analyze the impact of changes in its structure and production. Finally, the term ecosystem refers to a particular *method* of studying the interdependence between a given system and its environment. As such, an ecosystem identifies a particular way of framing these relationships in such a way as to permit a study of the interdependencies and behaviors that result. This conceptual ambiguity has been criticized as a critical problem within the field of Ecology . Without being able to clearly identify and delineate ecosystems based on its characteristics, a research community may struggle in its attempts to craft and operationalize hypothetical relationships in order to make empirical progress.

Clearly, the most common use of the term has revolved around the first conceptualization: a collection of units, the relationships among them, and the functions they

provide and exchange with each other (Hawley 1986), especially in the practitioner literature.

The term has been relatively effective, albeit poorly predefined, for describing the different units that are creating, participating, and servicing a given product or service. However, the second and third conceptualizations are important for researchers in defining the resource flows underlying these ecosystems as well as the method of investigating the system and its interdependencies. Therefore, the current study adopts elements of each of the three meanings of an ecosystem in an attempt to uncover the domain of interest, the flows that sustain it, and the interdependencies that exist as well.

2.1.1 Ecosystems as Units, Relations, and Functions

The characteristics of an ecosystem can be delineated by identifying the members that are included (units), the connections and interdependencies between them (relations), and the actions or behaviors (functions) they perform with respect to each other and their environment. These characteristics are defined further, with examples from open source ecosystems.

Units are those entities that enter into relationships with one another on the basis of the functions they perform. They appear in simple units (individuals) and complex units (combinations of individuals in various forms). The members of each unit are capable of performing distinguishable functions and sustaining relationships.

Open source ecosystems consist of both simple and complex units. Individuals may choose to participate in many different roles, sometimes filling several roles at once. For instance, a single developer may simultaneously be a member of the management team, a core developer, and an end-user of the software being developed. Several roles exist, including management team,³ core developers, partners, sponsors, component developers, and users.

³ In open source ecosystems, there may not be a specific “management” team by name. For the purposes of discussion, we identify those members who have the final say over project direction and specifications as the “management” team, realizing that this is not always a readily identified group.

Many of the relationships within an ecosystem are symbiotic in that the net benefit of their combined productivity exceeds the sum of the individual outputs . For instance, the relationship between the core organization and its partners is often a symbiotic relationship. The core organization provides the platform, while the partners build products and/or services that enable the creation of higher levels of value that are shared by both parties. For example, MComp has established relationships with a network of partners that not only sell its products to a wider range of customers, but also provide a number of services or complementary products that MComp would not have been able to provide. However, the relationship among various members is frequently commensalistic in that each partner's contributions and benefits may have very little impact on the benefits available to the ecosystem, but the individuals in the commensalistic exchange receive the benefits. For instance, two users who share support information are able to benefit from each other's expertise, which may not be useful to the remainder of the community. In some cases, the relationships in an ecosystem could be parasitic, especially when one set of units consumes an abnormally large portion of the benefits (particularly scarce benefits such as financial capital) produced by the members of the system. This occurs if one organization extracts all of a particular type of benefit from the ecosystem, as when the core organization captures the financial benefits without sharing among the other contributors.

A function is any repetitive activity that is reciprocated by another or other repetitive activities, as in an organizational exchange relationship. Functions are identifiable as such where activities have been subdivided and allocated to separate units (Hawley 1986). For instance, the function of a community of software developers is to produce code which the various users are able to utilize. Examples of the functions of the users are to (1) deploy the software, (2)

contribute capital back to the ecosystem, for instance by paying for the software license, (3) offering suggestions to the developers and management team, and (4) offering support to each other.

The stability of an ecosystem rests in part on its degree of closure or completeness. A stable system is conceivably capable of homeostasis when the following conditions are met. First, the functions performed are mutually complementary and sufficient to provide the operating conditions and inputs required by each. Second, a minimum population size is attained for the operation of the system. Third, there are few mobility costs to present barriers to the retrieval and flow of capital throughout the system.

2.1.2 Ecosystems as a Theory of Flow and Equilibrium

By investigating ecosystems in the context of open source software, a systematic view of open source software participation and output will be developed. A preliminary framework based on the Barnard-Simon theory of organizational equilibrium is shown below in Figure 1.

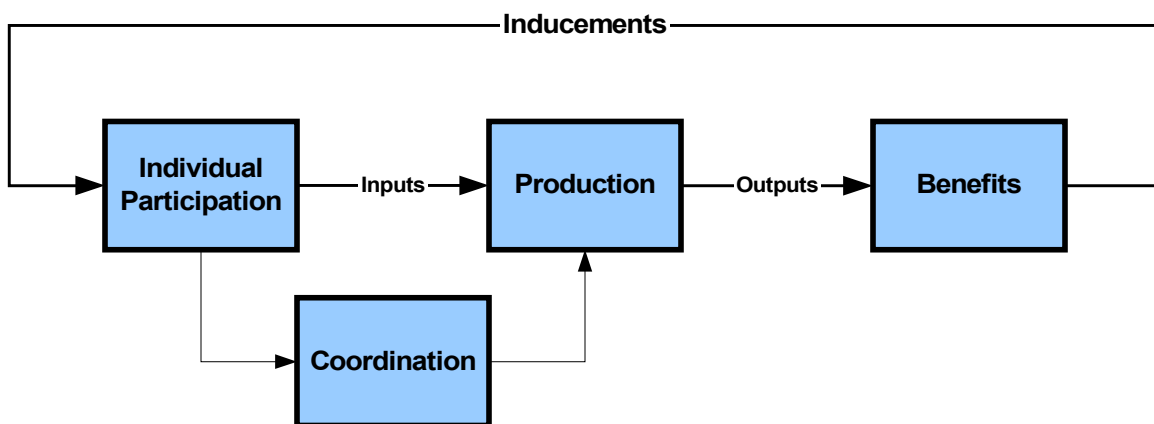


Figure 1: Barnard –Simon Equilibrium

According to Barnard-Simon theory, individuals have goals which they strive to achieve. To do so, it is often best to aggregate into an organization, as it is not often that an individual has

the necessary ability to solve a given complex problem effectively and efficiently. Stated another way, to ‘scratch an itch’ or to satisfy preexisting needs, an individual must find a way to connect with another individual or group of individuals that has the necessary ability to generate the desired outputs. However, these outputs are typically only available as the result of some set of contributions by participants in the ecosystem. These contributions are aggregated and transformed (via a coordinated production function) into a package of outputs that in turn yield benefits to be returned to the participants. If the benefits accumulated by the contributing participants does not exceed the perceived value of their contributions, based on either experience (in the case of continued contributions) or expectations (in the case of initial contributions), there will be less incentive to participate going forward.

From this viewpoint, the purpose of an organization is to combine the contributions of a number of individuals and groups of individuals toward a specific set of aims. The specific material and behavioral outputs of the organization (goods and services) produced by an organization result from the capital contributions and participation of a number of units, as well as the coordination mechanisms necessary to harness them into a coherent package. These outputs result in a number of benefits (in the form of converted capital), which are appropriated by the various participants according to the structure of the organization itself. So long as the participants continue to receive benefits in excess of their perceived cost or effort of participating, the organization will achieve a relative equilibrium and continue to exist. However, once the benefits are no longer sufficient to compensate the participants, the organization will grind to a halt unless an adaptation toward a new equilibrium results.

The flow of capital resources throughout the ecosystem is enabled by a web of exchange relationships. Within the ecosystem, organizational exchange can be defined as “any voluntary

activity between two [or more] organizations [or individuals] which has consequences, actual or anticipated, for the realization of their respective goals and objectives.” The necessary capital elements are acquired from the environment or from previous accumulations and transported to other units through functional activity occurring via direct or indirect relationships with other units. Because these capital resources are scarce (and thus few individual units possess all of the resources they need), ecosystems rely on the existence of generalized social exchange among the contributing units. The units in a generalized social exchange system transfer resources directly to other units or to the system as a whole until each unit has acquired the desired benefits. However these benefits (in the form of acquired resources) are not necessarily provided by the unit to which a contribution is made.

The exact path of this flow depends upon the resources being exchanged and the specific relationships that exist. At different points, several resources are combined to produce specific system outputs. For instance, the contributions of several developers are combined to create a single software module, which in turn is combined with other modules in the design of a software application. This application is licensed to an end user who installs the package along with an add-on module created by another firm. These functional outputs and the capital benefits that result are then used for subsequent exchange with other units in the ecosystem or allowed to pass through to the environment itself.

2.2 Ecosystem Health

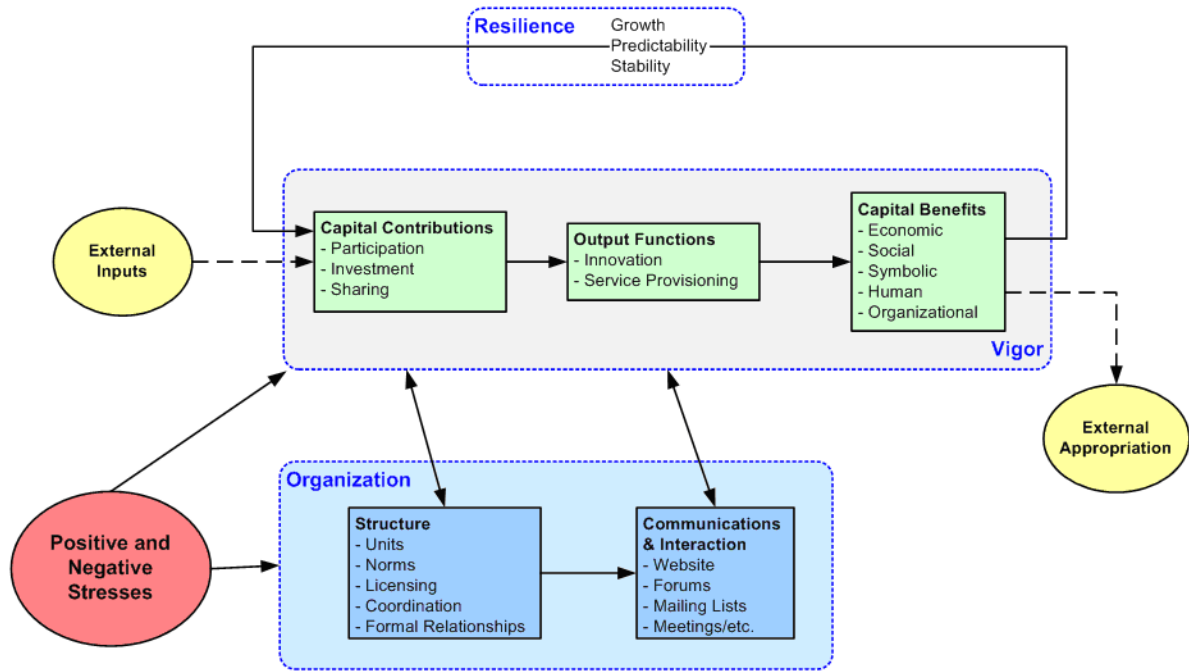


Figure 2: Conceptual Framework of Ecosystem Health

Health denotes both ‘freedom from disease’ and the capacity to achieve reasonable goals or meet needs . Other definitions emphasize health as a condition in which the functions of a given organism or body are duly and efficiently discharged . As discussed earlier, these definitions can be applied to the current context in stating that labeling ecosystems healthy denote not only its soundness but also its capacity for production of functional outcomes and benefits (and the accumulation of these benefits) by contributing members. Thus, the concept of ecosystem health is multidimensional, encompassing aspects such as its organization, vigor, and resilience . Specifically, ecosystem health implies that the ecosystem can maintain its structure (organization) and aggregate function (vigor) in the face of external stress (resilience).⁴ Figure 2

⁴ The terms efficiency, productivity, and durability, respectively, have been conceptualized in human ecology as dimensions of viability, which is a similar concept to health (Hawley 1986).

shows a conceptual framework for ecosystem health and the interaction of these dimensions. We now examine these dimensions in more detail.

2.2.1 Organization

The organization of an ecosystem includes the structure and diversity of units and the interactions between them. Thus, it refers to the ability of the members of the ecosystem to access and accumulate the necessary resources for production and for the satisfaction of their internal needs. The key lies in the capacity of an ecosystem to *efficiently* communicate and transport resources as the members diversify into specialized roles. Theories in human ecology have hypothesized that as the number of units and relations among them increases, the more likely such disorganized systems will attempt to increase the regularity and control of exchanges between these various units in an effort to strengthen the relationships and thus increase the organization of the ecosystem . Less organized ecosystems will have fewer unit types or fewer interactions between them. Conversely, a highly organized ecosystem evolves into an increasingly diverse set of specialists with an equally diverse set of exchange pathways .

In human ecology, the adaptation and development of a social system is considered to be constrained by its ability to communicate and transport resources. As changes in the environment arise, the members of a system form new interdependencies in order to adapt. However, this can only be accomplished to the maximum capacity of the existing exchange relationships . The relationship between productivity and transportation is reciprocal in that the increased ability to transport resources encourages increased production, which in turn strains the ability to transport resources, encouraging the search for additional capacity . This additional capacity is attained either through the increase in population size (i.e. increased number of units) or increased specialization and thus diversity, which increases the efficiency of the system by lowering the

costs of production and transportation of resources. It is this diversity and specialization that affects the health of a system. For those systems in which the costs of communicating and transporting resources among the various members is near the capacity allowed by the existing set of exchange relationships, there is little room for adaptation to new conditions. Diversity and specialization enable the ecosystem to establish more focused interrelations and thus provide the ability to adapt to changing conditions by enacting new exchange pathways to facilitate the continued flow of capital.

Additional efficiencies can be gained by increasing the regularity and strength of the relationships between members of the system. The structure of the relationships within an ecosystem includes the social and operational norms shaping the behavior of the participants, the mechanisms that coordinate the contributions and actions of the participants toward defined goals, and the contractual requirements (or lack thereof). These relationships are carried out through the communication and interactions between the members. These interactions between members are determined by the existence and strength of formal and informal arrangements, norms, intraorganizational structures, and coordination mechanisms. Organized ecosystems are typically characterized by structured, formal, and stable relationships among the units, whereas less organized systems (such as the typical open source software ecosystem) are often highly unstructured, informal, and temporally unstable.

Thus, the first step toward understanding the operation and capital flows in an ecosystem is to identify the units involved, the roles each plays in the functional outputs generated by the organization, and the norms, contracts, licensing arrangements, etc. affecting the relationships between the various roles toward the creation of the necessary functional outputs. An

understanding of the structure and organization of these exchange relationships precedes the investigation of the capital flows and productivity (or vigor) within the ecosystem.

2.2.2 *Vigor*

The purpose of an organization is to combine and coordinate the contributions of a number of individuals and groups of individuals toward specific functional outputs. These contributions as well as the resulting inducements can be classified as different forms of capital, including *social*, *symbolic*, *human*, *organizational*, and *economic* capital. This capital is acquired, converted, combined, and distributed throughout the ecosystem by the units themselves. As such, vigor is the total throughput or productivity of the ecosystem. Similar to the gross domestic product (GDP) as calculated in economics, this consists of the full range of outputs produced by the members of the ecosystem, and the capital resources contributed to produce them. In this section, I discuss the contributions made by the members, the functional outputs, and capital flows that are required to move from contribution to outputs and back to contributions in a feedback loop.

The contributions made by the units of an ecosystem are made in one of three forms. These units may actively *participate* in the actions required to perform a given function. This includes the actual training process itself and other behavioral contributions. Other capital, particularly economic capital, can be made available to the ecosystem via an *investment* or transfer from one unit to another. Other capital is not transferred but simply *shared* or made available to other units, as is the case for many knowledge-based products including organizational and human capital. The source of these contributions can be the capital accumulated in previous cycles of the production process, capital acquired from other previous

activities externally to the ecosystem, or the direct contribution or acquisition from the environment.

The functional outputs produced in software ecosystems include the innovation of software and source code as designed and coded by the developers. It also includes services required by the other members of the ecosystem such as training, installation, testing, maintenance, and support . If done well, these outputs are convertible by the members into their desired capital benefits. For instance, the quality of the source code enables some developers to acquire additional wages (economic capital) or reputation (symbolic capital). The degree to which these benefits meet the needs or expectations of the contributors serves as an inducement for future contributions . Failure to meet these expectations lowers the incentive for continued contributions, reducing contributions and thus the level of vigor (and health), in future periods.

The primary function of capital is to denote the potential to generate future benefits through subsequent participation in the production process . In our model, capital is a medium of exchange and storage that enables a given unit to both contribute to the ecosystem and derive benefits as a result. It is this role as a medium that capital enables the specialization of units within an ecosystem and the interdependence between these units . Each unit's potential for self-production is not typically insufficient for satisfying every need they possess. By exchanging the surplus outputs created as a result of one unit's production for the surplus outputs of another unit, both units may be able to achieve a higher level of satisfaction than if they were strictly producing for their own consumption. As larger numbers of units contribute to the ecosystem, each with different production functions and consumption requirements, a richer set of exchange relationships and capital paths is established to match the increasingly complicated

interdependencies. Thus, ecosystems can be explained via examination of the flows and possession of capital between the various units that compose them.

As discussed earlier, these contributions and inducements can be classified into different types of capital. We have chosen to employ a typology with five types: economic, social, symbolic, human, and organizational capital. In previous research, the notion of capital within a given organization has included several of types in their analysis. Several writers have focused on the relationship between paired types of capital or on the attributes of a single type. Where multiple types of capital were included, one or more of the capital types (most often, symbolic capital) was often omitted from the analysis. We included all five types in an attempt to view a more complete picture of the ecosystem and its activities.

The most common, economic capital consists of financial, physical, and property related assets and is the most commonly recognized form of capital. These assets, particularly financial capital or money, are highly liquid and easily transferred among parties in an exchange. As a medium of exchange, economic capital serves to enable the easy conversion of products and services through its easier conversion into money and its recognizable property rights. Indeed, the vast majority of research in the management and economics disciplines discusses the generation and accumulation of economic assets as both a starting point and a target of business organizations. This view is understandably appropriate, given the ubiquity and near-universality of money and its equivalents.⁵ However, it is not the only capital available for use by an individual or organization. The other types are equally important in identifying the contributions made as well as the desired returns to the individuals and organizations involved in exchange

⁵ De Soto (2000) argues that property rights associated with economic capital are not as prominent outside the economic systems of the Western Hemisphere because of the absence of historical infrastructures which allow third world nations to recognize ownerships and thus convert property into financial wealth. As such, economic capital may not be universally recognized or convertible.

relationships. The capital structures or capital profiles which exist in an organization are influential in providing for the activities necessary for responding to changes in its environment or practices. Without considering the broad spectrum of capital being exchanged and created, researchers will result in an oversimplified, incomplete view into the structures, processes, and mechanisms that are available to the ecosystem. In this section, I will take a closer look at these other capital types.

Table 1: Capital Typology

Capital	Definition
<i>Economic</i>	Includes financial, physical, and manufactured capital resources.
<i>Social</i>	The ability of an individual or group to capitalize on the social connections that are available; includes structural, cognitive, and relational dimensions (Nahapiet and Ghoshal 1998). (See also: Adler & Kwon, 2002; Bourdieu, 1985; Coleman, 1988; Lin, 2001; Nahapiet & Ghoshal, 1998)
<i>Symbolic</i>	The amount of honor or prestige possessed within a given social structure; includes aspects such as reputation, legitimacy, authority, status, and rank (Bourdieu 1985).
<i>Human</i>	Skills, knowledge, and abilities of an individual that can be used to generate income or other useful outputs (Becker, 1993).
<i>Organizational</i>	Institutionalized knowledge and codified experience stored in databases, routines, patents, manuals, structures, etc.; essentially, the knowledge, skills, and information that stays behind when an organization's people go home at night. (Youndt, Subramanian, and Snell 2004)

Social capital has many different definitions, often depending on the context of the research. A recent comprehensive definition is as follows:

Social capital is the goodwill available to individuals or groups. Its source lies in the structure and content of the actor's social relations. Its effect flow from the information, influence, and solidarity it makes available to the actor."

In essence, social capital refers to the ability of an individual or organization to capitalize on the connections that exist because of the network of relationships a person has within their social structures. Social capital also denotes the characteristics of norms, trust, ties, and reciprocity that occur within these relationships. In business ecosystems, individuals and organizations are able to capitalize on their social standing to generate other more useful forms of capital. keystones are units that occupy key functional roles for the survivability of the entire ecosystem. In occupying these highly significant roles, keystones are typically able to appropriate increased levels of benefits as compensation. In particular, units that are responsible for the acquisition and transportation of resources from the boundaries of the social system are more likely to become keystones (Spencer, as discussed in Turner, Beeghley, and Powers 2002). Methods for exercising social capital include occupying these keystone roles in a social system, sharing information and materials with other units, and establishing new relationships with other influential members of the ecosystem or adjacent ones.

Bourdieu describes symbolic capital as the amount of honor or prestige that a person possesses within a given social structure (Bourdieu 1977). This prestige is typically not a self-referent concept, but one that requires external legitimization and can include such aspects as reputation, authority, legitimized competence (i.e. degrees or certification), titles, etc. Symbolic capital can be attained through the exchanges one has with other members of the social structure. Conversely to economic capital, the more one ‘gives away’, the more symbolic capital one accumulates in the form of prestige, status, and reputation. Thus, units that give away more software or that provide more services often have higher perceived status in a given social system. For instance, people in open source communities that contribute more code to the

community (without financial compensation) are afforded increased reputations and status, thus increasing their symbolic capital. Thus, the tendency for open source communities to recognize and acknowledge past and current contributors reinforces the symbolic capital that is available by the individual contributors and the communities themselves.

Human capital consists of internal resources that a person is capable of using for their production and benefit (Husz, 1998). Included in this concept are an individual's skills, knowledge, health, and values . Human capital is acquired by the training, experience, and knowledge search of individuals. Because of its internalized nature, the individual cannot acquire human capital as an end-product, but most often must actively participate in its creation (Ben-Porath, 1997) These assets are deployed in the production process by means of the individual efforts of the members of the ecosystem. The aggregate possession and exercise of these efforts on an organizational level is typically defined as *intellectual capital* , which are subsumed under the concept of human capital for parsimony's sake. Open source ecosystems allow participants the ability to increase their skills and knowledge through a variety of activities. Most notably, developers are able to learn from existing source code and submit their code to a peer-reviewed process that is generally supportive of learning endeavors . The norms of openness among open source firms allows for an easier way of accessing the source code and knowledgeable developers to assist new developers in their self-education and training efforts.

Organizational capital consists of the institutionalized knowledge and codified experiences that are owned by an organization. It has been described as the “knowledge, skills, and information that stay behind when an organization's people go home at night” . Organizational capital is stored in the databases, manuals, routines, systems, cultures, patents, and structures that an organization uses to accumulate, retain, and distribute knowledge. This

capital is often created and developed from human capital through the execution of repetitive activities or structured experiences . The codified structure and routines that result are often considered an intangible or tacit resource, which could potentially lead to a strategic advantage . Organizational capital differs from human capital in that it resides within the organization itself, not in the individuals themselves. It also differs in that it is much more difficult to transfer between units, instead remaining within and unique to the organization.

Once it is contributed or made available within an ecosystem, capital can be converted between types to satisfy the needs of specific units, albeit with varying difficulty . For instance, organizational capital is more difficult to convert between units than economic capital. As an example, users who work on shared documentation (e.g. Wiki pages) regarding the results of their efforts at installing and using a given piece of software are essentially converting their human capital into organizational capital for the ecosystem. Alternatively, the existence of this capital can influence subsequent contributions by other members. The reputation of developers or other prominent members of an ecosystem (symbolic capital) can be significant toward attracting both venture capital funds (economic capital) and the services of other contributors (human capital).

They also possess differing depreciation, consequences, or friction due to disuse. For instance, the value of human capital diminishes over time as the specific skills or knowledge achieve disutility due to increases in the general knowledge within a field or just plain “forgetting.” Without efforts to increase one’s experiences and knowledge, the current level of human capital will eventually become miniscule. Thus our model of ecosystems and ecosystem health must explain the effect of both sudden and gradual stresses on the storage and flow of these capital types in the ecosystem.

2.2.3 Resilience

The resilience of an ecosystem is its “ability to maintain vigor and organization in the presence of stress” . In other words, a resilient system maintains its exchange relationships in order to continue producing outputs following perturbations to the entire system or individual units. As originally conceived in the ecological literature, resilience refers to the persistence of relationships and the ability of a system to exist even if there are changes in the equilibrium of the system . Specifically, ecological resilience is measured by determining the amount of stress that an ecosystem can absorb before changing its structure and processes . This differs from stability (also called engineering resilience), which refers to the ability of a system to return to the preceding equilibrium state following a disturbance .

For business ecosystems, resilience refers to the ability of the individual and organizational members to successfully adapt to extenuating circumstances , including both the ability to resist the effects of stress (or stability) as well as the ability to recover from any ill effects that may result . As resilience is defined above, the ecosystem may not return to its exact structure or level of output after the stress, but may have to establish a new pattern to adapt to the changing environment.

In some respects, stability and resilience can be considered as distinct levels or phases in the management of resilient systems, where resilience is tested after stability fails. In response to a stress or a disturbance in the existing equilibrium of an ecosystem, the members have three responses available . First, the members can do nothing, expecting the stress to be short lived and the system to return to normal. Second, the members can strive for stability in an attempt to adjust the parameters of the system to return to a desired state. Third, the members can accede to the need for resilience over stability and adapt to the new conditions or the new environment to create a wholly new equilibrium. Often, these systems are either unable to perceive that a change

in their internal structure or environmental conditions is about to occur (or is occurring) or unwilling to accept the strategic and operational changes that successful adaptation would entail . In much the same way, civilizations such as the Roman Empire were able to resist certain stresses and recover from yet others, but ultimately collapsed in the presence of others . Thus, resilience requires not only the *ability* to react (or adaptive capacity – (Gunderson, 2000)), but the ability to *perceive* the need for change or adaptation often before it is necessary . One model of organizational adaptation to environmental jolts is comprised of three phases: anticipating the stress or jolt, responding to the jolt, and readjusting to the new environmental and internal conditions .

Ecologists describe the process for succession from one ecosystem state to another as a four phase process . The exploitative phase is marked by the rapid colonization into a new area, complete with a high degree of competition. This is followed by a mature or conservative phase with slower growth and less competition as the emphasis is on the accumulation and storage of resources and capital. This is followed by a period of release or “creative destruction,” a term Holling(1993) borrowed from Schumpeter (cf. Elliott, 1980), in which the stored up capital is released following a disturbance such as fire, pests, or storm. Finally, the system renews itself by redistributing resources in a reorganization phase, which serves as a prelude to the ensuing exploitation phase that starts the cycle anew. This cycle parallels processes described for both ecological and societal (including organizational) systems to react to disturbances. In particular, this resembles processes described in organizational literature, such as the “innovator’s dilemma” and product life cycle models in which the growth phase of a particular product or organization is followed by a period of maturity or stability and a period of decline or revival .

The latter two phases, release and reorganization, are keys to an ecosystem's resilience. The stresses that occur in the release phase enable the capital, structures, and processes that have been produced and retained by the constituent units of the ecosystem to be destabilized and made available in the reorganization phase for the formation of a new equilibrium state that better fits the new conditions. The organizational literature proposes that these jolts may be an opportunity to liberate resources , encourage organizational learning, introduce major process and structural changes, and destabilize power structures .

We define the stresses to be the stimulus that is applied in a given event, particularly those that are sufficient to encourage a reaction from the members of the ecosystem. It is these stresses and the resulting actions by members of the ecosystem that are the unit of analysis for this research. The specific stresses that each ecosystem encounters may differ from one ecosystem to another. These differences can be classified into two dimensions for comparative purposes: source and impact. Source classifies the origin of the event trigger as either the exogenous environment in which the ecosystem operates (such as increased competitive activity) or endogenous changes within the ecosystem itself (such as diminished capital contributions by key members). The second dimension identifies the polar outcome of the stress, which may be positive or negative ("eustresses" or "distresses") with respect to its effect on ecosystem health. For instance, the increased capital that results from an infusion of venture capital may be beneficial with respect to the needs of the employees and investors, whereas the departure or forking of the core development team would be detrimental to the development of code. It is important to note that just as events such as forest fires or spring floods may be necessary events for the health of biological ecosystems , organizational distresses may play an equally pivotal role in the long-term survivability of an business ecosystem . In the preceding example, the

forking of the core development team may lead to additional diversity and productivity in an ecosystem as the two distinct teams generate compatible functions.

A more detailed example of the effects of a negative stress-inducing event (distress) can be seen in the monthly download history of the MComp Application Server (Figure 3). When the MComp codebase was forked in mid-2003, the community experienced a dramatic drop in the number of downloads made via SourceForge. One possible interpretation of this event is that the loss of key developers caused a drop in the *human capital* available in this ecosystem.⁶ Alternatively, the very public nature of the split lowered the legitimacy or status of the software, which is a decrease in the *symbolic capital* of MComp' ecosystem. Finally, the departure and resulting accusations and threats altered the levels of trust and social cohesion, or *social capital*, in the ecosystem.

Since late 2003, the company has been able to recover through continuous innovation of its flagship product, acquisition of several other OSS middleware projects, hiring of key managerial personnel, signing of numerous partners (including Compugiant, Dell, and Microsoft), and receipt of venture capital funding . With the changes in its environment, such as the sponsorship by BigWare of a key OSS rival (CWare), and the recent acquisition of MComp by OpenSoft, it remains to be seen if the peak level of average downloads (reached in May 2003) can be achieved in the near future, despite the impressive, albeit gradual recovery that has taken place since late 2003.

⁶ In an earlier interview, Thomas Smith has described the departed developers as 'B' players who were insignificant with respect to the code base upon which MComp AS is built.

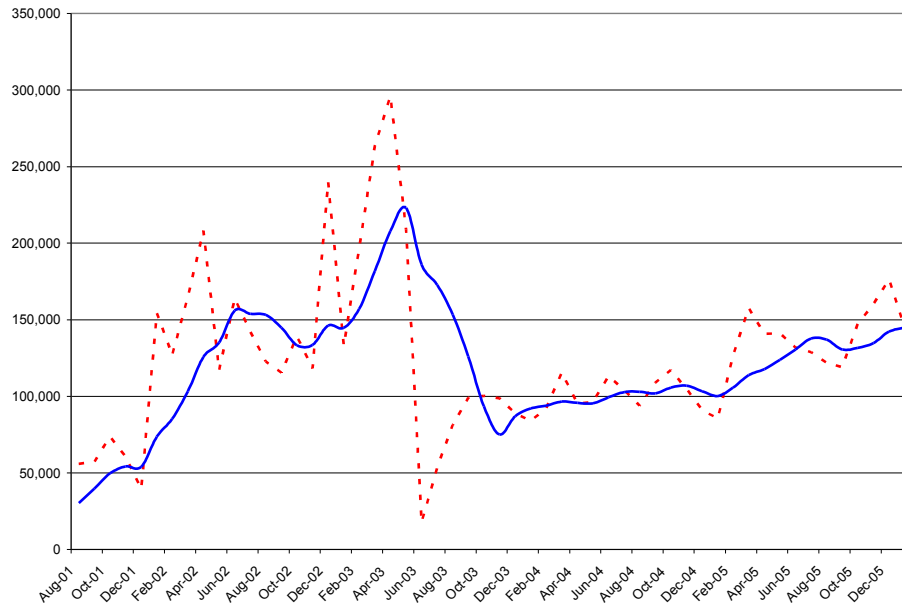


Figure 3: MComp Download History by Month (with smoothed average)

In summary, the ability of an ecosystem to continue to exist depends on its ability to maintain a web of relationships between a diverse base of units (organization) to produce a useful set of outputs (vigor), while resisting the effects of stresses which act to disrupt it (stability) or adapting to the changing conditions (resilience) in an effort to survive. In other words, the health of an ecosystem is a key factor in its survival.

2.3 Competing Frameworks

Several examples of the ecosystem metaphor exist in organizational theory literature, including several specific applications from the software industry. Other similar concepts include networks, value webs, stakeholder theory, and collective strategies, several of which I examine later in this section.

2.3.1 Business Ecosystems

Several organizational researchers have called upon an ecosystem metaphor to illustrate their research. In this section, we identify several of these researchers' use of the concept and their findings.

Iansiti and Levien focus on the strategic management of different members in an ecosystem, especially the keystone, defined as the dominant member of the ecosystem. The goal is the creation of a network of partners that enable the keystone to satisfy its business goals, while enabling the partners to thrive in their specific niches as well. As conceived in this framework, health is defined as the collective productivity of the members (as measured by product releases and net financial performance), the creation of different niches and specializations satisfied by an increasing number of suppliers and vendors, and the rate of survival of these members (similarly to Hannan and Freeman(1977)'s population ecology studies). The conceptualization of ecosystem health proposed in the present study focuses on a wider range of capital needs than simply economic capital.

Moore defines an ecosystem as "an economic community of interacting organizations and individuals – the organisms of the business world." Further, he states that these organisms "co-evolve capabilities around a new innovation." Moore emphasizes the cooperative strategies within the ecosystem, stressing the role of the core organization in creating an environment in which the organizations and individuals can satisfy their needs. This includes the creation of a market for products, a supply chain establishment, and the necessary coordinating infrastructure.

Bidwell and Kasarda discuss the ecosystem concept as directly applied from human ecology (particularly the writings of Amos Hawley) in an attempt to explain the resulting structure of an inter-organizational system. They also include the flows of resources among these members as a dependent variable resulting from the processes of population selection, population

increases, structure, and environmental change. In turn, these flows affect the structure and population selection in subsequent cycles in the community's existence. The resources they consider are restricted to technology, labor, and materials as direct resources along with money and product demand as indirect resources.

Messerschmitt & Szyperski focus specifically on the software industry and the various components necessary to provide functionality for end users and organizations alike. These components include developers, commercial firms, distributors, universities, and regulatory bodies. There is no summarizing definition for a software ecosystem in the book, but the reader can infer that the emphasis is on the specific functions and contributions provided by each member, including the obvious functions of development and revenues as well as the less obvious parts such as regulatory requirements, academic research, and more.

Adomavicius, et al considers the relationships among innovations and products within a given technological ecosystem. Their framework divides an ecosystem into three layers that revolve around the components, products and applications, and support infrastructure. Innovations in each layer affect subsequent technologies in each layer. Thus the innovation patterns in an ecosystem can be defined according to the key drivers, such as advancing capability of component makers leading to better products, increasing needs by consumer applications driving innovation at the component layer. We contend that the focus on technologies omits the influences wrought on the process by the social practices and relationships of the organizations in an ecosystem.

These characterizations of business and technological ecosystems resemble the conceptual framework presented in this research in several ways. For professional OS, there is little difference between the keystones of Iansiti & Levien and the corporation at the center of an

POS ecosystem (i.e. MComp, Inc.). These units attempt to control the flow of capital within the ecosystem to ensure that they are able to acquire their desired level of profitability and value appropriation. For these organizations, the strategic implications of these core organizations are well discussed in the studies above. The interaction between the community members and the environment is addressed in nearly every study; however, the precise delineation of internal vs. environmental boundaries is unclear because of the completely open nature of these communities.

However, there are several key differences between the ecosystem concept applied here and similar concepts from the organizational research mentioned above. Our conceptualization places more emphasis on the end users as active members of the ecosystem. This is especially true of many open source software ecosystems since they rely heavily on these external contributions to provide a number of services that are not provided by a single vendor. Also, the framework presented here considers more than simply economic capital. Instead, the ecosystem model examines the flows and contributions of several other types of capital within the ecosystem, which were discussed more in the ecosystem health section of this research.

2.3.2 Network organizations

A network is characterized by an “interconnected group or chain of retailers, businesses, or other organizations” . Comparatively, a system denotes a set of interacting elements “forming a connected or complex whole” with reference to the operations or interactions they involve. The difference is in the formation of a whole, compared to simply the uncoordinated interconnection of the various parts acting independently. A network implies that the units act of their own accord, albeit with the help or assistance of other units. In an ecosystem, the individuals and units are interdependent upon each other for their operations, despite their

separate autonomy. Certain functions, which may be performed by one or more units, are necessary in order for the desired benefits to be created and made available to the ecosystem.

In organizational research, network organizations are “characterized by repetitive exchanges among semi-autonomous organizations that rely on trust and embedded social relationships to protect transactions and reduce their costs” . This repetitive exchange and relative autonomy differentiates them from markets and hierarchies, categorizing them as a form of hybrid organization along with strategic alliances, joint ventures, franchises, outsourcing arrangements, and others . Network firms are also able to alleviate resource uncertainties by capitalizing on these social relationships in order to strengthen ties to particular sources of dependence .

In addition to their social relationships, network organizations often contain elements such as cospecialized or joint-owned assets (including less tangible ones such as expertise and knowledge), joint control and decision making, and a collective purpose . These elements enable networked firms to capture other benefits, such as learning, legitimation and status, and economic benefits from cost and quality . Other common themes include cooperation, trust, and market orientation .

As in many ecosystems, networks often have a central firm that acts as an intermediary between the resource suppliers and customers demanding the collective goods and services . These firms essentially manage the flows of information and goods through a temporary set of relationships in order to satisfy this demand and collect a fee for their services . This requires a highly flexible but interconnected structure with known parts and some elements of central control in order to satisfy the necessary market demands.

Ecosystems and network organizations share several similarities, including their focus on repetitive transactions, distributed production, and distributed decision-making. Thus, it is reasonable to consider an ecosystem as a type of network organization. However, there are several differences that result in different emphasis for research and practice. The units in an ecosystem are comprised of a wide range of individuals and organizations, including the contributions of more peripheral units. Thus, a wider range of units is usually studied for ecosystems than for networks. Also, the units in an ecosystem combine functions to generate more interdependent and unified functional outputs than those of networks. This unified functionality is more similar to that of a hierarchical structure, albeit without the centralized control structures.

2.3.3 Other theories

Other theories have been proposed to discuss organizational structures and relationships similar to the one considered here, including alliance constellations and value webs, stakeholder theory, collective strategies, and others. In this section, several of these are briefly discussed.

A constellation consists of a set of firms linked together through alliances, which in turn are agreements between two or more organizations to share resources, decision-making, and profits . This concept has also been described as a value web . While similar to an ecosystem in many respects, the constellation as theorized is a designed network, as opposed to the largely ad hoc nature of ecosystems proposed in the current research, especially for open source software ecosystems. This line of research has focused on the extended set of resources available to the constellation compared to the individual firm as a way of applying frameworks such as the Resource-Based View of the firm to interorganizational systems . Other research has focused on the performance advantages created by these alliances and returned to individual firms, the

formation of these alliances, and the governance structures that are employed . However, there has been little research attempting to develop theory that identifies the factors which mitigate the risks of alliance failures , which is addressed in the current research.

Collective strategy refers to “the joint mobilization of resources and formulation of action within collectivities of organizations” . Similarly to the current research, collective strategy is based on research from both human ecology (particularly Hawley) and bioecology. However, its focus is on a systematic formulation of joint policies and strategies, along with coordinated actions, by the organizations in a given collective , as opposed to a more emergent responses. According to this research, the types of collectives (and thus, the types of strategies available) can be classified according to two dimensions: the direct or indirect nature of the associations between units and the commensalistic or symbiotic interdependence between the units. This yields four types of collectives, denoted as confederate, conjugate, agglomerate, and organic . The current research contends that there are rarely such clear-cut distinctions in the set of relationships within an ecosystem. For many of these relationships, direct relationships exist; however, other relationships may be more indirect. Similarly, commensalistic and symbiotic relationships exist, especially as the ecosystem boundaries are expanded to include a broader range of participants. Additionally, collective strategy is focused mostly on the ways in which organizations work together, as opposed to addressing each organization’s need for autonomy or the conflict which arise between the two . The rationale is to increase the predictability each organization faces by decreasing the possible changes and thus the decision-making uncertainty within the ecosystem . As such, collective strategy is more of a tool for maintaining stability rather than encouraging resiliency. As the current state becomes less tenable, collective strategies may lead to irreversible damage that forces the ecosystem into a significantly different state,

which requires a new set of negotiated relationships to be developed (much like the reorganization phase theorized by Holling in regards to bioecological systems). Finally, collective strategy research offers no means of assessing and measuring the health of the collective set of organizations.

Stakeholder theory emphasizes the responsibility that an organization has for not only the stockholders, but the various individuals and organizations that “can affect or is affected by the achievement of the activities of an organization” . In so doing, an organization’s leaders can better ensure their ability to survive and thrive over time. Since Freeman’s book was published, this concept has been hijacked to focus largely on social responsibilities, however it was not written solely for this purpose. Subsequent research has focused on the identification of stakeholders as well as their importance to the firm in terms of the power each possesses, the legitimacy of their claims, and the urgency with which the firm must address these claims . Although the current research shares a broad view of constituency , the primary focus of stakeholder theory is on the relationships the various individuals and groups have with a powerful central firm to the exclusion of relationships that may exist between them without the firm being involved.

Finally, virtual organizations are goal-oriented enterprises operating under a centrally controlled ‘metamanagement’, which consists of analyzing, tracking, assigning, and adjusting the resources required to satisfy the desired goals . The key value of virtual organizations as conceived by Mowshowitz and others is the ability to systematically and flexibly switch to other suppliers with whom a firm has relationships in order to capture cost, reliability, or other advantages .

What these other organizational and strategic theories have in common is the recognition that a firm is not an isolated entity that is capable of enacting its own success of its own accord. Instead, it must depend on a number of relationships or alliances with other organizations or individuals in order to achieve its desired goals. However, these theories differ in several ways, including the degree to which the firm has the power and control to direct the actions of the set of relationships. Virtual organizations and stakeholder theory tend toward a largely hierarchical arrangement with a powerful firm at the helm. On the other hand, collective strategies and alliance constellations imply a more shared decision-making approach. Owing largely to their roots in the management literature, most have a focus on the operational and especially strategic management of firms within the ecosystem. However, none of these theories explicitly defines the nature of the flow between constituents in these arrangements or the assessment of their health or sustainability.

2.4 Open Source Software Ecosystems

Open source organizations have been described by several different terms, with the most common being a community or bazaar. The term ‘bazaar’ was introduced by Eric Raymond to describe the “different agendas and approaches” held by the various contributors to early OSS projects such as Linux . The term suggests a busy, chaotic market in which various goods are exchanged, as opposed to the orderly and structured process of building a cathedral. Raymond’s focus was largely on the exchanges of code and ideas among the developer and user base, which was appropriate given the structure of OSS projects in the early days. Recent researchers have recharacterized bazaars as a form of hybrid governance among the sponsors and adopters of open source products, which is held to be distinct from markets, hierarchies, and networks .

The most common term used in reference to open source software has been community, which is often used synonymously with bazaar in the open source literature , but is defined as a hierarchically lower structure in ecology literature . Among OSS researchers, community typically denotes those contributors and users that are involved in the creation of code and structures for OSS projects. These authors typically rely on the direct application of the virtual community definition, with very few actually defining OSS communities distinctly. The specific implementation of the term depends upon the author's intentions, with many focusing primarily on the development of code (often exclusively so), new member attraction, and community development concerns .

There are obvious similarities between bazaars, communities, and ecosystems in open source ecosystems. Raymond observed that Linux “behaves in many respects like a free market or an ecology, a collection of selfish agents attempting to maximize utility which in the process produces a self-correcting spontaneous order more elaborate and efficient than any amount of central planning could have achieved” . However, I continue to use the term ‘ecosystem’ to further explore the metaphoric uses of the term, especially in the context of health.

In this section, I will discuss the application of the ecosystem metaphor to business ecosystems, especially open source software ecosystems. We begin by discussing the units involved, the relationships between them, and the functions they generate. Then, I show how these are combined in a dynamic flow of resources throughout the ecosystem.

Within OS ecosystems, the participating units occupy several different roles. Typologies in prior research focus on the development and innovation functions and include as many as eight specific roles, including bug fixer, code reader, and more . The relationship between the roles has been described as “onion-like” with the administrators at the core, developers

encompassing them, and users at the outermost extreme. This reflects the common perception of developers as advanced users that have taken a more active role, which is not necessarily the case. For many communities, the relationship is best described as a series of overlapping circles similar to a Venn diagram in which some members are administrators but not developers, and some are developers but not users (and vice versa). For example, the corporate structure of MComp, Inc. includes a CFO, VP of Sales and Marketing, and other non-technical positions that have few if any coding responsibilities.⁷ The Utopian Foundation, by comparison, only allows ascension to higher roles via merit earned via contributions, typically code contributed to a specific project.⁸ However, this framework of roles fails to account for the many other units within the typical OSS ecosystem, especially ‘professional’ open source ecosystems. This set of roles focuses exclusively on the internal operations of the firm, especially those involved in software development processes, instead of a more complete view of the ecosystem.

The contributions by these units must be coordinated in order to achieve the desired outputs. This coordination arises from structural elements such as norms, licensing, and contractual relationships, as well as the interaction between the units themselves. All OS communities are subject to universal open source norms such as reciprocity, meritocracy, reputation, and sharing . In addition, the products they create are bound by the specific open source license under which they operate,⁹ which constrains the operations of both technical and managerial layers.

⁷ Not that the persons occupying the positions are incapable of technical contributions.

⁸ There is no specific restriction that disallows members who contribute consistently to documentation or other efforts from being granted committer rights. However, they are less likely to progress much further due to the technical responsibilities of the project managers.

⁹ This is typically either BSD and GPL licenses or derivatives. In depth discussion of license restrictions is necessarily broad beyond the immediate scope of this paper.

Interaction in OSS ecosystems occurs via several different communications media, depending on the specifics of the relationship between units, the specific business model within the ecosystem, and the level of interdependence required to perform the desired actions. Communications with peripheral members is often handled using a more asynchronous, publicly accessible media, such as message boards, mailing lists, and knowledge bases. This enables these communications to be shared with a wider range of individuals in a shorter amount of time. Coordination efforts among more interdependent units (such as development teams and central management teams) more often occurs via real-time communications media such as Internet relay chat channels, direct email, or in the case of proximate units and centrally located teams, face-to-face meetings. Where media such as mailing lists are employed, these teams tend to establish restricted communications channels to isolate their communications from the rest of the ecosystem.

The capital contributions required to produce the software products, support services, and distribution functions in OSS ecosystems are largely voluntary, even in the most hierarchically ordered ones. The software is typically developed by a completely volunteer staff, with more respected members assuming responsibility for the direction of the project. Support is provided by the developers and users themselves. In professional open source ecosystems, both development and support may be provided by employed or contractually bound units. Even in these cases, there is typically an increasing number of external users who provide bug fixes, feature requests, complementary modules, technical support, documentation, and other goods and services for usage by other members of the ecosystem. In so doing, many of the participants are able to satisfy their personal motivations, including current and future wages, social ties,

increased technical knowledge, and localized reputation. Thus, the contributions provided by these individuals and organizations are vehicles for the attainment of capital returns.

As OSS organizations take on new stakeholders with different skills and different needs, the increases in complexity necessitate changes in the coordination mechanisms and structure required to maintain the stability and productivity of the organization. In a previous paper, I have proposed that these organizations grow in four distinct stages . In the introduction phase, the typical OSS project is quite small, often consisting of 1-2 developers who decide to create an application to satisfy a personal need or to fork an existing product following a disagreement. Because of the small size, there is little formal structure, division of labor or specialization needed or incorporated at this point. Instead, the members tend to assume whatever role is needed at a given point. The vast majority of the code development, documentation (if it exists), user support, etc. is handled by the same 1-2 developers. Many projects never leave this stage, instead operating indefinitely without much further expansion . As users begin to take notice of the products created by the original founders, the project enters the growth phase. At this point, different members join the ecosystem in order to help with various subtasks and projects in return for some compensation. As these additional members join the ecosystem, specialization is necessary in order for these tasks to be productively combined to meet the ecosystem goals. The founders must create structures and processes to communicate their wishes to the new members as well as to enable the members to communicate task information directly among themselves. The organization begins to standardize many of the repetitive, routine tasks such as code contribution (i.e. via Concurrent Versions System or CVS), user support requests (separated mailing lists or discussion board). This increases the amount of certain information processing capacity of the organization. At the same time, these additional tools allow those units who are

involved in a certain portion of the community to filter the information that is unneeded at a given point. For example, end user support requests are restricted to a particular forum, freeing the developers from being directly exposed to these messages.

The maturity phase represents the largest of OSS organizations. At this point, participants and stakeholders may number into the thousands. There may be multiple products and multiple versions of each. Because of the very large size of these organizations, communications and coordination via rich media becomes nearly impossible. To accommodate this large size, the structure becomes highly standardized, including nearly all communications within the organization. Additionally, smaller subgroups form around specific functions and/or roles, especially in larger ecosystems.

Because of the high degree of differentiation among the participants, the maturity stage is perhaps the zenith of the organization's range of products and services offered. In order to satisfy a wide range of benefits by participants as well as instrumental needs by end-users, additional versions and releases of the core products are released as well as more customized, user-focused services offerings. The institutional layer becomes especially formalized and structured. The managerial layer also becomes somewhat more structured (mostly as a result of edicts by the institutional layer). The technical layer is still not as structured, mainly because of the uncertain nature of participation in this layer. In an effort to reduce the participatory uncertainty, many mature organizations attempt to "hire" their top developers, better ensuring their contributions to the organization. The product and service offerings become more formal as well in order to standardize the contributions made to them and the delivery methods needed to distribute them to the end users. Software from organizations at this stage is highly modularized in order to

minimize the disruptions resulting from the contributions of a large, interdependent, yet disconnected participant base.

In the declining stages of the organization, an inability to satisfy the capital requirements of participants leads to falling membership, which decreases the amount of specialization that is possible. As given specialist units either abandon the organization or are sharply reduced in numbers, their effectiveness is reduced as well making them far less likely to continue to exist. The prime objective of the remaining institutional layer is the adaptation and survival of the organization in the current environment. If it is able to find a way to adapt, the organization will survive if not enter a revival phase. The formal coordination mechanisms and structures of the preceding stages exist but are difficult to administer due to the smaller size of the organization. As a result, the organization becomes somewhat less formal despite the existence of the same mechanisms as before.

Change is not restricted to these evolutionary changes. In the past, open source organizations have taken on sponsors or been taken on by sponsors, either directly or indirectly. IBM and other companies are direct supporters of various open source communities. Specifically, IBM has donated legal services, source code, and manpower to the Utopian Software Foundation. Other firms have provided indirect support by hiring and compensating developers for their participation in a given community. IBM provides this level of support as well by funding developers to work on Utopian and Linux projects. The code developed by these developers is donated back to the community for usage by other developers according to the mandates of the specific license used. Also, open source organizations such as MComp have pursued and received venture capital funding while others have incorporated and become for-profit firms (e.g. MySQL). Finally, several corporations have converted their core businesses to

open source based enterprises, such as RealNetworks, who converted much of its software into the open source product Helix.

The addition of formal sponsorship arrangements changes the community in several ways. First, direct sponsorship introduces new values and norms at the institutional level in order to satisfy the desired benefits to the sponsoring organization. Second, indirect sponsorship affects the organization by adding a mediator between the outputs of the community and the desired benefits of a sponsored participant. For instance, the IBM developers who contribute code and time to Utopian do so at least partially in order to receive financial compensation directly from IBM, who receives the business benefits from Utopian in return. If IBM pulls its support (by cutting compensation from these once-sponsored developers), it can be safely assumed that these developers would be less inclined to work on this project.¹⁰ Third, new direct sponsorship often changes the manifest goals or business model of the organization. An open source organization that accepts venture capital finds itself “answering to” a different set of constituents that may have different set of goals and values that affect the outputs of the institutional level and result in changes in the coordination of the firm. Fourth and finally, the sponsorship may come with changes in the balance of benefit requirements that the firm creates. For instance, taking on a sponsor who expects to receive some degree of economic benefit from its participation will lead to a focus on economic benefits and not the original symbolic capital (for example). This change in the goals or domain of the organization will likely affect the continued participation of existing and potential participants.

¹⁰ A similar situation occurred in the open source world when Great Bridge hired several key developers from the PostgreSQL database project. When Great Bridge ceased operations less than 16 months after starting up. These same developers were suddenly unemployed, temporarily crippling the development process of the community.

However, this change in sponsorship results in a more stable base of participants of the firm by reducing the uncertainty surrounding their attainment of personally valuable benefits. This reduced uncertainty in turn allows these stable participants to take advantage of more formal, personal forms of coordination (such as face-to-face communications) that are less likely among participants or communities without sponsoring. Note that this generally applies only to higher levels of the organization, as users are not typically beneficiaries of a sponsorship initiative.

There are other changes worth mentioning here. Some organizations have changed their business model from a purely open source to a dual license model that allows them to extract licensing revenues while remaining open source. Other firms have begun to charge for services and revenues, which also changes the balance of benefits and ultimately the participation levels within the organization. These changes will attract or repel current and potential participants based specifically on the fit between the model and their capital needs.

These changes, both evolutionary and revolutionary, alter the structure, relationships, and productivity within an ecosystem in response to both positive and negative events (or stresses). As these changes occur, the units must alter their exchange relationships, behaviors, and responses in order to adapt to these new conditions. Even if the changes are restricted to a few units of the ecosystem originally, the adaptive response of these units may ripple through the ecosystem as other units must adjust to the altered contributions and expected returns. By uncovering the mechanisms that units in thriving ecosystems have enacted in response to these stresses, practitioners and researchers can establish baseline a framework for understanding the formation and maintenance of ecosystem health among open source ecosystems.

2.5 Research Questions

This research examines the health of professional OSS ecosystems using a case study methodology. Specifically, the study will identify the generative mechanisms that influence the ability of these ecosystems to survive despite the myriad stresses they experience. Professional OSS firms exist for the purpose of generating profits for their investors and employees, typically via a combination of commercial licensing, paid support, and education. Because of their clear value proposition, the quality of their products and services, and their recent gains in the software industry, these firms and their ecosystems will likely be an increasingly significant part of the IS deployments of the future , making them an ideal context for investigation. The application of this research will enable researchers and practitioners to further understand and evaluate the sustainability of open source ecosystems. The research questions to be addressed are as follows:

1. What mechanisms does an OSS ecosystem employ to respond to stresses in an attempt to remain healthy (and thus survive)?
2. How are these mechanisms, and thus the health of OSS ecosystems, developed over time?

3.0: METHODOLOGY

3.1 Philosophical Foundation

In this research, we adopted a philosophical position based on the principles of realism . Realism is a philosophical paradigm based on the writings of Roy Bhaskar . Ontologically, realism asserts that the world exists independently of our ability to perceive it. Epistemologically, realism holds that we can only achieve a fallible, incomplete perception of knowledge. As such, we must admit that knowledge is at least partly dependent on our interactions within social systems, which parallel the natural systems in which objects actually exist. This view of science is based on the following claims :

1. The world exists largely independent of humans' knowledge of it.
2. Despite our incomplete and/or faulty knowledge of the world, we can employ our empirical observations and previous theories to identify the underlying world.
3. The world consists of not only events but objects and structures that have powers and liabilities capable of generating these events.
4. Social phenomena such as actions, texts, and institutions are concept-dependent. We therefore have not only to explain their production and material effects but also to understand, read, or interpret what they mean.
5. Social science must be critical of its object. In order to be able to explain and understand social phenomena, we have to evaluate them critically.

The general structure of realist causal explanations is based on the statement that “object X, having structure S necessarily possessing causal mechanisms (m) under specific conditions (c) will lead to event (e)” (see Figure 4). Thus, the nature of realist studies requires the identification of the structures and mechanisms that could conceivably lead to an event or series of events (as observed empirically), given a certain set of observable conditions. The occurrences of these observable events are investigated to retroduce specific mechanisms that have the capacity to generate them . The existence of these mechanisms may either be known via existing

observation or hypothesized for later examination and corroboration. Similarly, these mechanisms are explained with respect to the structures in which they exist. The mechanisms of interest typically include the interactions between individuals and groups in the context of larger collectivities .

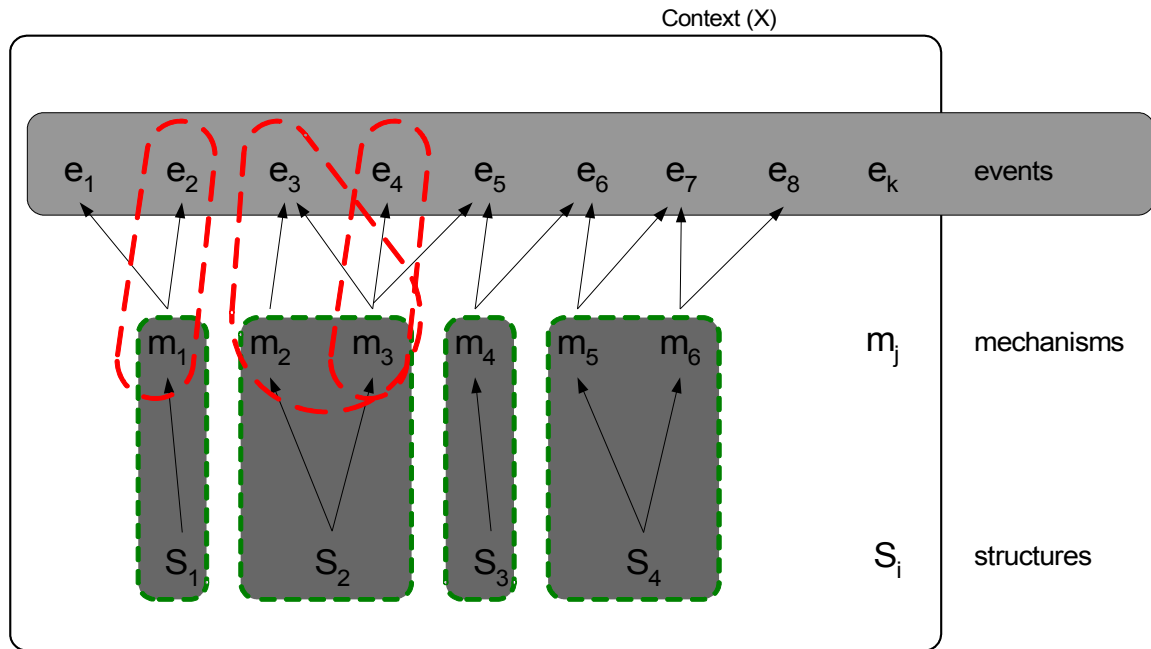


Figure 4: Realist Explanation Framework

The resultant outcome of a given action is based not only on the activation of these mechanisms (or combinations of mechanisms), but the specific context in which they exist. Context consists of an inner component, which includes the structure and culture within the organization, and an outer component, which includes the social, regulatory, and competitive environment in which it operates . Each structure is situated within a given context, which enables certain mechanisms to be available or not. The context also impacts the outcome of the actions taken via these mechanisms.

We conceptualize that within the context and structure of an open source software ecosystem, a set of observable events will arise in response to a given set of stresses. These

events are generated by mechanisms that revolve around the acquisition, conversion, synthesis, or distribution of different forms of capital among the participants within the ecosystem. As such, the task of this research is to ascertain what mechanisms are enacted by these members in order to stave off the effects of negative stresses or encourage positive ones (‘distresses’ and ‘eustresses’, respectively).

Unfortunately, there is no universal, unambiguous definition exists for mechanisms. A recent article cited 28 different definitions of mechanism from social science research, categorizing them into four classifications. In this article, several authors were quoted with contradictory definitions, while several other definitions were not included in the list. Yet another article listed several different mechanisms that were identified by social researchers, including norms, voluntary agreements, the French Revolution, and Rational Choice Theory. Researchers have also differed as to whether or not mechanisms should be observable (or not), tied to systems (or not), or regularly occurring (or not).

In realism, the observability of a mechanism is often tied to the belief that the underlying social structures which lead to the enactment of a given action are not perfectly observable. However, these structures are empirically identifiable only through the activities that result from them. Thus, we can empirically identify the structure of a given social system through the observation of the activities which produce the actual events that occur.

For the purpose of this research, we will employ the following definition for mechanisms: entities and activities organized such that they are productive of regular changes from start or setup to finish or termination conditions . Entities are the things that engage in activities, whereas activities are the producers of change. In the context of this research, entities are the set of actors (including the ecosystem as a whole) and activities are those operations that lead to the

acquisition, conversion, synthesis, and distribution of capital such that the system is changed in some way. These observable activities are generated by the actors in the ecosystem as a function of the portfolio of capital that they possess or have access to during the enactment of a given event. Through these activities, we hope to gain a better understanding of the structure and effectiveness of technological ecosystems.

3.2 Phases of Change in Ecosystem Health

We will examine these mechanisms and the changes they produce through the study of several stress-inducing episodes in the history of two professional open source ecosystems. The episodes that we analyze are first examined within the context of their impact on the health of the ecosystem. We theorize that each episode follows a loosely applicable pattern of five general phases associated with changes in the health of an ecosystem, as shown in Figures 1 and 2. These phases include two near-equilibrium states on either end in which the needs of the participants are balanced with the production and availability of capital required to meet these needs. The initial state is considered an antecedent to change and typically arises over time as a result of self-organization and negotiation on the part of the units in the ecosystem. The end result of these change phases is an additional antecedent phase that may only be a transitory antecedent state preceding the next change. We also note that these states are not truly at equilibrium as we expect the degree of change to be continuous, complex, and interrelated.¹¹ We note that the following figure is not to any scale, nor is it indicative of any particular episode. In fact, it could be safely argued that any measure of the health of an ecosystem in this context would be primarily a qualitative assessment.

¹¹ In fact, complexity researchers argue that there is *no such thing* as equilibrium in organizations and other complex systems for these various reasons.

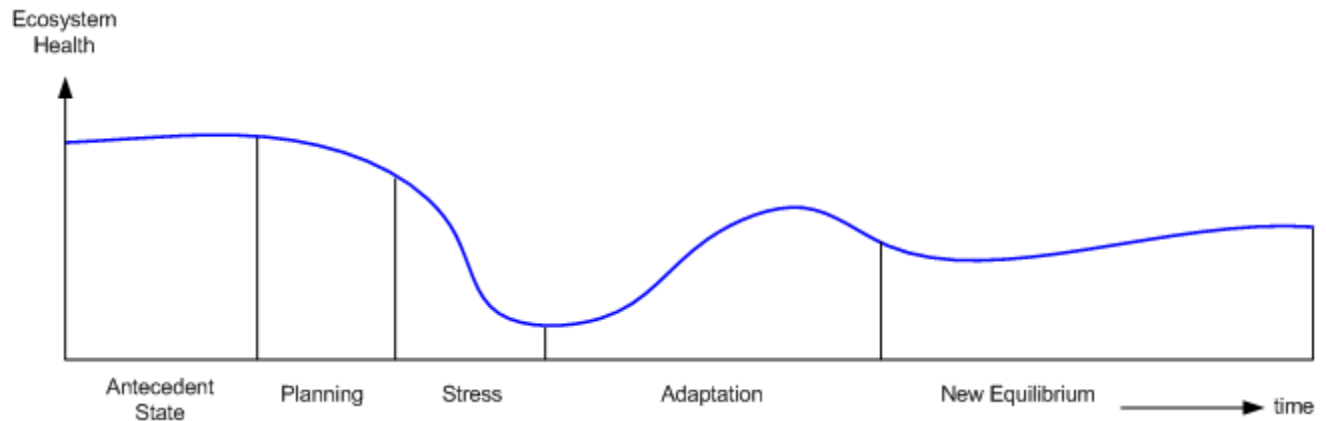


Figure 5: Phases of Change in Ecosystem Health (negative change)

In anticipation of any stresses or changes that may occur, a planning phase may exist in which the units of the ecosystem detect and prepare for future stresses that may be perceived as a result of efforts to monitor the health of the ecosystem (Meyer, 1982). The plans developed at this point are often the result of ‘what-if’ analyses and are designed to be executed in response to potential stresses. In other words, the mechanisms that are enacted upon the occurrence of a stress are often planned and designed in advance by anticipating the resources and routines that will be needed should a given situation arise.¹² Of course, many of the stresses for which the units of the ecosystem strategically prepare may never actually occur or might not anticipate. However, this expected foresight is a key function of an organizational unit and its success is dependent on prior experience with and learning from similar environments. In the case of endogenous change, this preparation and planning is the responsibility of the agent responsible for initiating this change about, which often is the central units responsible for the regulation, control, and growth of the ecosystem.¹³

¹² Note the similarity to dynamic capabilities here (see Teece, D. J., G. Pisano, and A. Shuen (1997) "Dynamic capabilities and strategic management," *Strategic Management Journal* (18) 7, pp. 509-533).

The stress itself triggers changes in the health of the ecosystem. This stress is defined as *any action that alters the health of an ecosystem (positively or negatively) as measured by its vigor, organization, and resilience*. This includes changes in the amount of capital produced or otherwise available, the pathways through which this capital flows, the material goods or services provided, the overall structure of the ecosystem, the efficiency with which it operates, or the ability to devise and execute plans to respond to future stresses.

For many sudden, typically external, episodes, adequate contingency plans may not have existed. The precursors that foreshadow these jolts may either be non-existent or simply overlooked by the members of the ecosystem. In these cases, the stress itself triggers the planning activities conducted within the ecosystem (and thus, the duration of the anticipation phase as shown in Figures 1 and 2 would be significantly shorter or perhaps even nonexistent with respect to the particular stress encountered). As such, an ad hoc response must be developed to address the demands of the new system parameters. In still other cases, the stress may not be detected even after it has already occurred.¹⁴

Lewin (1947) argued for a change model that consisted of three states: unfreeze, change, and refreeze. For unexpected stresses in particular, the stress has the effect of ‘unfreezing’, or altering the near-equilibrium and introducing a degree of uncertainty and discomfort among the members of the ecosystem. With proper execution of endogenous change, much of the

¹³ Thompson (1967) argued that this was typically done within an administrative layer, which buffers the internal layers of the organization against the fluctuations that exist in the environment. Similarly, we propose that the management team of the commercial open source firm at the center of the ecosystem is the ‘outer layer’ that interfaces the most with the environment and shields the technical core, here the internal and external developers, from many external influences.

¹⁴ Diamond (2004) theorizes that complex societies collapse as a result of either failure to anticipate a stress, failure to perceive a stress that has already occurred, failure to attempt to solve a perceived problem due to individual interests acting with no regard for the collective (i.e. the tragedy of the commons), and failure to solve a problem due to lack of resources or a late response. It is easy to map these possibilities to commercial organizations as well.

uncertainty associated with this unfreezing can be minimized or avoided by making the previously developed plans known throughout the ecosystem in order to enable them to devise their own plans for adapting to the changing environment.

Following the occurrence of endogenous or exogenous stresses, there follows a period of adaptation (or ‘change’ according to Lewin (1947)’s model) in which the various units must renegotiate their position within the ecosystem to match the resultant changes. This may require simple execution of contingency plans or a wholesale reorganization of the ecosystem depending on the degree of change initiated by the stress.

Following this adaptation phase, the various units have renegotiated their relationships within the ecosystem. As such, the system evolves to create a new relative equilibrium. Note that this is not likely to be same degree of health as before. This may be true for very simple, low-impact stresses (such as single units joining the ecosystem), but for most stresses there is a high likelihood that the vigor, organization, and resilience of the organization will be different from the antecedent stages.

3.3 Research Design

Building on existing literature on case study methodologies , particularly in Information Systems and Management , this research was designed to identify generative mechanisms that promote and enable the health of open source software ecosystems. One of the strengths of case study research is its applicability in situations where the phenomenon of interest is being investigated “within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” . Within a realist framework, such intensive research designs enable the study of causality by explicitly analyzing the causal mechanisms underlying the processes that are observed within a small number of cases .

We have followed the guidelines for conducting an explanatory case study as described by Yin (2002). The basic methodology is adapted from chapters and articles on explanatory case study research , realist data collection and analysis , and qualitative research validity , among other articles. Using this methodology (see Figure 6), we began with a basic idea for how the theoretical model should look. As concepts arise which are not in answered by the current theoretical framework, it is modified to include the new data. For this study, we have chosen to focus on the individual episodes as cases. After each case, the theoretical framework is compared with the findings of the current episode, modifying the model as much as possible. When the last of the episodes is studied, the resultant theoretical model is completed.

3.3.1 Case Selection

For the purposes of this study, we have selected two open source ecosystems based on their adoption of the professional open source (POS) model. By investigating two sites with literal replication based on the underlying business model, the study allows for the corroboration of results due to similarities in the inner and outer contexts of POS ecosystems (e.g. revenue focus, corporate structure, etc.) while retaining the opportunity to differentiate between specific contextual differences. As with all POS, the organizations at the center of these ecosystems exist for the purpose of making money for their investors and employees. Also, both ecosystems have experienced a number of known changes or stresses in the recent past and are expected to encounter other such events in the near future. By employing a literal replication based on the underlying business model, the study allows for the corroboration of results due to contextual similarities between the two cases while retaining the opportunity to observe differences resulting from specific internal interactions.

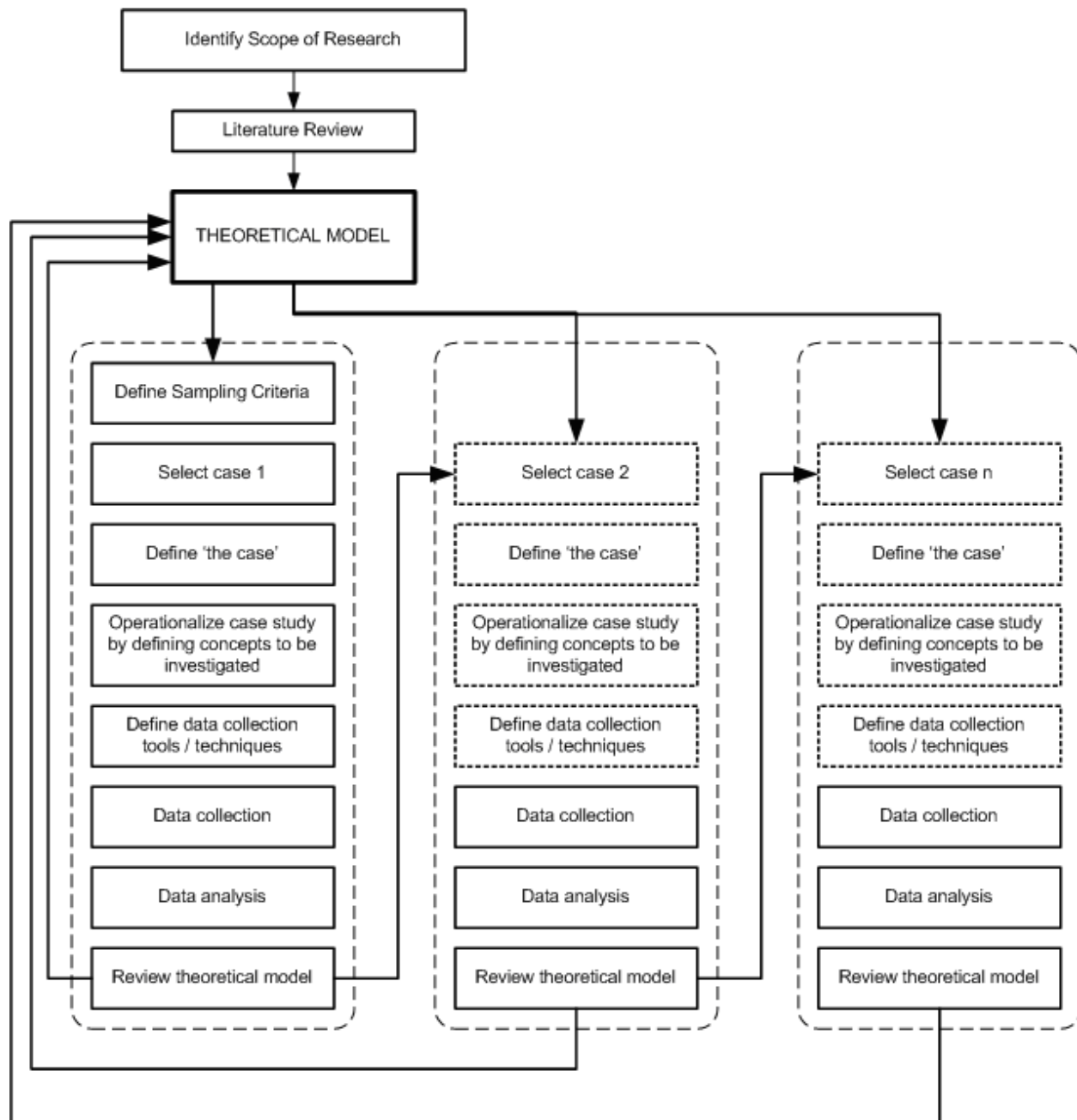


Figure 6: Explanatory Case Study Methodology (adapted from Fisher, Ziviani 2004)

The first site revolves around the MComp family of products (also known as JEMS Suite). MComp was founded in 1999 as an application service provider (ASP), but found that market to be dwindling in the wake of the dot-com era. MComp became a thriving company with a very successful J2EE compliant application server and other middleware components that has

supplanted many of the larger competitors among its target market . In the spring of 2006, MComp was acquired by the OpenSoft corporation in a deal announced to be around \$420 million dollars. I was fortunate to have been part of a research team that interviewed the CEO (Thomas Smith) in 2004, 2005, and again in 2006. Those interviews are part of the data that were used for this study.

The second site is anchored by the BComp Corporation, which was founded in 2004 by a group of former software industry executives. The BComp BI (business intelligence) project developed and released a comprehensive open source business intelligence software platform, including data mining, analysis, and reporting tools that they acquired and integrated into the platform. Based on recent research (Ventura Research, 2006), the market for open source BI software is expected to increase, putting BComp in position to expand as well. In October 2006, I was able to visit its offices in Orlando, Florida, where I was able to meet and interview the founding team and several of the employees.

Prior to the investigation of either of these ecosystems, a pilot study was conducted on a smaller, sponsored open source software ecosystem. The Evergreen project developed an integrated library system for deployment throughout much of the state of Georgia's public library system. The purpose of this pilot was to validate the data collection and analysis methods prior to their application in the main studies. Additional details from the pilot study can be found in Appendix B.

3.4 Data Collection

Methodologically, neither scientific nor critical realism is confined to a single type of research . Given the fallibility of empirical observations, the correct method to employ is the one that best enables the researcher to truly understand the underlying social structures and

mechanisms. Intensive research designs that aim to build causal explanation in a limited number of cases may best be served by qualitative analysis of individual agents in a specific context. Alternatively, designs to understand the patterns and regularities across a number of different mechanisms and contexts may be well served by cross-sectional surveys or statistical analysis . Triangulation of methods may be essential for understanding different versions of a single reality as a means of validating the retroduction of episodes to mechanisms. In this study, I have employed triangulation across multiple qualitative methods. The purpose of the data collection efforts was to marshal evidence related to the mechanisms that enabled each observable episode to occur. The data were collected via the accumulation of archival data, interviews, and observations. By including a combination of these three data sources, the validity of the data was increased.

3.4.1 Episode Identification

Data collection began with the identification of a series of stresses and the resulting episodes that occurred in both ecosystems, including changes in funding, organization, governance structure, and more. An episode here is defined as a sequence of actions and processes by members of the ecosystem in response to a given stress. Each episode is described by a brief history of the observable actions and results. These episodes were identified by reviewing a number of online sources, especially the main project website, press releases, and archived mailing list and discussion board communications. Data were also obtained from past media reports such as news articles, product reviews, and blog entries. The information gained in this process was subsequently used to focus and frame the personal interviews that follow.

Additionally, episodes were classified according to the impact they produce on the vigor and organization of the ecosystem as typified by changes in the levels of each type of capital. For

instance, the simplest interpretation of an increase in venture capital funding is that economic capital is increased by a corresponding amount. Additionally, alignment with a VC firm may increase the social capital of the ecosystem by introducing relationships with other significant parties. The ability to attract funding from a top-shelf VC fund may also increase the legitimacy (or symbolic capital) of the recipient. Verifying the classification of these capital changes from the members' point of view was another component of the interview process.

3.4.2 Interviews

After identifying the specific stresses, a series of interviews was conducted to identify the resultant changes in the operation of the ecosystem. In order to obtain a complete picture of the flow and accumulation of capital through the ecosystem, participants were interviewed from across a wide range of the ecosystem, including developers, core members, active and passive users, investors, and partners. Other interviews were conducted with analysts that were external to both ecosystems in order to gain an additional perspective. Table 2 below shows a summary of the interview data collected. The full list of interviewees can be seen in Appendix C. A total of 39 interviews were conducted for a total of 1660 minutes (over 27 hours) of interview time. There were several interviewees who were members of both ecosystems, so the sum of the first three columns does not equal the combined figure.

Table 2: Summary of Interview Data

	MComp	BComp	External	Combined
N	17	25	2	39
Avg Length	45.5	41.2	52.5	42.5
Total Length	774	1031	105	1660

Specific interviewees were selected by first making contact with the CEO or other members of the firm, followed by taking a sample of other ecosystem participants derived from the project's online materials and/or contacting specific members of the ecosystem. Where

possible, a snowball technique was followed, allowing us to reach subsequent interviewees based on the suggestion (and hopefully introduction) of current interviewees. Where possible, multiple interviews were conducted for each classification of roles to get a more complete perspective. The interviews were conducted via face-to-face meeting, telephone, and even via instant messaging due to the distributed nature of both ecosystems.

The interviews were based on a semi-structured instrument developed from the stresses identified in the archival data collection phase. An example of the interview guide and consent script used for this research can be found in Appendix D. During the first portion of the interview, respondents were asked a set of general questions concerning their involvement with the ecosystem, the contributions they perceive themselves making, the perceived benefits they receive, and the relationships they have with other key roles/participants in the ecosystem. Next, they were asked to rank a number of the stresses, with the respondent selecting the 3-5 most significant stresses for further discussion. Additionally, the respondent was invited to include any other significant stresses that they feel should be included in this list. Using a methodology that was based loosely on the critical incident technique, the questions in the third and final interview phase were centered on the respondent's opinion of cause, actions, and outcomes the most significant stresses. This includes specific identification of the impact on the flows and accumulations of each type of capital.

3.4.3 Field Observation

Where possible, the primary researcher spent time observing the activities of the participants of the ecosystem. For instance, the organization sponsoring the open source application to be included in the pilot study is in close proximity, which allowed the primary researcher to observe a number of meetings and activities in their native format. This included

weekly face-to-face developer meetings, staff meetings, and subcommittee meetings (in which the staff and developers provided members of the user community with updates on the current progress of the application being developed). These proved to be very helpful in getting a better understanding of the underlying structures, behaviors, and functions of the participants.

I was also able to attend MCompWorld in the Summer of 2006. MCompWorld is a set of presentations and meetings for members of the MComp ecosystem, including a wide range of users, administrators, developers, and partners. In doing so, I was able to meet several members face-to-face and establish a rapport for subsequent data collection. I was also able to visit BComp's offices from October 24-27, 2006. While there, I was able to meet and interview several members of the founding team as well as the other employees. While there, several of the employees put me in touch with other members of the ecosystem, including other members of the management team, users, developers, and partners. I was also able to sit in on several privileged meetings and conferences involving the senior management team and marketing staff.

There was no active participation by the researcher. Instead, I remained as passive as possible while taking notes of the salient actions and conversations that I encountered during each of these observations. My goal was to 'fit in' with the members of the ecosystem without any active membership and as little influence on their actions as possible. Upon returning from the observation site, I was able to expand upon my recorded field notes by adding reflexive remarks, including personal impressions, thoughts, explanations, and concerns of my experiences.

Because open source ecosystems are highly dispersed geographically, they typically rely heavily on electronic communications media such as discussion boards, mailing lists, and Internet relay chat (IRC). For instance, developers in the pilot study participate in two IRC

channels for much of the day as they discuss development and procedural matters with each other and with other external developers working on similar applications or in similar organizations. In order to capture the reality of their distributed existence, these online communications were also included in the data collection rather than relying solely on interviews and physical observation. This data collection took advantage of ethnographic and field research methodologies which have been specifically proposed for electronic data.

Because of the highly visible nature of the MComp ecosystem, I was able to utilize a number of online forums for data collection, including the MComp forums, blogs, and message boards, the discussion forums at www.theserverside.com, archived mailing lists and message boards from the early years of MComp and eMComp, and separate discussion forums for the acquired components including GSoft.org. These conversations are typically unedited and unmoderated records of electronic communications that were occurring at the time specific actions occurred. Thus, they were extremely valuable in getting the complete story of what was happening in response to specific actions without having the participants' revisions due to hindsight. Because the number of messages that I reviewed numbered in the hundreds if not thousands, I do not have an exact count). I was able to review several sources of archived communications for BComp as well, however there is far less information available due to the relative newness of the project and the lower profile of the project and its employees.

3.5 Data Analysis

Analysis of all interviews, field notes, electronic transcripts, and archival data was performed coincidentally with the data collection phase. As soon as possible following collection, each of the interviews and field notes were transcribed and stored in the case study database. The transcribed files were then analyzed as soon as possible, preferably before the next

interview or field visit. When immediate analysis was not possible, the notes from preceding interviews were reviewed to allow for emergent topics to be included in subsequent collection rounds.

The coding scheme used in this study was based on template coding , which is a hybrid combination of theory driven and inductively derived code generation methods . The original codes were based on the theoretical framework described earlier. For instance, a set of codes was generated for the episode sequence, each of the capital types and their circulation, transformation, or accumulation, each role encountered in the ecosystem, and the functional outputs (innovation, marketing, and support). These codes were compared to the emergent raw data and rewritten as necessary in order to ensure compatibility.

The coding scheme was developed and published in a codebook in which each entry will include the name of the code, definition, and a description (Boyzatis 1998, pg. 31). The final version of this scheme can be seen in Appendix E. The validation of each code was attained through its observation within the dataset . The actual coding of interview transcripts and notes was done using Atlas/TI. As new codes were generated in response to the data itself, they were added to the codebook.

The reliability of the codes was tested by comparing the resulting efforts of an additional coder familiar with the current study. This additional coder was given a copy of the codebook along with a brief summary of the theoretical framework at that time. The coder was given approximately 30 minutes of an interview to be coded using the existing coding scheme, after which we would meet to reconcile any differences in the codes selected for each segment identified until we reached consensus as to the correct interpretation. After the initial round of coding, the percentage of total matches was 57%. After meeting to clear up any misconceptions

and ambiguous codes, two new segments (one from each ecosystem studied) were coded using the revised schema. The percentage of matches for these segments rose to 83% and 85%, respectively. As this percentage exceeds 80%, we can conclude that the coding scheme has sufficient reliability .

Following the completion of the coding process, the process moves to the interpretation phase including the completion of data displays to guide the search for regularities, irregularities, patterns, and contrasts. The interpretations from the two distinct case sites were combined and compared for similarities and above all differences. An example of the data comparison displays that was used in this interpretation is shown in below. This table was used to show the antecedent stresses for each episode, the resulting impact on each capital type, and ultimately, the mechanisms used in each episode. The analysis performed on this data is shown in chapters 4-6, including several displays based on this original template.

Table 3: Data Comparison Display

		Episode number			
		1	2	...	i
Raw Info	Gen'l Description				
	Cause/Antecedent				
	Actions				
	Result				
Stress	Source of Stress				
	Positive/Negative				
Capital Impacts	Economic				
	Human				
	Social				
	Symbolic				
	Organizational				

Mechanisms	<i>m1</i>				
	<i>m2</i>				
	...				
	<i>Mk</i>				

3.6 Validity Assessment

As the data collection and analysis phases were being carried out, a number of validity tests were included in the study to assess the variation built into theory, the acknowledgement of process, and the quality and significance of the theoretical findings . The framework developed here is based on the few existing research frameworks for testing the validity and reliability of research within qualitative realist research . Included in this framework were four criteria upon which the resultant theory and method can be judged: descriptive validity, interpretive validity, theoretical validity, and generalizability (or transferability).

The first criterion in judging the quality of realist studies is assessing the *descriptive validity*, which is the accuracy of the researcher’s account of the episodes being studied . In other words, did the subject say exactly what is being reported or did the researcher “mis-hear, mis-transcribe, or mis-remember his or her words” . Equally important, was anything omitted or left out? Ideally, the data used in the research should be completely auditable by another researcher . In this study, several methods were employed to address threats to this validity, including recording (when possible) and transcribing all of the interviews, allowing the participants to read and cross-check interview transcripts to verify that they were not misquoted, and using multiple interviewers/observers where possible .

The second criterion is *interpretive validity*, or the accuracy of the researcher’s inference of observed behavior or interview data. In realist studies, the perspective of the interview subjects is acknowledged as the lens through which they experience the ultimate reality of the

situation. Thus, it becomes important to assess the degree to which the subjects' perceptions are accurately interpreted by the researcher. This validity is addressed in the current study by asking informants to clarify their statements to ensure that the researcher is able to interpret the meaning correctly and enabling the participants to review transcripts and crosscheck the researcher's initial interpretation of the data via follow-up interviews (as needed). We also assess the degree to which these perceptions accurately reflect this reality by including triangulation of perceptions within each role or organization within the ecosystem. Theoretical validity encompasses two different types of validity. Construct validity refers to the validity of the constructs or concepts used in the development of the theoretical framework resulting from the study. To address this, the current study used an a priori theoretical coding scheme that was modified as the data were analyzed. This coding scheme ensures that the constructs being studied are nomologically valid with respect to the existing literature. Additionally, experts identified from the data collection sample were consulted during both data collection and analysis to assess if anything is missing, surprising, or useful. Theoretical validity also includes internal validity, which refers to the relationships between the constructs. As is common in many qualitative case studies, this can be assessed by comparing the developed theory to alternative causal theories to see which best explains the episodes and mechanisms being studied . Note that this first two criteria are similar to *confirmability*, which includes verifying and affirming the researcher's interpretations of what he or she has heard or seen, and *credibility*, which is the truth or value of the findings .

The fourth criterion for evaluating realist research, *generalizability*, is not always a primary goal. Instead, intensive study attempts to understand the theory and causal mechanisms behind the specific case being investigated. The specifics of the context and setting for the research are treated as contingent factors to be accounted for in the current study. As such, the

developed theory examines the particular case as well as offers possible clues as to how the context and setting of subsequent research into theoretically different ecosystems may result in different outcomes . In order to extend the results of the current study to other ecosystems, the existence of the mechanisms identified in this case must be evaluated in the context of the other ecosystem to be studied. Generalizability, which is nearly synonymous with transferability , can be evaluated with respect to generalizing within the current setting to specific persons and episodes that were not directly studies and generalizing to other settings. To address the generalizability of the current study, multiple informants were selected purposefully, instead of randomly, to ensure that theoretical representativeness is addressed.

(Note: Most names of individuals and organizations changed or omitted for confidentiality purposes.)

4.0 MCOMP CASE ANALYSIS

4.1 EMComp/TCorp Founding

4.1.1 Antecedent

In the late nineties, Thomas Smith was a sales engineer at Sun Microsystems. Smith, a former paratrooper in the French army, had graduated from the Ecole Polytechnique in Paris with a PhD in Theoretical Physics. Following graduation, he had taken a job as a “presales phone support agent” with Sun and had move up the ranks to become the official spokesman for Java in France. True to his scientific and research training, he moved into the engineering side because he had wanted to do something more technically challenging. While working on a Java-enablement project for SAP Labs, he was exposed to the Enterprise Java Beans (EJB) specifications, which had been just been released by Sun.¹⁵

It was love at first sight, finally a comprehensive server side specification with built in transactions and security. (Thomas Smith, Nov 2001 interview)

At that time, there was no open source-based EJB software being developed, nor was there much expertise built up with the specification since it was relatively new. For Smith, this was an opportunity to satisfy his desire to work on his technical skills and learn this new technology at the same time.

The prospect of working for myself was also appealing. (BusinessWeek interview, September 3, 2003)

4.1.2 Planning

In order to do this, Smith could remain at Sun, but that would perhaps limit his ability to really learn and apply this technology to the depth that he would have liked. It would also have

¹⁵ EJB 1.0 was released by Sun in March, 1998.

precluded him from releasing it as open source, which was relatively new at that time. So, in early 1999, Smith quit Sun to start working on an EJB-based application server, which Smith named EMComp.

[I] decided to step onto the other side of the mirror. I wanted to really implement the specification, so I set out to bang out some code, which I eventually released as EMComp. (BusinessWeek interview, September 3, 2003)

By releasing the software as open source, the company would be able to capitalize on the skills and talents of a wide range of participants from around the world, much as Linux and Utopian had been able to do at that point.

However, leaving Sun meant that he would eventually need to find a way to generate an income for himself and his wife to be able to survive. The only thing he would have to do was find a business model that could earn sufficient funding to support him in this endeavor. Fortunately, the US was in a technology funding boom in the late 1990s, so he had every reason to assume that he could obtain the necessary financial capital once the server development was done.

Given the business climate at that time, I felt that there was a good likelihood of finding venture capitalists to fund the project. In other words, once I firmed up the product, I could stay focused on the product while the suits could figure out how to make money and build a real company around it. (BusinessWeek interview, September 3, 2003)

4.1.3 Stress

EMComp version 0.3 was released to the public as open source in March of 1999. In order to support himself financially, Smith and a partner founded TCorp in September of 1999. The business model behind TCorp was to provide application hosting services using the EMComp server. In addition, TCorp employed several developers in order to fund the development of the EMComp server. Smith assumed the role of CTO responsible for the development of the server while Faure was responsible for obtaining funding in order to grow

the TCorp business. In an interview in January of 2000, Thomas stated that his goals for EMComp and TCorp were to “have fun, grow, code. Commoditize J2EE.”

4.1.4 Adaptation

Listening in on the eMComp email list is like being a fly on the wall of a great party where all the guests are java/ejb heavies who are having a great time tossing ideas around. It's what development ought to be like. Can't you feel the ground move under your feet? Yeah, that's them! (enhydra-announce Mailing list archives, dated Dec. 8, 1999, last accessed May 12, 2007)

Smith developed the earliest versions of the MComp¹⁶ server, which he released as open source. As the code matured, more people contributed to its development.

By the time I reached 0.6, great people were helping me out. Folks like Randy Terry and many others started pouring in ideas and by the time 1.0 was out EMComp was already a technology maverick. It then became MComp and took on a life of its own. (Thomas Smith, Nov 2001 interview)

By the Spring of 2000, there were approximately 400 registered developers working on MComp, including 10 regular developers and five TCorp employees. Among those employees was Randy Terry, a Swedish Java expert who was the first employee and the designer of MComp 2.0, which is regarded as the version that set MComp apart from much of the J2EE world. Randy joined the firm to enable him to work full time on the development of the server. Randy was also a member of the initial MComp board along with Thomas Smith, Ted Parker, Oleg Nitz, and Dan O'Connor. Later TCorp board members included luminaries such as Bruce Perens, primary author of the Open Source Definition. These individuals were charged with managing the people, outside communications, and CVS patches.

Initially, the project attracted the attention of three classes of participants. Users wanting a J2EE application engine or hosting space could easily download and use the product and

¹⁶ In April, 2000 the server was renamed “MComp” from “EMComp” to avoid a legal conflict with existing trademarks. “We drop the “e” as we hear that e-commerce is out of fashion anyway ;-)” (From the website via <http://www.archive.org>, last accessed 5/11/07)

contributing feedback to the developers. The developers were courted by appealing to the satisfaction of seeing their work implemented by the users. System administrators were encouraged to try the software and contribute code and feedback, including sharing their Linux administration requirements.

Initially, Smith was very liberal in assigning read/write access to the source code in the Concurrent Versioning System (CVS) repository. Access writes were granted to virtually anyone that wanted them, including students, developers, or users. Despite the obvious risks, this became a very important part of the development community's success.

Thomas was very open in giving getting CVS access to the source very quickly. The mentality was that basically he gave you the benefit of the doubt. As soon as you wanted you got the required access to it as long as you did not mess up you got to keep it which was different from other Open Source projects.

So, I think that was one of the key things and I think one of the good things that Thomas did to initially create the community of developers to get everybody on board quickly by being open with the access. (Ted Parker, personal interview, 3/4/2007)

There was some concern about whether TCorp violated the trust that developers had for the project since their contributions were being used by TCorp to earn revenues instead of remaining fully open source. Smith and other employees had to go to extra lengths to explain that TCorp was mostly a *user* of the MComp software, just like many of the users. TCorp was not intending to sell the code itself but the services around the software.

Pretty much all of the contributors to our software are people who*need* an application server to do their job. They are customers of MComp so to speak. We, as TCorp, are also customers to MComp, since we are going to use it to run our business. Also, I want to be very clear on the fact that while TCorp is the main sponsor and administrator of MComp, we are not MComp. MComp is much bigger than that. MComp is a community of individuals and companies who have the same need: to have a kickass application server. (Randy Terry, Mailing list archive dated 6/20/2000)

Smith and TCorp compensated those individuals who had contributed software and bug-fixes, even if they were not employees. The first distribution of stock options in TCorp was made in December of 1999 to anyone who contributed significantly in **any** way to MComp.

We share our company, and we feel that if we are going to have a financial reward, YOU should share in it as well. (Mailing list archive dated April 19, 2000)

MComp was not the only open source EJB server available for users. ExOffice Technologies launched a competing product (OpenEJB) in December of 1999 that was also based on Terry's architecture. OpenEJB was founded by Richard Monson-Haefel, who later was a co-founder of the Utopian Cigar project.¹⁷ Interestingly, the OpenEJB server was integrated into the Cigar project as well as Apple Computer's WebObjects. Other OSS application servers included EJBHome and JOnAS. However, MComp was the most well developed and well known OSS Java app server available at that time.

EMComp was originally licensed under the GPL license. In November 2000, the license was changed to the LGPL after consulting with several respected members of the open source community including Richard Stallman and Brian Watkins. Unlike the GPL, the LGPL enables users to build proprietary applications on top of the MComp code without being required to release their applications under an OSS license. It also enables the MComp code to be modified by anyone for their internal usage without releasing it as open source. However, if the modified source code is distributed to others, the LGPL requires that it be released under the LGPL license as well. This last clause ensures that the MComp software is not converted to a proprietary license and redistributed by some other company, which differs from the BSD-style licenses such as those deployed by the Utopian Software Foundation (USF). This reciprocity obligation

¹⁷ Cigar is a rival OSS project that was created by the Utopian Software Foundation. More details on this project can be found in section 4.1.8

protects the interests of the MComp community and also reduces the probability of multiple incompatible versions of the software by ensuring that any modifications and changes are available to anyone.

Ironically, Smith attempted to have MComp join the Java-Utopian group during the summer of 1999. At that time, the governing body of the USF (specifically then-chairman Brian Watkins) wanted to wait for a more opportune time and Smith decided to pull the attempt off the table. Eventually, this led to a massive disagreement between the USF and the MComp community, especially between Smith and Watkins. Again, this foreshadows actions from later episodes, including the creation of the Utopian Cigar project. It also marks a critical juncture in the eventual history of MComp.

If you look at the later events with the Utopian and Cigar for instance and how BigWare is taking advantage of the Utopian license. That I think is the obvious difference and given that popularity that MComp had already early on I think it would have been inevitable that MComp would have ended up being adopted or forked by a larger commercial entity. And that certainly would have changed the history quite a bit. (Ted Parker, personal interview, 3/4/2007)

4.1.5 Analysis

4.1.5.1 Capital

The primary foci of this episode are the creation and evolution of EMComp/MComp and the founding of the TCorp Corporation. Both played significant roles in the later evolution of the larger MComp Group.

The formation of the ecosystem resulted in the establishment of a working software application and a thriving development community to support it. The software was initially created by Smith based on his development skills and knowledge of the EJB standard [human capital]. The adoption of the EJB standard [organizational capital] was instrumental in coordinating the efforts of the developers as well as constraining the architecture and design of the EMComp server.

The license [organizational capital] adopted by the ecosystem both coordinates and restricts the choice of actions by developers and users. MComp choice of the GPL and especially LGPL license both attracts some participants, due to the ability to embed the software without having to open source the rest of the application, and repels other participants away because of the requirement of distributing modified code as open source. Had the early plans to convert to a BSD license been carried out, it is likely that MComp as a company would not have developed in the same way, since the BSD licenses allow users to convert OSS software to a proprietary license, effectively taking the original organization out of the picture.

Similarly, the CVS [organizational capital] enables the project leaders to control the flow of contributions into the source code. Marc's liberal granting of CVS rights lessened his ability to control every aspect of MComp' development, but this was offset by the increased size of the development community and thus the pace of software development.

There was a reciprocal, self-reinforcing relationship between growth in the size of the development community and the amount of source code available. As more people joined the development community, the density of the structural ties within the community was increased [social capital].¹⁸ As a result, more development expertise was available [human capital], and thus more source code [organizational capital] was produced. Conversely, the more source code became available (and the more features added), the more people that found the software useful and became involved. The increases in both the developer community and the software added to the credibility and legitimacy [symbolic capital] of the project as well.

¹⁸ Both Nahapiet and Ghoshal (1998) and Burt (1992) argue that this density is not more efficient because of the redundancy of the information passed among these links. In this case, we assume that the additional developers are able to provide less redundant knowledge and information due to their unique skill levels and experiences.

The initial working capital [economic capital] for TCorp was provided from the personal funds [economic capital] of Thomas Smith and David Jones. Their intention was to develop a business model that would enable them to earn a suitable return for themselves as well as to pay the employees and other contributors relative to the amount of work they performed. In other words, they were trying to find a way to pay wages [economic capital] to open source developers for contributing their development skills [human capital] to the ecosystem.

Table 4: Capital Observations – MComp Founding

<i>Capital Type</i>	<i>Instance</i>
<i>Social</i>	Development Community Relationships
<i>Organizational</i>	EJB Standard, License, CVS Source code, SW architecture
<i>Symbolic</i>	Credibility
<i>Human</i>	Development Expertise EJB Expertise
<i>Economic</i>	Personal Funds Working Funds (MComp Firm)

4.1.5.2 Mechanisms

The flow of capital embodied in the founding of the EMComp/TCorp ecosystem begins with Thomas Smith's *productivity* converting his human capital into the early versions of the EMComp server. Recalling that the reasons he began this project revolved around his personal interest in the evolving EJB standard, it seems that Eric Raymond's first lesson of Open Source holds:

Every good work of software starts by scratching a developer's personal itch.

After Smith released the product as an open source project, the needs for managing the development process changed considerably. Specifically, *coordination mechanisms* were needed in order to establish and maintain procedures and guidelines for integrating the contributed

capital and resources in order to efficiently produce the necessary outputs. The software architecture, development methodologies, and other documents and procedures are instances of tools used to manage these processes in the MComp case. The initial design of many of these mechanisms was constrained and enabled by the norms of open source software, and the covenants of the GPL/LGPL license.

As the software became more effective, it gained the attention of a wider range of potential participants who had a need that the software could satisfy. We posit that the organizational capital (in the form of the software, architecture, license, and development routines) motivated these individuals to participate through *attraction mechanisms*. We define these mechanisms as the tendency to attract and influence participants to join the ecosystem. In the MComp case, the organizational capital had a positive effect on the level of participation.

In turn, this increased participation led to growth in the amount of human capital available as these new individuals establish working relationships with existing members of the ecosystem. Through these *knowledge acquisition* mechanisms, the knowledge possessed by the new members becomes available for later exploitation. As the *productivity* of these individuals was directed at the development of the EMComp application software, there was a corresponding improvement in the features and functionality of the software. This improvement was dependent on the *coordination* mechanisms (i.e. CVS, license, and architecture) to efficiently direct this accumulated productivity.

The increased community and the successful release of the MComp software had positive impacts on the credibility of the software. Within 13 months of its founding, the MComp community had over 400 registered developers and had released two stable versions of its software. This level of activity legitimizes the ecosystem and the efforts of the participants. The

resulting increased levels in credibility and legitimacy are another *attraction mechanism* that helps attract additional participants. There is a self-reinforcing bandwagon effect of the capital flow from participation to credibility (through *legitimization*) and back to participation (through attraction) that manifests as the other capital elements (e.g. software, coordination, development expertise) are available within the ecosystem.

TCorp was founded in order to monetize the usage of the MComp server. The intention was to create an application hosting provider that would operate servers to enable customers to run J2EE compliant applications without having to deploy the servers in-house. By using the ‘free’ MComp server, TCorp would be customers of the MComp community. This led to some skepticism on the part of the development community regarding whether or not this would be a conflict of interest. The TCorp board members tried (and apparently succeeded) to convince the rest of the ecosystem that their intentions were not to convert MComp to a proprietary model once the product reached production quality.

TCorp is a company grown out of an open source group, not the other way around. It’s a company done by hackers, for hackers. (Thomas Smith, from the mailing list archives, dated 4/19/2000, last accessed 5/12/07)

I want to be very clear on the fact that while TCorp is the main sponsor and administrator of MComp, we are not MComp. MComp is much bigger than that. MComp is a community of individuals and companies who have the same need: to have a kickass application server. (Randy Terry, from the mailing list archives, dated 6/20/2000, last accessed 5/12/2007)

The initial funding for TCorp was the result of an *investment* by the two founders, who clearly expected to generate a return for themselves after the application had been satisfactorily developed. From this funding, several of the most active developers and contributors to the MComp code were compensated with stock options. A few were hired by TCorp as employees to ensure that they had sufficient time to work on the source code. This *compensation* mechanism allowed the most influential developers to generate a more immediate return for their

programming skills and contributions. The possibility of attaining a salary from their contributions was touted by the TCorp board to *attract* additional contributors.

We are going to do a second round of stock pretty soon, to reward those of you that contributed in **any** way to MComp. We share our company, and we feel that if we are going to have a financial reward, YOU should share in it as well. CAN YOUR OTHER OPEN GROUPS DO THAT? (Thomas Smith, Mailing list archives dated April 19, 2000, last accessed May 13, 2007)

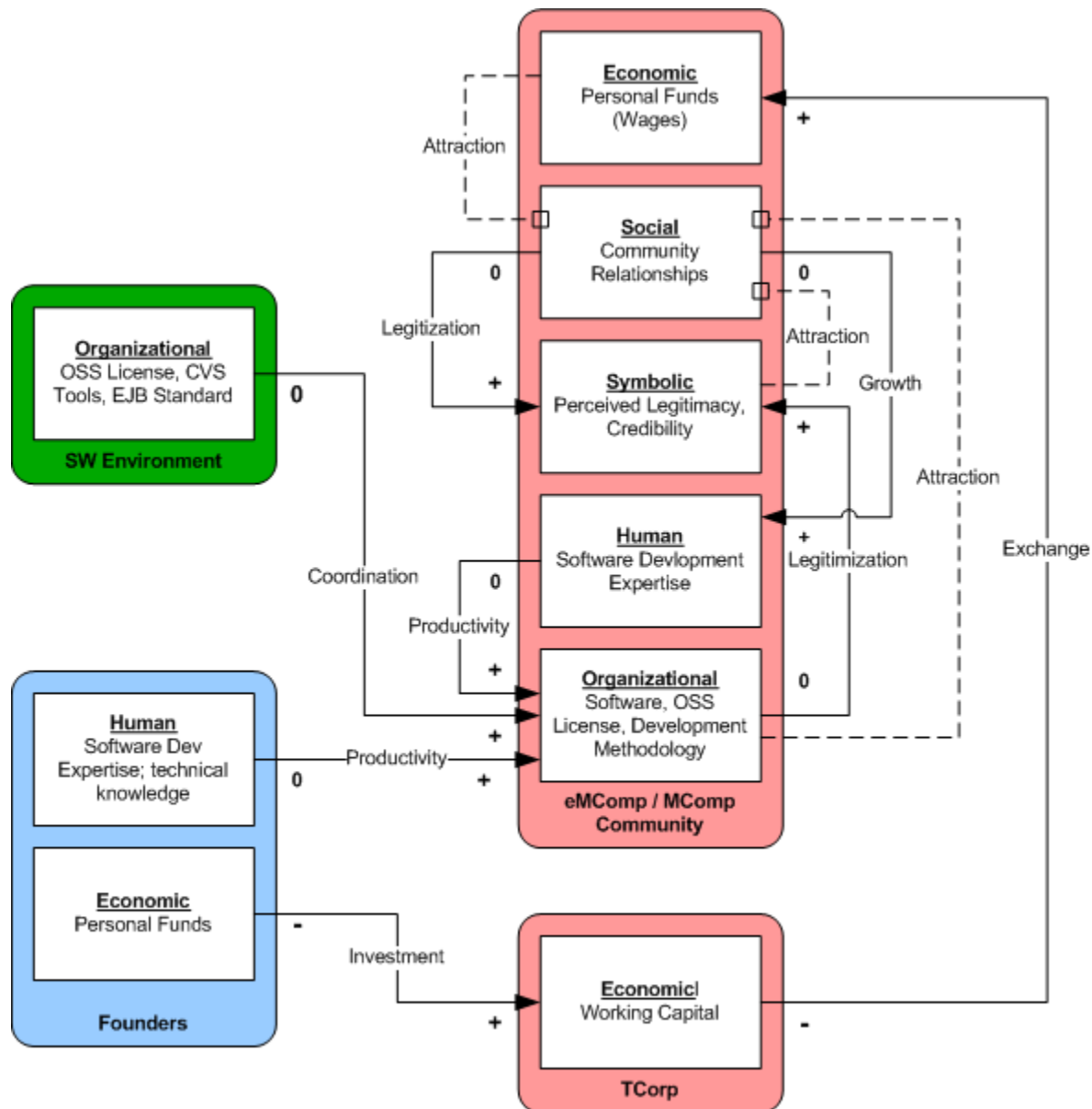


Figure 7: Capital Flow Diagram – MComp Founding ¹⁹

¹⁹ A legend for the capital flow diagrams can be found in Appendix G.

4.2 TCorp Failure

4.2.1 Antecedent

By all accounts, the development community surrounding MComp was thriving. The number of developers was climbing as the quality and functionality of the software improved. Thus, the MComp project and the application server software itself had gained a reasonable amount of credibility among the Java ecosystem, especially for an open source software product.

As discussed in the previous episode (MComp/TCorp Founding), the founders of TCorp intended for the company to support the development of MComp by employing several of the key contributors and issuing profit-sharing options for many others. The way they intended to do this was by selling application hosting services, or running customers' applications on TCorp's servers for a fee. By running these applications on the server software being developed by the MComp development community, TCorp would save thousands of dollars in licensing fees compared to running them on proprietary software. By mid-2000, the company employed 5 people including several key developers and had issued stock options on at least one occasion.

Thomas Smith and his family had invested \$500,000 of their personal savings to create and develop both the MComp project and TCorp. Unfortunately, this would not be enough for TCorp to survive long term. In order to survive, TCorp would need to either develop and implement a business model that could generate sustainable revenues or find additional funding from a venture capital firm or other investor.

4.2.2 Anticipation

The CEO, David Jones, had corporate financing experience from his career with Paribas Capital Markets, Arthur Andersen, and Lazard Freres in Paris. His primary responsibility with TCorp was to promote both MComp and TCorp to potential investors. Armed with a business

plan based around application hosting services, he and Smith attempted to get VC funding for TCorp in order to survive.

Unfortunately, neither Faure nor Smith possessed experience in this business, which made it very difficult to find VC firms willing to fund the venture. They were able to meet with several top-tier VC firms, but none were willing to provide funding for TCorp's ASP-based business model.

The elation of getting an interview with Sequoia Capital quickly dissipated as [General Partner] Doug Leone told us "This is not just a bad business play, it's a horrible business plan."

Additionally, this occurred near the close of the dot-com boom, which meant that funding for technology based startups was difficult for anyone to find. This was particularly bad for OSS firms, since no firm to date had found a way to reach profitability.

4.2.3 Stress

Without additional investment funding or a business model capable of generating sufficient revenues, TCorp went out of business in November of 2000, taking Smith's investment with it.

I was broke, and so were my friends, family and fools who had invested in my venture. (Thomas Smith, online interview)²⁰

Smith and Faure dissolved their partnership and went their separate ways. Having lost nearly all of his savings, Smith left Silicon Valley for his in-laws house in Atlanta, where he could take time to plan his next move.

4.2.4 Adaptation

The failure of TCorp as a business meant that several of the key members of the MComp development community were suddenly unemployed. As a result, it was possible that the level of productivity would take a hit as these developers shifted their efforts to finding other jobs.

²⁰ quoted from an online archive, last accessed 5/7/2007

There was no certainty at that point of any financial compensation for the work they were doing. And in fact, everybody who was working either as an intern or employee or contracting for TCorp at the time, they disappeared. I think I'm the only exception. (Ted Parker, personal interview, 3/4/2007)

However, the software and development methodology itself survived because it was held separately from TCorp, so that the failure did not directly affect the MComp community. For those contributors who were already contributing for free, the TCorp failure was of little personal concern since they did not have a financial stake in the firm. So although there was some impact in the level of development, the development community as a whole remained largely intact. And because the software was licensed as open source, the development and usage of the MComp software could continue with little disturbance.

The biggest risk to the community was the loss of leadership that would have occurred if Thomas had not decided to continue with MComp.

The question mark there would have been if, from the Open Source community, there would have been new leaders who have the vision and the energy and all that to lead the project or if it would have gone through a slow death where people eventually go to do other things. (Ted Parker, personal interview, 3/4/2007)

Fortunately, Thomas decided to use the time to regroup and think about how to build a business model that could take advantage of the MComp software and earn money in the process.

I just wasn't ready to give up yet on a company of my own. My first company had failed, but I had still awakened the next day. If I gave it another shot, I felt fairly confident that I would still be able to find a salaried job in the tech industry. (Marc, BusinessWeek, 9/3/2003)

4.2.5 Analysis

4.2.5.1 Capital

When TCorp went out of business, the working capital [economic capital] that it possessed was removed from the ecosystem. As a result, the nature of participation within the

MComp development community was significantly altered. The key developers, who had been identified based on the value of their contributions to the project, were no longer paid wages [economic capital] for their participation. As a result, many of them no longer participated in the project.

The reason these departures were significant was not due to the number of contributors but to the value that these used to bring to the MComp. The individuals that had been selected for compensation were those who had made “significant contributions in *any* way”, such that they were the most prolific or important members. Thus, their departure left fewer community relationships [social capital] and by extension, a lower level of development expertise [human capital] in the development community. We can also state that this reduced the ability of the remaining members to continue to develop and more importantly maintain the software, which called into question the credibility [symbolic capital] of the development effort.

Despite these key defections, including nearly all of TCorp’s board of directors, one of the founders, and countless other developers and contracted contributors, the MComp ecosystem survived. It is important to note that TCorp did not own the organizational capital that existed in the ecosystem. Remembering our definition for organizational capital as “those elements that remain when the employees go home”, we can observe that the software architecture, source code, development routines, license, etc. [organizational capital] were not affected because these folks left. The *rate* at which the amount of skill and knowledge [human capital] from the ecosystem and from CEO Smith was being converted into *new* organizational capital would likely be reduced, but the amount of organizational capital that was already vested in the ecosystem was not subject to reduction despite the lower participation by key contributors. In fact, because of the contributors’ attraction to the existing organizational capital, there was little

change in the level of participation among volunteers and those who may have received some compensation but were not involved primarily for the money.

There was no discernible difference in the open source community, those people who were contributing for free anyway. (Ted Parker, personal interview, 3/4/2007)

Therefore, we can conclude that the capital structure of the ecosystem changed in several ways due to the departure of a key entity of the ecosystem (TCorp), which led to a lesser state of health (in terms of productivity, number of members, number of relationships, and stability).

However, the ecosystem was able to restructure itself in order to continue to exist.

Table 5: Capital Observations – TCorp Failure

<i>Capital Type</i>	<i>Instance</i>
<i>Social</i>	Community Relationships
<i>Organizational</i>	Source code
<i>Symbolic</i>	Credibility
<i>Human</i>	Development Expertise
<i>Economic</i>	Personal Funds Working Funds (MComp Firm) Wages

4.2.5.2 Mechanisms

TCorp's inability to find sources willing to pursue an *investment* round led to the end of the working capital of the firm from which it funded operations. It would be interesting speculation to consider how the eventual history would have changed had this investment occurred, since the business model in place at the time was not fully compatible with the strategic direction that was ultimately taken.

With no working capital available, there was no way for TCorp to continue paying the key contributors for their efforts. As a result, these individuals were less inclined to continue

their association with the development community with no certainty that they would receive *compensation* for their efforts. As we discussed earlier in relation to the Barnard-Simon Theory, individuals are less likely to contribute when they don't expect to receive benefits which they consider fair for the amount of effort they expend. This reduced *attraction* works in reverse from the previous incarnation in that it results in a development community that is smaller.

The smaller community also works in reverse with respect to two mechanisms previously mentioned. The *legitimization* mechanism is reversed because the level of activity is reduced, which lowers the credibility of the MComp community. The smaller community also reduces the amount of knowledge that is available for exploitation by the remaining members. If the only contributions were from members who were being financially compensated, it is questionable whether the project would have survived. But this shows one of the strong points of open source software in that the software is accessible separately from any single company that may go out of business, which makes complete failure difficult. Because the MComp software was still available, those members whose relationships were established because of an attraction to the software itself were still able to satisfy their wishes and remained involved in the project.

4.3 MComp Group Founding

4.3.1 Antecedent

Following the failure of TCorp, the development community surrounding the MComp software was continuing to thrive even without the financial support. The primary message boards, where most of the conversation was held regarding the state of the project and the development activities, remained very active. Many of the previously employed developers had either left or severely curtailed their involvement in the project, but the volunteer developers had simply continued developing the software as they had been doing beforehand. As a result, the

software continued to be visible and attracted new users and developers, which made it viable in its industry space.

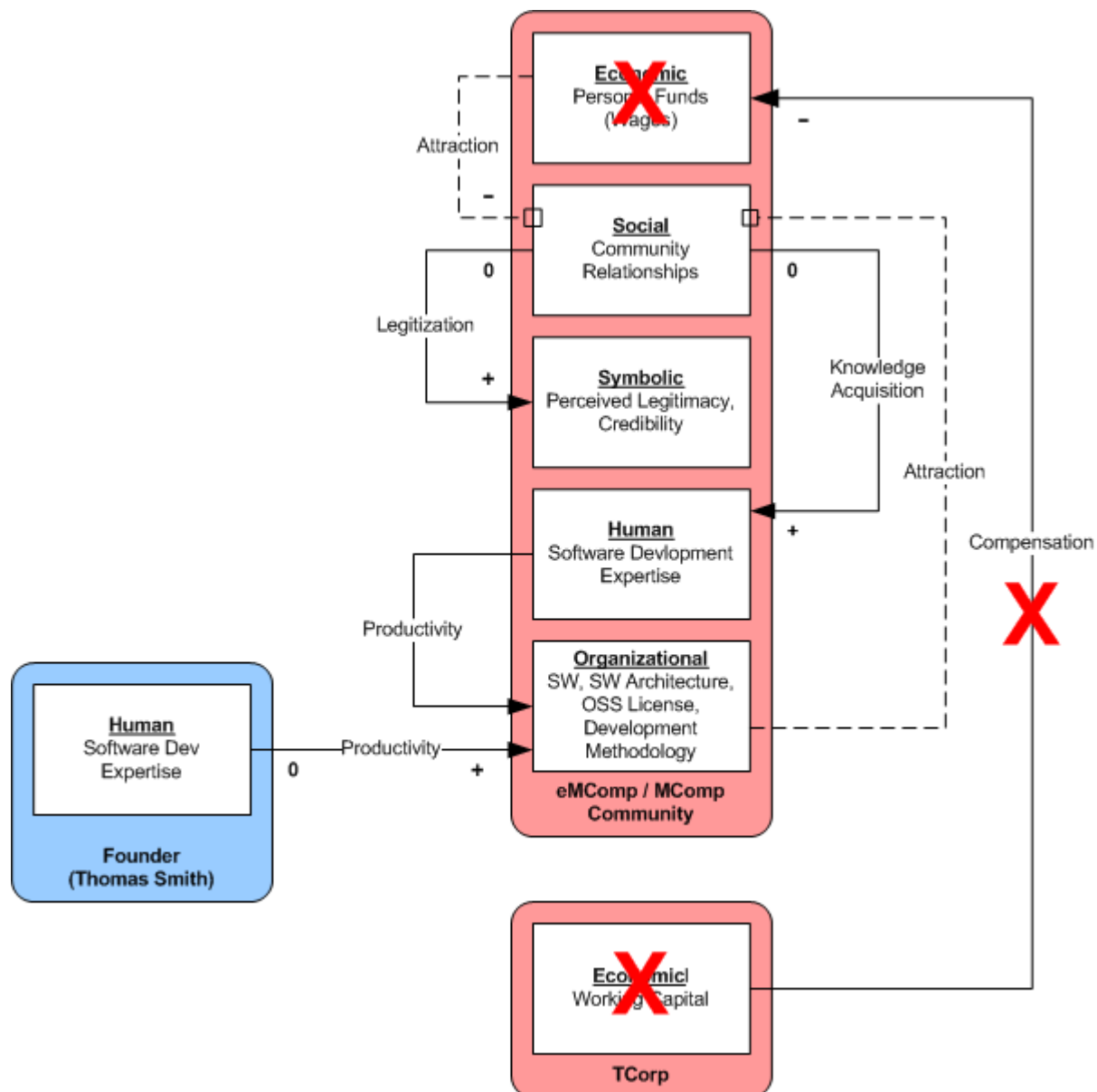


Figure 8: Capital Flow Diagram – TCorp Failure

Smith had run out of money and relocated to Atlanta. He was no longer in a position to financially support the MComp project, nor was he able to draw any income from his development or managerial efforts. However, he still felt that with all of the positive things that had been accomplished over the previous two years, there should be some way to build a

business around the software and the community. But this time, the emphasis had to be on building a great product and (unlike the first time) finding a way to make money.

I have given and given and given. We are facing serious needs now that go beyond the "calling". The calling got me going 2 years now and got me to self maintain as long as I could, in fact burn my savings. I am again beyond exhaustion now and so is Randy, in fact it is getting so bad that I just have to face the music.

Find money or die.(Thomas Smith, MComp-Dev mailing list, dated Feb 21, 2001)

4.3.2 Planning

The new MComp ecosystem required a new business model compared to anything that had been attempted with TCorp. The reincarnated version of MComp would have to be built on three basic principles. First, the software and the community that was involved with developing and nurturing it needed to remain “free” and open source. Smith felt that the biggest strength of MComp was the quality of the product and the vitality of the community surrounding it.

The problem is not in recruitment now, you guys are IT! Nobody has this MComp-dev list and talent, nobody! It is not the patch flow, since patches do come and people can work on the code. MComp user is a screaming success of support with 3 levels. (Thomas Smith, posting on MComp-Dev mailing list, dated Feb 6, 2001)

As such, both the quality of the product and the vitality of the community needed to remain true to their open source foundation in order to insure their growth. This time, Smith attempted to more directly leverage the talent in the community as well as the server to generate revenues.

A second principle was that the company would need to be immediately profitable since there was little possibility of getting venture funding in the current climate.

I had to keep revenues ahead of expenses at all times. Since I had already lost my savings, I had to make money on my venture from the get-go. I had no choice. (Smith, BusinessWeek interview, September 3, 2003)

The third principle was that the revenues would need to be sufficient to sustain the entire team of MComp developers and contributors. Thomas insisted that these revenues should be shared throughout the ranks of the organization, including volunteers, instead of being concentrated solely in the hands of the employees. In so doing, he hoped to gain support of the developers and users rather than alienating them.

The earlier experience with TCorp convinced Smith and many others that this was not a sustainable model unless there were some ways of not only providing a high quality product developed by the community, but also paying several of these members (not just Marc) to provide the necessary management and support services.

The problem is "delegation". To delegate I need dedicated people. I work full time on this, because I can support myself. Randy to some degree. But that's it! ... Dedicated resources need to be full time. I am sorry but there is just no way around it. Managing MComp takes 10 full time people imho today. We can't do like Linux and wait 10 years for things to slowly grow and manage themselves. In 10 years J2EE will be gone (if succesful [sic] :). This is the time! (Thomas Smith, MComp-Dev mailing list, dated 2/6/2001)

The business model that he wanted to put in place included revenues from several service activities such as training, support, consulting, and OEM contracts. Each of these services leveraged the knowledge and skills within the existing ecosystem to satisfy the needs of other members. However, the new business plan and the manpower that they would need in order to address these changes were difficult to put into place without a significant amount of cash upfront.

4.3.3 Stress

In early 2001, Smith got several requests via the mailing lists for training on EJBs and MComp. Several posters needed training either for themselves or for the employees at their firm. Initially, he was focused on trying to rebuild the business and was somewhat hesitant to do this training, which he did not originally see as being profitable.

People came to me saying ‘Can you train me on this?’ One came and I said, ‘No, I can’t do that.’ Once ten came and said ‘Can you train us on this?’ And I said “Sure, I can!” (Thomas Smith, personal interview, 2005)

The first training classes were held onsite at the requesting company’s location. In February of 2001, Smith announced an open enrollment course to be held in Atlanta in May “by popular demand and in order to partially finance the continued development of MComp.” The twenty seats for that training sold out at \$3,000 each, bringing \$60K in revenues.

Parallel with that effort, he and a partner were selling copies of the documentation online to the developers at \$10 per manual or \$100 for a subscription. On the mailing lists, Smith offered to share the profits from the documentation sales with anyone who significantly contributed to writing it.

This is "MCOMP GROUP" all of you that write doco are automatically part of this "virtual company". There is a 30% cut that goes towards the maintaince [sic] of MComp org. The rest 70% is shared among authors. (Thomas Smith, MComp-Dev mailing list, dated 3/15/2001)

This documentation effort brought in excess of \$200K the first year. (Thomas Smith, personal interview, 2005) Combining the revenues from training and documentation efforts, Smith and the rest of the MComp team began to believe that a sustainable business model around MComp was indeed possible to create. Thus, in August of 2001, the MComp Group, LLC was officially formed.

4.3.4 Adaptation

As the training and documentation took off, other requests began to come in from customers for consulting and support. Knowing that he would not be able to provide all of these services himself, he reached out to the community for potential help.

From: Thomas Smith
Sent: Saturday, April 28, 2001 3:58 PM
Subject: [MComp-user] SUPPORT OF MCOMP --IMPORTANT-- PLEASE READ

Folks,

We have found out that there is an exploding demand for support on MComp technologies.

Would you be ready, *on behalf of MComp Group (MCG)* to provide some support -- obviously on a retributed [sic] basis?

At this point, this is not a final plan but simply a call for participants to identify available and willing talent.

If we embark in that activity as MCG, we'll have to streamline and coordinate it. Hence your answer is *very important* to get started.

More on the subject in the near future if indeed resources prove available.

Regards

Thomas Smith, Ph.D

Several people responded and the MComp Group was on its way to creating a sustainable revenue flow. This business model continued through several iterations for several years, generating revenues sufficient to hire developers and fully support the development of the MComp software.

The core of the new business model was the separation of the MComp Group (MCG) from the open source project, dubbed MComp.org (MCO). MCG consisted of the group of MComp developers “selling services around MComp and supporting their own creation” whereas MCO was the “non-profit, open source loving and recruiting ground it has always been.” Essentially, the activities of MCG would be able to support not only the developers but the activities of MCO as well. In so doing, the OSS nature of the organization would be preserved while enabling the establishment of a dedicated core of developers that would be able to manage the growth and management of the code base on a full-time basis.

I believe we can earn a good living at our trade, our trade being MComp. The reason is that I place my peers before many other things. I will find a way to get many of us to the point where we can survive and even thrive financially. That is my goal. (Thomas Smith, MComp-Dev mailing list, dated 2/21/2001)

Several people disagreed with the practice of earning money from an open source project, however. This included profiting from sales of documentation, consulting, and customer support packages as these were traditionally provided by the volunteer community surrounding the software. Several members of the community such as Randy Terry eventually left over this largely philosophical divide. Others remained, with the understanding that the MComp Group was indeed planning to continue pursuing a strategy, dubbed Professional Open Source, in which the open source product would be used to generate financial benefits for the people who contribute most towards its success (Watson, Wynn, and Boudreau, 2005). It is safe to say that this conflict was never completely resolved between the two sides, with some complaints being voiced even after the acquisition of MComp by OpenSoft in 2006.

4.3.5 Analysis

4.3.5.1 Capital

The specific *stress* within a given episode is the action that alters the health of the ecosystem. The failure of the TCorp organization clearly left the ecosystem in a vulnerable state. The specific action that restored some of the health to the system (and thus, the actual stress of this episode) was the first training class, which effectively seeded much of its subsequent growth. The first two training classes introduced \$120,000 into the coffers of the MComp Group, which allowed the rest of the business plan to be enacted.

The ability of the ecosystem to generate revenues [economic capital] depended on its ability to capture the value of the capital that existed, including the software and the skills of the participants. From the earliest days of EMComp, there had been a tremendous accumulation of both human capital and organizational capital. The human capital has grown along with the size of the development community, as the skills of the new participants were made available to the rest of the ecosystem. The organizational capital followed from this as the accumulated

conversion of human capital to such things as software, documentation, and support/maintenance tips [organizational capital] found in the message forums and mailing lists. However, the next phase would require the company to learn how to make money from this accumulated capital.

MComp is maturing really fast, we went from "technology development" (1st stage) to "group development" (2nd stage) and now to "business development" (3rd stage). Most groups don't have 1, we are technologically advanced and they need to catch up. I believe 2 is also our strength, this list, this crowd, it is huge... we have 500 downloads/day SOLID. Some might be more savvy on 3? more savvy on business? sure!... but hey we are learning fast! (Thomas Smith, MComp-user mailing lists, dated 1/27/01)

The difficulty was therefore in keeping the key contributors content enough to enable the necessary capital flows to continue. For those whose contributions were tied to a technological need (e.g. developers or IT staff), these needs were simply a software application that met the specific technical requirements. Other contributors were hoping to learn more about technologies such as J2EE and EJBs.

Other contributors, such as Thomas and others, were attempting to learn more, but also to earn a living which would in some ways subsidize their ability to do so.

I know that this is mostly a labor of love for Thomas and Randy (the heart and brains of MComp). But if they are going to continue to devote vast amounts of time to MComp, they can't work 100% for free. Nor should they. (Nor should they work even 1% for free, unless they want to.)

Don't get me wrong... I think that there are many motivations for the people who work on MComp, and some of those reasons are of the "good for humanity" type (and the "this is fun" type too). But if they were to view the open-source license of MComp as a business strategy to grab market share and make their services and associated products more valuable, I say good for them. (MComp-user mailing list, dated 1/25/01)

One of the primary problems with OSS is the lack of ability to control the project schedule for volunteer skilled developers. These people typically have other primary roles and responsibilities which preclude them from devoting their full attention on a volunteer project. Thus, tasks which are relatively complex or less fun (such as documentation, security/logon, etc.)

often remain on the ‘back burner’ unassigned. A full-time staff would be able to address these issues as well as other time consuming services such as on-demand consulting and support that would be difficult to accomplish on a part-time basis.

As the EJB specification found its way into the mainstream, there were several needs that were not being addressed by the ecosystem. Users were requiring training and consulting [human capital] in order to take advantage of this emerging technology. These services were not easily obtained from indirect communications media such as email or discussion forums. Instead, these services were best handled in an interactive format, preferably face-to-face. The non-interactive nature of open source software projects typically precludes these services from being provided.

The provisioning of training services, documentation, and consulting by the core team of developers enabled the MComp ecosystem to solve two problems. First, these services resolved several perceived personal or organizational needs by the participants. The training classes were an efficient way for an organization to acquire additional expertise and knowledge of MComp and the EJB specs [human capital]. Similarly, those users and developers requiring specific assistance with a development project or task were able to access these services [human capital] to meet their needs. Second, the financial compensation [economic capital] that MCG received in this exchange enabled the continued existence of a full-time core which could efficiently manage the development and growth of the organizational capital upon which much of the ecosystem was based. This compensation also allowed the core team members to receive personal wages [economic capital] from the firm in order to meet their individual financial needs, which helped ensure their further participation in the ecosystem.

The establishment of the MComp Group (MCG) created a separate but interrelated part of the ecosystem with a capital base largely separate from that of the developer community

centered about MComp.org (MCO). However, MCG and MCO were interrelated in many ways. The two shared a number of social ties [social capital], with several members of MCG actively participating on the forums and mailing lists for MCO. The two entities also shared each other's legitimacy and credibility [symbolic capital] since a failure of one would impact the other. MCG was perhaps more dependent on the credibility of the community encompassed by MCO than vice versa, as proved by the TCorp failure which did not destroy MCO. Also, the two shared a common base of organizational capital with MCG having possession of some additional resources (primarily documentation at this point). Finally, as would be expected given open source norms, both entities depended on the continued transfer of effort between them, which was important to Smith when the idea for the MCG was devised.

Table 6: Capital Observations – MComp Group Founding

<i>Capital Type</i>	<i>Instance</i>
<i>Social</i>	Community Relationships
<i>Organizational</i>	Documentation Codified Support Source code
<i>Symbolic</i>	Credibility Legitimacy Reputation
<i>Human</i>	Product Expertise Development Expertise Technical Knowledge
<i>Economic</i>	Revenues Wages

4.3.5.2 Mechanisms

The key mechanisms in this episode were the exchange of human and organizational capital for economic capital, satisfying the mutual needs of both MCG and the end-users in the ecosystem. This flow was precipitated by the awareness of both parties of the gaps in their existing capital portfolios. The users recognized the gap between their current and desired levels of technical knowledge [human capital] which other MComp developers could satisfy. Similarly,

the core of the MComp team realized that their biggest need at the outset of this episode was money [economic capital] to continue the development of the software.

These perceived gaps triggered the motivation (or *gap awareness* mechanisms) for both sides to engage in the exchange relationships. MCG was able to enact *knowledge transfer* mechanisms (i.e. training and consulting) to share their technical knowledge of the software and underlying technology with the other members of the ecosystem. In exchange, the members provided compensation which met the needs of MCG and its members. As the ecosystem matured, more relationships were set up to trade additional human capital via consulting and direct consulting in exchange for further compensation. Additional *coordination* mechanisms evolved to establish the parameters and expectations around these relationships. It is the relationships that literally saved the MComp ecosystem (and particularly the MCG) from demise.

The economic capital acquired by MCG allowed them to compensate members of the MCO for their efforts in producing the MComp software (*productivity*) and writing documentation (*codification*). These codification mechanisms are specific forms of productivity mechanisms which allow individuals to convert their human capital into stored organizational capital. In this case, the resulting documentation is available for subsequent users to convert back into human capital. The conversion of human capital into source code, which we have defined earlier as *productivity*, entails some degree of codification since participants can learn more about software development by examining the source code.

This documentation also enabled MCG to establish an additional set of relationships for the exchange of documentation, pairing a *compensation* mechanism with the transfer of human capital to the members. Because the software was released open source, there was little opportunity for the organization to receive similar compensation for the *adoption* of the software

itself. Instead, users could download and install the software free of charge from the repository on Sourceforge.net. As such, the documentation and services were the only resources which MCG could exchange for the necessary financial capital.

As the money started flowing in, there was a consequent increase in the *legitimization* of the *MComp Group*. *Legitimacy* can be defined as the “generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate”. The general consensus throughout the software industry seemed to be that MComp actions were within the scope and rights of the license and represented a laudable attempt at finding a way to provide significant income for open source software developers. In the process, Smith himself also gained a certain degree of reputation and status [symbolic capital] as the financial and organizational success of the organization grew.

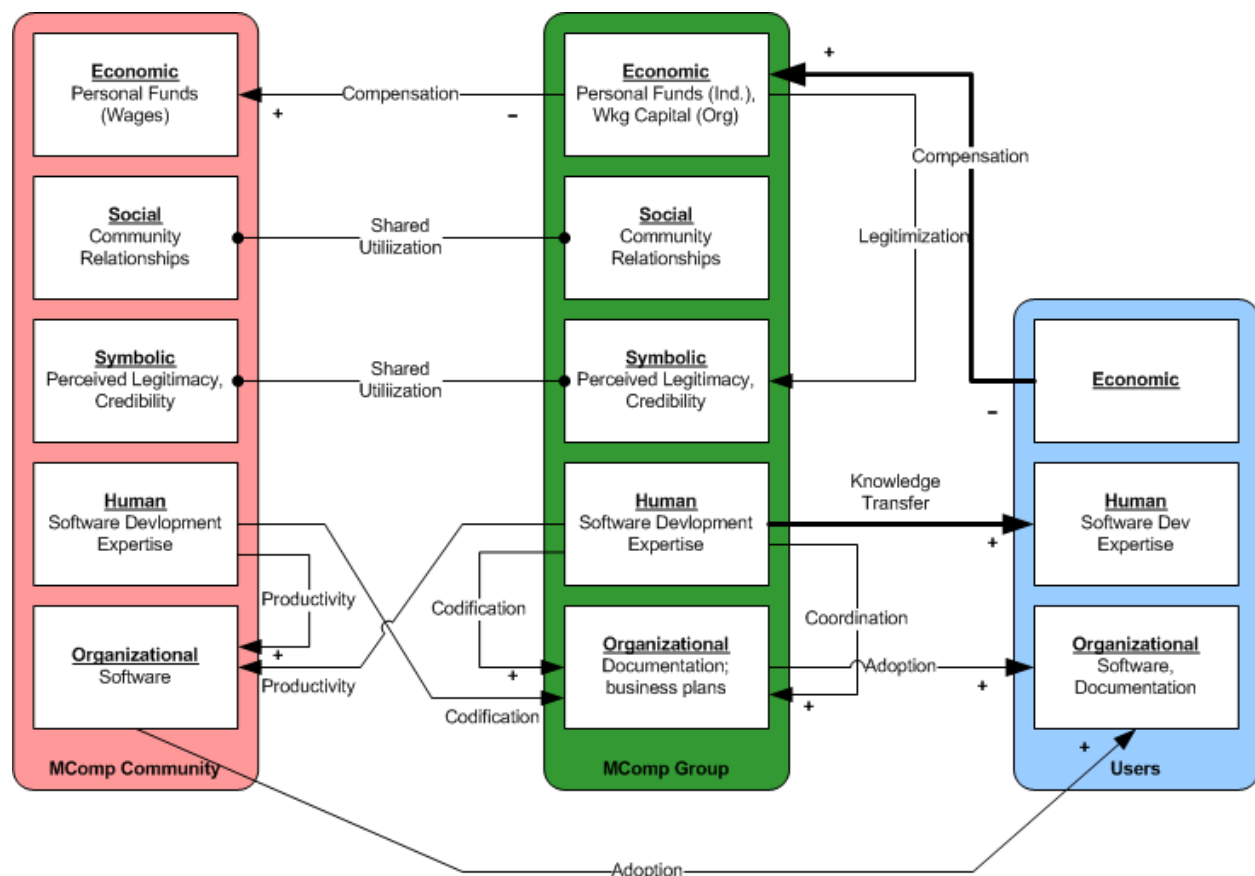


Figure 9: Capital Flow Diagram – MComp Group founded

4.4 Bill Coleman Hiring

Over the life of the firm to date, there have been several managerial hires that have had a positive impact on the success of the firm. Without question, the most significant hire has been Bill Coleman, former general manager for Compugiant's Middleware Division. In fact, many of the other managerial hires were initiated by Bill Coleman. As such, we will focus the discussion of the officer hiring on the impact of his joining the company.

4.4.1 Antecedent

In 2002, the software was picking up traction among developers and OEMs. MComp Group (MCG) was following through with its mission to earn revenues through the sale of documentation, training sessions, and consulting services. The revenue mix had progressed from 100% training immediately upon forming the new company, to a 60/40 split training and documentation, to the current mix of about 40/20/40 for training, documentation, and consulting, respectively.²¹ The gross margin on training services was reasonable, at about 50%, but consulting has horrible margins because of the cost of labor involved. In order to scale the business with consulting would require hiring or contracting with significantly more developers.

Thomas Smith at that time had little managerial credibility based on his previous business failure. With the MComp Group, he pursued a conservative strategy of growth without taking on any additional funding or debt, which was succeeding but was not positioning the company to grow significantly from the current level.

In late 2002, Smith hired Ben Lewis as Director of Sales and Business Development (or rather, Lewis "hired himself" as the story is told around MComp). Initially, Lewis began signing training sessions for MCG, generating revenues for both himself and MCG until Smith officially

²¹ Per conversation with Thomas Smith, May 2005.

signed him as the first non-technical employee. Lewis gets credit from several insiders as being the one who saw much of the early business potential in MComp.

Ben was like the heart and soul of that company especially on the business side and getting the customers, getting the early customers, getting the revenue, saying we can create a business around this, we can sell this training. We can do all these things. ... You'd never say [Thomas Smith]'s not an entrepreneur. But at the end of the day, the person that took this from a cool little technology project to a business; it was Ben Lewis. (MComp developer, personal interview, 1/18/2007)

But even Lewis had little experience running a large company, so at some point the company would need more experienced management in order to continue to grow.

Meanwhile, Bill Coleman was winding down his tenure with Compugiant. His previous company, CSoft, developed a J2EE application server that was distributed under a proprietary license. Compugiant acquired CSoft in 2001 and Coleman was hired as CTO and later General Manager of Compugiant's Middleware division. In 2002, Compugiant retired this division as it merged with Compaq. At this point, Coleman retired from Compugiant to ponder his future.

4.4.2 Planning

Before closing CSoft down, Compugiant (following Coleman's suggestion) decided to give away the application server for free (instead of charging license fees for its usage) in order to capitalize on the partnerships and subsequent revenue streams. Unfortunately, Compugiant shut the division down before the plan could fully mature, but the news of this plan reached Smith and Lewis at MComp. They sent a letter to Coleman and Compugiant's CEO to discuss possibly finding a way to service part of that relationship. Coleman responded, suggesting that he agreed with such an approach and that they should meet to talk in a few weeks after he left Compugiant.

Smith and Lewis went to New York for a training class a few weeks later. During that trip, they found time to meet Coleman for drinks.

We started talking and we walked out of there and Mark and I looked at each other and we were like ‘we need to hire him’. (Ben Lewis, personal interview, 1/31/2007)

4.4.3 Stress

In September of 2002, Coleman became a senior advisor and part-time member of the MComp Group Board of Advisors. In September of 2003, he joined full time as Executive Vice President, Strategy & Corporate Development.

4.4.4 Adaptation

Over time, Coleman’s role grew to the point that Smith described him as his “right hand man.” His accomplishments within MComp include leading the project to obtain J2EE certification from Sun, leading the negotiations for venture capital funding (which was Coleman’s suggestion originally), and hiring much of the executive team. The company experienced significant growth during his tenure in terms of both revenues and employees. As shown in Figure 10, the sales figures have gone up tremendously since his arrival. In a blog posting, Coleman has claimed that monthly sales increased from September 2003 to July 2005 by about 9X.²² Similarly, employee headcount rose from 10 to over 250 during his tenure.

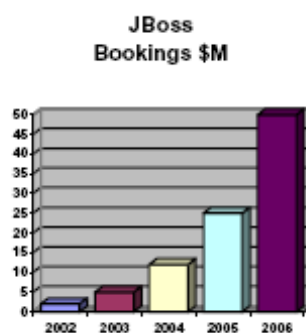


Figure 10: MComp Bookings by year, 2002-2006²³

²² Bill Coleman’s Blog, last accessed 5/21/2007.

²³ From Bill Coleman’s resume, last accessed 5/21/2007.

Specifically, Coleman is credited by many people in the ecosystem as the one who enabled the company to mature from a small startup to the company that was later acquired by OpenSoft.

Bill Coleman getting hired was kind of important because it set the precedence of okay, this is going to be really kind of a business driven company. We're going to think about strategic things. (MComp Developer, personal interview, 1/25/2007)

Coleman came on in an instrumental point because they were moving from being kind of a training company to be a fully featured software vendor. And Coleman had been a big part of the CSoft sale to Compugiant and understood the Compugiant Middleware Group pretty well. I think for them they needed some help in kind of transitioning from five guys in a garage to 50 to 100 guys. And Bill Coleman had the right expertise. He understood the middleware market. He understood the commercial middleware He understood cause he understood the middleware buyer. (Raven Zachary, personal interview)

It was really Bill Coleman who did a great, great job of setting things up and helping Thomas go get the investment money there. And actually I learned a lot watching Coleman and Thomas. (Todd Mayweather, personal interview, 2/2/2007)

Coleman's greatest achievement was establishing a more stable business model that could scale easily to enable MComp Group (MCG) to generate repeatable, predictable revenues. The core of this strategy was the establishment of a partner ecosystem to handle much of the services load while still providing revenues to MCG. Much of his thinking on this model was based on his experiences with CSoft, but MCG and open source provided the perfect environment to enact such a model. By signing additional partners to handle much of the first and second-level support, MComp could focus on the more profitable third-level support. The majority of the labor expense was fielded by the partners, making the margins for MCG on these relationships significantly higher than handling all of the support themselves. Additionally, OEMs and ISVs (independent software vendors) were signed to support contracts to cover the MComp software they embedded into their products and software. From these types of contracts,

MCG was able to establish stable, dependable revenue stream which would enable them to acquire venture capital funding or perhaps later, to go public.

Coleman left in early 2006, just as the OpenSoft acquisition went final.

My job was to help get the thing off the ground and going and that's the part that interests me personally....I had kind of accomplished what I had come to do, I mean, the senior management team is hired, the business model, the *repeatable* business model was in place, we had surrounded ourselves with strong partners, and things like that. (Bill Coleman, personal interview, 6/13/2006)

4.4.5 Analysis

4.4.5.1 Capital

Prior to joining MComp, Coleman had been an entrepreneur with a company that had developed a J2EE application server and been acquired by Compugiant, where he had been in charge of a large software division. Because of this history, he brought knowledge [human capital] of several topics that were in demand by the MComp Group team, including entrepreneurial, managerial, strategic, and software industry knowledge (particularly in middleware). These experiences served as a tremendous source of relevant managerial knowledge that was of great benefit to Smith and the rest of the MComp Group executive team.

Coleman also had developed a number of contacts within the software industry and among the venture capital community [social capital]. Many of the subsequent executive hires were brought in by Coleman to help establish a strategic team around the MComp Group that could help it mature into a professional organization. Additionally, his success in building a company that had been acquired by a major corporation, he held a reputation as a successful entrepreneur [symbolic capital], which would prove to benefit MComp in later episodes.

Prior to his arrival, the managerial team with MComp had been able to execute the business plan that had been established to take advantage of the training and support opportunities presented to them by customers. Unfortunately, this business model was not

capable of growing much further than its then-current level. Coleman was instrumental in crafting a new business model for MComp [organizational capital], introducing a number of changes that enabled the firm to grow their revenues by a factor of 10.

Table 7: Capital Observation – Bill Coleman hiring

<i>Capital Type</i>	<i>Instance</i>
<i>Social</i>	Industry Contacts Partnership Relationships Community Relationships
<i>Organizational</i>	Business Model
<i>Symbolic</i>	Personal Reputation Legitimacy Credibility
<i>Human</i>	Management Experience
<i>Economic</i>	

4.4.5.2 Mechanisms

By most accounts, Bill Coleman’s experience and knowledge of the software industry, particularly of the middleware space, was a crucial factor in the growth of MComp. Thomas Smith and other members of the MComp Group management team were able to benefit from Coleman’s ability to share his knowledge and experiences with them (or *knowledge sharing mechanisms*). Other members of that team were able to share their knowledge and experiences from different viewpoints as well. For example, the COO had been a senior level executive with two very large software companies and ITwo (President of the Americas) and thus had significant software experience and credibility as well. Similarly, the CFO had held similar senior executive posts.

The key to this episode is the application of Coleman’s human knowledge in the implementation of a new business model. In establishing the new set of routines and business practices, the strategic destiny for MComp was altered. The new business model was effective as

an *attraction* for new customer and partner relationships as the firm sought the repeatable, consistent revenues that were unattainable under the previous business model. It also encouraged the *attraction* of new contacts among venture capitalists and corporate investors, which will be important in later episodes. But none of this would have occurred had it not been for the establishment of the new business model.

The implementation of the new business model also led to an increased level of credibility and legitimacy for the firm. The ability of the firm to attract and secure venture capital funding was a subsequent direct result of this *legitimization*. Additionally, MComp acquired much-needed credibility in the enterprise software industry and among VCs because of Coleman's participation (*shared utilization*). They also were able to benefit from the business contacts and VC relationships that he brought to the company (*shared utilization*).

Many of the changes to the business model that were introduced during Coleman's tenure have proved to be innovative within the open source industry, leading to many open source firms copying the model to build their organizations. As they have, Coleman's reputation [symbolic capital] as the original 'mastermind' behind the success of the business model has grown, enabling him to work with other new open source firms to help them achieve similar success as MComp.

4.5 RDT Defection

4.5.1 Antecedent

By early 2003, MComp had grown in stature and credibility. The downloads of the MComp Application Server had grown from approximately 25,000 per month in 2001 to 150,000 per month. Version 4.0 of the software was being prepared for release vs. version 2.0 released in 2001. There were 16 fulltime employees of the MCG, including 9 consultants, 2 other

developers (not including Thomas Smith), and a five person administrative staff. There were also 18 other people listed on the MComp website as ‘active core developers’.

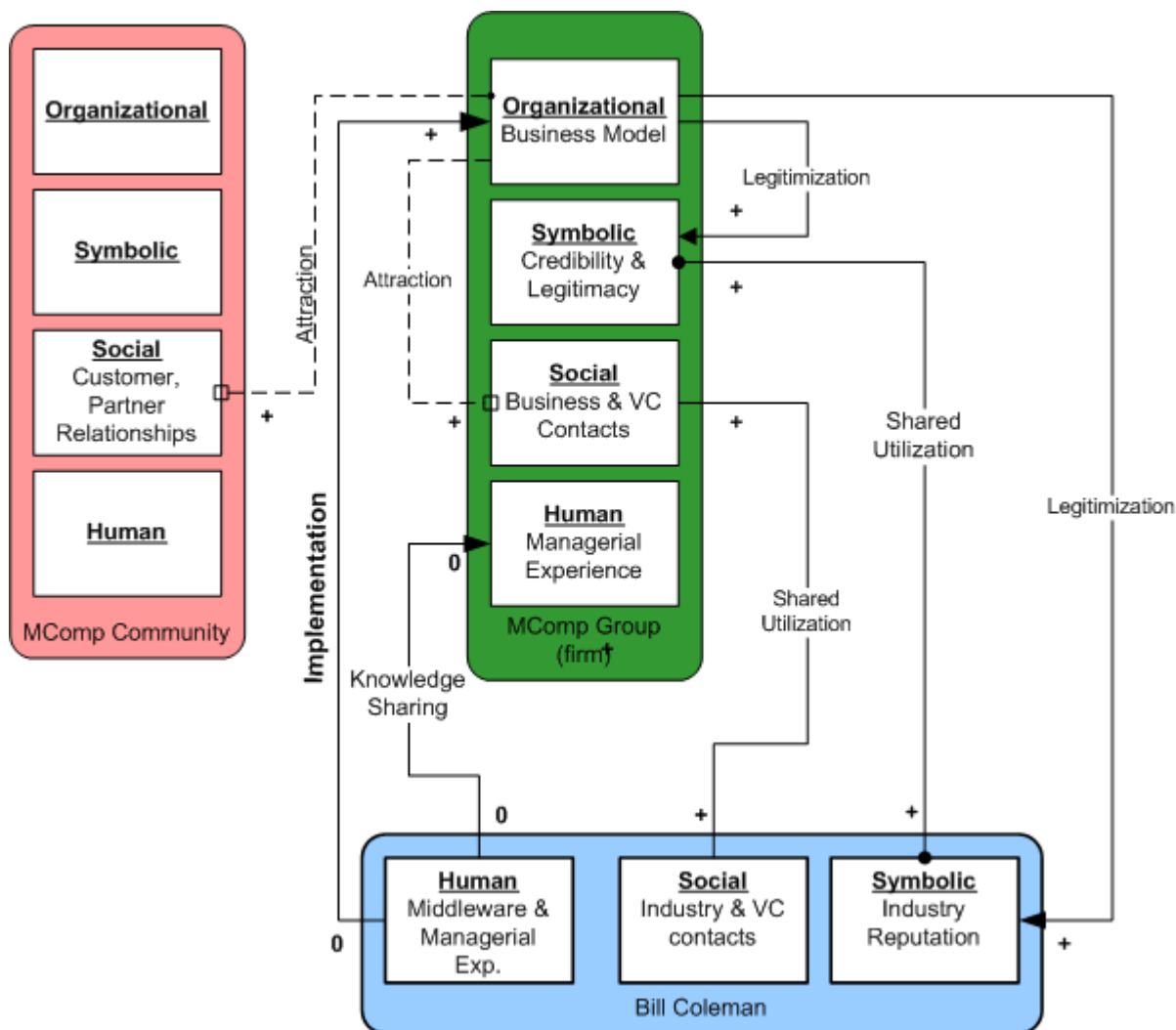


Figure 11: Capital Flow Diagram – Bill Coleman Hiring

The MComp Group (MCG) was continuing its mission of providing documentation, training, and consulting services to generate revenues from which they were able to pay their employees and consultants to fund the development of the MComp software.

In March 2003, MComp developed a compensation plan (written by Thomas Smith’s father) that offered “economic interest options” and cash bonuses to 37 developers based on their

contributions to the MComp App Server in 2002 and earlier. These options and cash were offered to these developers without any obligation, regardless of whether they were currently employed by MCG or not. The compensation plan was voted on by the members of MCG with one member (Will Baker) strongly dissenting while the others, including founders Smith and Scott Stark felt that the previous developers deserved a piece of the company.

A vocal opposition ensued within the MComp ecosystem, with Smith being accused of being a hypocrite for attempting to profit from open source software. For many people, this amounted to Thomas Smith taking the voluntary efforts of a number of contributors and converting them to benefit his personal wealth. Smith would counter with the argument that the software remained free and that the profits were only achieved from services provided on top of the software.

A group of MComp insiders became displeased at the allocations they received as a result of the compensation plan. They also believed that their cut of the revenue stream was too low compared to the cut that MCG retained, which was countered by the MCG management team.

Guys used to think we were taking too much off the top mind you they went for a week of training we paid them \$10,000 for the week. ...If we were charging the customer \$4,000, they got \$2,000. Taking 50% of a spread when you have a business operating is ridiculous. And they thought Thomas was making too much money and they thought that they were better than that. What are you going to do? (Ben Lewis, personal interview, 1/31/2007)

One of the insiders claimed that he only got six hours of support work in exchange for being on call for two years. He also suggested that the distribution of equity and compensation was not handled appropriately.

We did not expect to make money from writing our code. But when somebody started making lots of money by selling access to US the developers (not selling distributions of the code or anything) - then we felt we at least deserved a fair

share of the branding and scalable income. Not just to get paid for the hours we worked - we can get that anywhere. (Greg Wilkins)²⁴

Thus, they felt that they wanted something different for their continued involvement in MCG.

4.5.2 Planning

For several months, these developers met in secrecy while they planned their defection from the MComp Group. The idea was to form a company which would compete with MCG for the training, consulting, and services business they currently received. The planning for this, including setting up training dates, developing a corporate identity package, building a website, and creating a document subscription service had been conducted while six of the seven founders were consulting on behalf of MCG, including two full-time employees of MCG. Additionally, the founders downloaded a full copy of MComp' software, which they intended to maintain and support themselves, essentially 'forking' the code.

From the perspective of the MComp Group members, the stress was unanticipated by them. Thus, no planning efforts were done by the management team or other members of the ecosystem.

4.5.3 Stress

On June 5, 2003, the Rival Development Team (RDT) members announced their existence. The announcement was timed to coincide with the start of JavaOne the next day in San Francisco (for which the RDT had already registered an exhibit booth). The official announcement stated that the RDT was "a partnership of peers with the guiding principles of integrity, openness, and fairness." Their stated intentions were to provide support for not only the MComp project but also to provide support and integration services for other open source

²⁴ From an online article, posted July 2, 2003. (Last accessed 5/20/2007)

projects. At their launch, they had built a website that featured the ability to register for training courses on two continents, purchase documentation subscriptions, and arrange support contracts.

Since the RDT formation had been done in secrecy, no one at MCG knew it was coming, making the defection a complete shock to them. Many, including Thomas Smith, did not find out until shortly after arriving in San Francisco for the conference. Others believed they had seen signs of discontent from founders, but did not believe it would come to this.

[Y]ou got to remember back at that time I mean, it was like a family. I mean, it was a small group of guys and it's kind of like...it's almost like Civil War for these people to break off and have a succession. (MComp Developer, personal interview, 1/25/2007)

The defectors included two full-time members of the MComp Group who had contributed significant amounts of code and direction over the previous couple of years.²⁵ The other 4 members were members of the core development team at the time they left. This group consisted of the entire Engine crew (Engine was the component used for enabling Java to run in conjunction with a web server), the team leader for the persistence engine used by MComp, and developers with key experience and knowledge in messaging and other features of the app server. The defection also left MComp with a mere 8 consultants, only 1 of whom was in the USA.

Many inside MCG were both shocked and disappointed that the defection had occurred, largely because of the way they left.

It was a big surprise. It was a bit disappointing that they did it the way they did it by attacking...well, what looked to us like attacking the existing MComp Group and the MComp community. (Ted Parker, personal interview, 3/4/2007)

²⁵ In a subsequent message board posting, one of the RDT founders stated that none of the RDT partners were employees of MComp LLC, but instead were independent contractors. As such, they were not bound by rules of employee ownership of intellectual property (message board, last accessed 5/21/2007). It would be easy to suggest that this could have also been a reason for the subsequent decisions to hire the developers instead of simply contracting their services.

I was just appalled particularly after going to their website and them talking about their values as an organization and the number one being integrity. And I thought this is not the correct way to leave a company. It doesn't matter if you have a bone to pick. The proper way to leave a company is to leave a company and then build your own company, not spend time that you're building on behalf of the other company to build your new company. (MComp Developer, personal interview, 1/10/2007)

For their part, the RDT team seemed a bit surprised at the MComp Group's reaction to their departure.

Ask any of the RDTers and we will all tell you we were shocked at how personally [The MComp Group employees] took our split from MComp Group. We were truly stunned that you no longer wanted us to work on the OS project and disappointed that friendships were severed because we did not accept Marc's structure and decided to try something else. (RDT founder, posting on theserverside.com, dated 2/13/2007)²⁶

4.5.4 Adaptation

As can be seen in Figure 12, the incident seemed to have a significant effect on the number of downloads. Although the downloads increased significantly in the months following the RDT defection, there was an immediate reaction from the ecosystem as the number of downloads fell from 200,000 in the May 2003 to approximately 25,000 as the episode played out in June.

The software industry outside MComp believed that it could be a good thing, citing the possibility for increased support options for the MComp software. However, there were plenty of concerns over how MCG would survive, since the RDT folks effectively split the available pool of services revenues between the two organizations.

If MComp Group is lucky, they will lose less than half of their customer base. If they are not, they could lose enough customer base and sponsorship to force them out of business. (comment on Slashdot.net, dated 6/5/03)

²⁶ message board posting, last accessed 6/15/2007

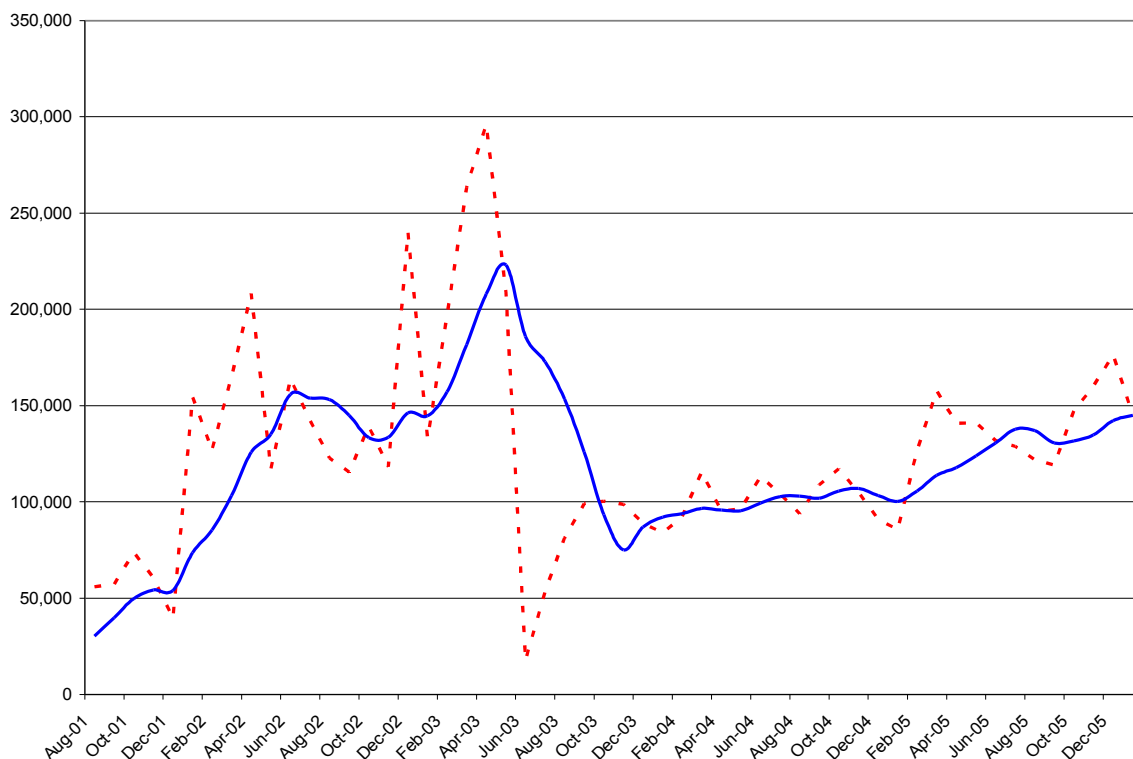


Figure 12: MComp Download History by Month (with smoothed average)

Initially, there was little reaction from the MCG as they needed time to digest the news. The sentiment expressed publicly was that this was no big deal, since the RDT founders took little business with them. Thomas Smith responded that he was “lucky. I lost all the less talented people. All the B-players left, but most importantly all the A-players stayed. (personal interview) Lewis further stated that this group only handled “three percent of our customer base from a support contract perspective” with no customer dropping their MComp Group contracts.

The MCG also went on to suggest that the real reason the RDT partners left was that they were “greedy and impatient”²⁷ or that “people’s egos get in the way.”²⁸

²⁷ Thomas Smith interview, eweek.com, dated 6/10/03

²⁸ Lewis interview, dated 6/5/03

Initially the only reaction to the RDT founding was to remove the defectors from the internal mailing list at MCG, which was done almost immediately. Shortly thereafter, MCG began to take additional steps to protect their interests. The RDT team was warned that they would be sued if they took the MComp code and modified it, but still called it MComp, since Smith owned the trademark for “MComp”. In response, the RDT team replaced the word “MComp” in the copy of the source code they had acquired. The MCG also warned the RDT team against changing or failing to adhere to the restrictions of the LGPL license under which MComp was licensed.

In June of 2003, the RDT partners’ names were removed from the contributors page on the MComp website. This did not include removing them from within the code, which would have been a clear violation of open source principles on attribution and acknowledging credit. This also did not include removing the CVS rights (which allow the users to modify the source code) at that time. However it did not leave any outward impression that these people had ever contributed to the project. Additionally, MComp began to promote Thunder as an alternative to Engine, which was controlled by several of the RDT partners.

By July, the RDT partners realized that the trademark issues would largely preclude them from executing the business model as they had intended. At that point, they petitioned the USF to form a new J2EE project under the Utopian Incubator. They forked the MComp source code and renamed it to remove the MComp trademark from the source code. In so doing, they intended to use the renamed MComp code as a transitional code base which users could adopt immediately while the new code was being prepared. By removing the MComp trademarks, they believed they could avoid the legal war that was threatened earlier.

The proposed fork and redistribution of MComp code was the trigger which led to a massive escalation in the disagreement between the RDT and MCG teams. On August 6, 2003, the day after the Utopian Cigar project was announced, MCG announced several changes which were directly aimed at the RDT partners. The CVS rights for these developers were removed, citing a ‘breach of trust’. This meant they had no authority to manage or maintain the MComp code. There were several official reasons for these removals were based on the lack of public discussion of design issues, conflict of interest between the two projects (particularly the two different licenses) and the lack of trust in these developers by the MComp project administrators (including Thomas Smith). Additionally, the project leader for Thunder was hired as a MComp employee, plugging the gap in the product platform and in the human capital available due to the removal of Engine and the Engine project leaders. Finally, Thomas Smith announced that MComp would actively pursue the J2EE certification, in contrast to earlier statements that they had no interest in paying Sun to do so.

These changes effectively completed the isolation of the RDT members from the MComp organization. Also, many of these changes accelerated the pace of transition from a loosely connected band of developers to a more formally structured company. Several of these actions, such as the hiring of developers and the fate of the Cigar project, will be discussed in subsequent episodes as their impact proves to be significant.

4.5.5 Analysis

4.5.5.1 Capital

The departure of the RDT partners was a significant threat to the survival of the MComp Group. Immediately upon leaving the MComp Group, the RDT members held a significant amount of the expertise [human capital] available in the MComp ecosystem because of their knowledge in several areas (Engine, CMP, messaging). The loss of expertise in several key

components of the MComp platform, including Engine, could have also proved to be difficult for MCG to manage depending on the level of cooperation between the two parties. Because of the RDT members refusal to participate in the MComp developers forum, a number of formal and informal relationships with a number of developers and users throughout the ecosystem were severed [social capital]. Thus at least initially, MCG lost the ability to control the direction of certain aspects of the platform.

The RDT partners also held an exact copy of the MComp code [organizational capital] and tried to leverage their existing relationships with clients [social capital] and their access to the source code [organizational capital] and the continuing contribution of their expertise [human capital] to attract revenues [economic capital] from paying customers.

One difficulty of consulting and professional service businesses is the reliance on additional headcount in order to scale operations. The departure of the six consultants reduced the amount of billable service hours available to the MComp Group, which curtailed and limited the amount of compensation [economic capital] they could achieve. In addition, the competition between the two parties would likely have reduced the potential income available to either party. Additionally, the decrease in perceived solidarity and cooperation within the ecosystem, especially as the disagreement escalated into a war of words between the two parties and their detractors, impacted the sense of legitimacy of the entire ecosystem.

However the RDT partners apparently overestimated how much power [symbolic capital] they possessed. Perhaps the most significant capital holding of the MComp Group was the value of the ‘MComp’ trademark itself [symbolic capital] which had been registered by Thomas Smith himself. Over the life of the project, the value of the trademark and the brand equity it represented had increased steadily based on the number of users and the quality of the MComp

server software. By taking advantage of the value of this trademark, MComp Group was able to effectively disallow use of the code and the brand using the trademark [symbolic capital], effectively controlling the flow of capital in the ecosystem and limiting the ability of the RDT to sustain themselves.

Many of the users were bound to MCG via existing support and maintenance contracts, so very few of the users would be able to establish financial relations with the RDT group. Since there was little impact to the existing contracts, the immediate financial impact was also minimal, but the potential for long-term impact existed if the RDT business had been able to attract and retain customer contracts. By one account, only six of the 175-200 contracts in place at the time were serviced by the RDT partners before their departure. Thus, the onus was squarely on RDT to bring in new relationships and contracts from the MComp ecosystem.

MComp Group members controlled the access to the code base through their roles as project administrators. As such, they were able to retain full control of the source code, which it exercised by removing the CVS rights from the RDT partners upon the discovery of the ELBA fork and Utopian Cigar plans. Following the removal of their ability to commit changes and additions to the software, the RDT group had no more than a passive influence over the direction or functionality of the MComp code. The sum of these actions effectively cut the six former MComp consultants off from the organizational capital that had been built up in the MComp ecosystem over the preceding few years.

“...by the time we came to really formalize it, it was too late as Thomas owned the trademark, the company, had the client contracts, the www site and the CVS access. So we were had all lost our bargaining positions. If we had formalized it two years earlier before MComp was really big and was generating significant revenue - the deal would have been substantially different.”

Because MComp (and not the RDT) held control of the brand via licensing and trademarks [symbolic capital], contribution inputs via CVS access [organizational capital], and

capital distributions [economic capital], it could minimize the damage brought on by the defections. For those areas they were lacking, MComp was able to apply other aspects of its existing capital base to rectify the situation. This includes such actions as hiring rival developers, removing status-reinforcing code from the default install (Engine => Thunder), and pursuing J2EE certification [symbolic capital] for its products. However, MComp took a hit to its legitimacy and credibility [symbolic capital] because of the threat to the entire system.

Table 8: Capital Observations – RDT Defection

Capital Type	Instance
<i>Social</i>	Client Relationships Customer Relationships
<i>Organizational</i>	Source Code (forked) CVS access
<i>Symbolic</i>	Credibility Legitimacy Trademark
<i>Human</i>	Development Expertise Technical Knowledge
<i>Economic</i>	Revenues

4.5.5.2 Mechanisms

The primary mechanism in this episode was the *defection* by the RDT partners. Defection is defined here as “the act of abandoning a position or association, often to join an opposing group.” This differs from the definition proposed in Benkler (2002), who proposes that a defection describes “any action that an agent who participates in a cooperative enterprise can take to increase his or her own benefit from the common effort in a way that undermines the success or integrity of the common effort.” In this case, the six consultants abandoned their positions with the MComp Group in order to form a new partnership. It is not a guarantee that their actions would have undermined the ultimate success of the “common effort”, although we

can assume that there may have been significant differences in the way the MComp Group would have evolved.

The intention of the RDT partners was to copy the project software and documentation and make them available for *adoption* by end users in much the same way that the MComp Group had been able to do. This *forking* mechanism was legal under the dictates of the LGPL license, which explicitly allows such forks in situations where the needs of a particular user are not being met by their participation in the original project. It was not their intention to cease participating in the original project. They had intended to continue contributing source code and support to the MComp development ecosystem (via *productivity* mechanisms) using the CVS rights they possessed via their positions in the MComp Group.

The new organization would also be able to take advantage of the symbolic capital (such as the MComp brand) and community relationships that existed within the ecosystem and by the MComp Group. The partners had established linkages with both of these capital stores and believed they would be able to share the value that had been accumulated in them. In many ways, the Rival development team was attempting to establish an almost exact copy of the MComp Group, albeit with different goals, values, and intentions. Their selling point to customers was not only the level of technical and domain-specific knowledge and expertise that they possessed, but also their possession or linkages to these existing capital bases. These attributes would enable RDT to convince customers to establish exchange relationships by which they could trade *knowledge sharing* (in the form of training, consulting, and support) for financial *compensation*, similar to the relationships established by the MComp Group.

The advantages held by MCG can essentially be defined as *control* mechanisms. When the RDT partners left, they were relying upon the protections offered by the LGPL and by open

source community norms to shield them from any potential retaliatory efforts by the MComp group. These norms were effective in protecting their right to fork the software and to continue participating in the community. The MComp Group was able to cut off the *shared communications* links that the RDT partners held within the core mailing lists. They were also able to use their control of the CVS rights to prevent the RDT partners from making any changes or additions to the MComp software. Because they could fork the software at any point, this did not necessarily introduce a major obstacle.

What the RDT partners clearly underestimated was the value of the MComp trademark. By exercising the value of this trademark, MCG was able to control much of the flow of capital throughout the ecosystem. By asserting their ownership of and willingness to legally defend their trademark, MCG was able to essentially isolate RDT from the MComp ecosystem. This trademark defense enabled the MCG to use the word ‘MComp’ in any way without the permission of the trademark holder, Thomas Smith. Since this meant that they had little chance of getting access to the trademark, the value they could appropriate from the existing symbolic capital was limited because the MComp brand was no longer available for their use. For instance, they could not claim to support “MCompTM” software by name without permission from a rival. Additionally, the trademark was deeply embedded in the source code, so they were limited in how they could distribute the forked source code. Effectively, the trademark possession tilted the balance of power decisively in the favor of the MComp Group.

Professional Open Source firms that can retain control of the various forms of their capital are better able to resist the effects of stresses, and also to respond to these stresses to return to the previous or a new state of equilibrium. The comparative portfolios of capital between the two organizations serves as a measuring stick to evaluate the odds of survival of

both. Once RDT was cut from incoming financial support and existing resources (i.e. website, CVS, etc.), their odds of survival were sharply diminished and the relative strength of the MComp Group was increased.

As these examples show, if we posit the capital portfolio of an organization to be the elements of structure, it is clear that the ability to control and utilize this portfolio (capital) in order to satisfy the needs and expectations of the members is an important class of mechanisms used to resist or respond to stresses that arise. MComp was able to eliminate or minimize the benefits available to the defectors, thus protecting the operations of the ecosystem and the munificence of capital available to trusted members.

4.6 Acquisitions

Over the years, MComp hired the developers of several existing open source projects, including Nukes, Thunder, jBPM, and JGroups. In this episode, we will focus on Mr. Royal and the GSoft project, not only because it was repeatedly cited as the most significant project acquisition in MComp' history but also because of the abundance of information regarding this transaction and its aftermath.

4.6.1 Antecedent

As stated in the preceding episode, MComp had established itself as a viable software product in 2003 with over one million times in the previous year. By most accounts, the vision of building a business based on the services offered around the software was coming to fruition. The MComp Group (MCG) had built a corporate infrastructure including administrative, marketing, sales, finance, and technical support operations.

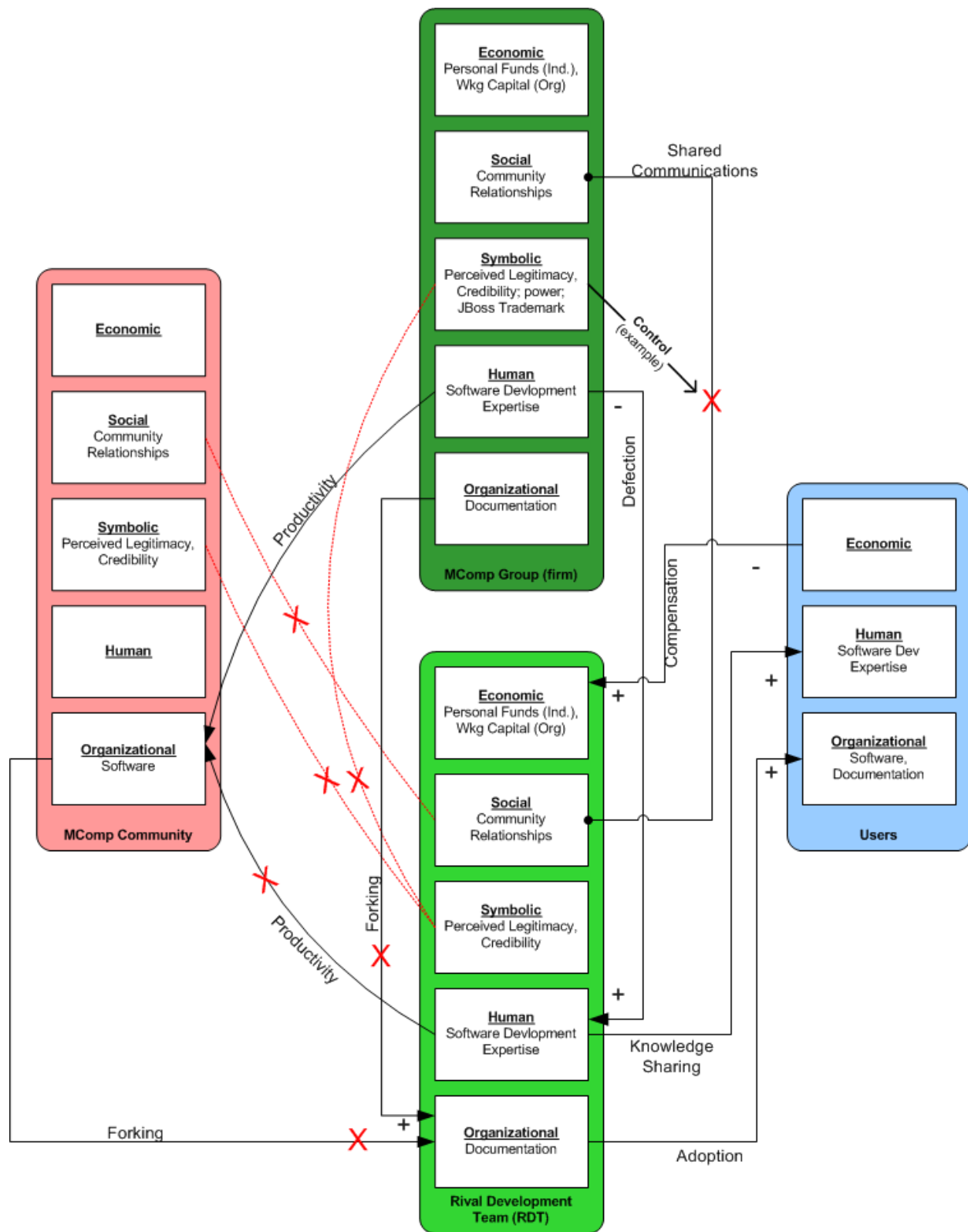


Figure 13: Capital Flow Diagram – Rival Development Team (some flows omitted for clarity)

However, the defection of the former developers that left to found the Rival development team exposed flaws in the business model that was in place. The existing modus operandi called for MCG to sell training or consulting services to customers and assign them to a set of independent contractors. These contractors would deliver the services in exchange for a portion of the fees paid to MCG, which was around 50%. For instance, a week of onsite training would cost the customer approximately \$20,000 of which \$10,000 would be paid to the contractors. The defection of the RDT partners was the result of a group of these contractors being upset over not receiving a higher percentage of these fees nor a significant equity stake in MCG.

The departure of these contractors was also damaging since it limited the available in-house knowledge possessed by MComp for the projects for which they were responsible. One of the chief selling points for MComp was that the services they provided were handled by developers that were involved with writing the very code upon which the software was based. With the RDT folks leaving, this would no longer be a valid statement since the support for components such as Engine, JMS, and MComp 4 Persistence would be handled by either developers that were not leaders for these projects or by developers from another company. For this reason, Thomas Smith considers this a ‘failed stage’ of the company.

That was a failed stage of the company because it’s just too difficult, you know, when money gets involved it’s just too difficult to manage a network of loosely affiliated partners and manage expectations correctly. So in fact that was a failed experiment in a sense that it ended up in a sour note and some developers leaving pissed off because they thought they were not making enough money. (Thomas Smith, personal interview, 2005)

Replacing this capital would require a change in the business model and the way employees were hired and retained within the MComp Groups culture.

4.6.2 Planning

Fortunately, there were existing products in the open source community-at-large that could be integrated into the MComp platform to replace the existing components. The web container Engine (which was led by several RDT partners) could be replaced by Thunder, which was an Utopian Software Foundation product. In fact, Thunder had been the default web container several months prior but had been switched for Engine. There were a number of end users that continued to deploy Thunder, so there was already existing support experience in the forums and among the remaining developers. JMS/MComp, the Java messaging system (JMS) implementation, could be replaced by JGroups, which was a mature messaging application that was also open source. Persistence²⁹ was being developed for MComp by two RDT partners prior to their leaving. GSoft, another successful open source persistence manager had been developed by Mr. Royal. These alternatives had been implemented by individual users and were thus familiar to several of the remaining developers of the MComp team, including the Chief Architect.

In June of 2003, upon the defection of the RDT developers, MComp Group began negotiating with the project leaders of these projects to become employees. The Thunder lead developer, was hired officially in August, but he had been consulting with MCG since June. This was attributed to the need to service a potential customer who wanted to run Thunder instead of Engine, necessitating hiring the lead developer (who had recently left a job with Sun Microsystems).

²⁹ Persistence is used in Java applications to move data in Java objects to and from a relational data store. This enables these objects and their data to continue to exist whether or not a given program is running.

Mr. Royal, lead developer of the GSoft project, visited the United States for the first time for a Java Consortium being held in Boston on June 27-29 of 2003. There, Will Baker and Ben Lewis met Royal and recruited him to join the MComp Group.

These guys are the perfect metaphor for the culture of MComp: a culture driven equally by technology and sales. Bill is a technology guy through and through. Ben is my perfect ideal of a fast-talking American salesman. If Ben tries to sell you something, you can't possibly not buy it. Ben sold me MComp. (Blog posting on GSoft.org by Mr. Royal, 4/10/2006)³⁰

Following this meeting, Royal investigated the opportunity. He came back to the US a few weeks later to meet with Thomas Smith personally. He also talked with several other employees of the company, including developer MComp Developer.

Will said 'Hey, will you send Royal an email...because he's kind of a little concerned about the security of the situation and things like that; send him an email. Let him know that it's a good gig.' And I emailed him and said, 'Hey, they pay me every time and it's been a great, great situation.' (MComp Developer, personal interview, 1/10/2007)

Royal also went back to several key members of the GSoft development team to see what they thought about the deal and to ensure that he was getting the best possible situation for the GSoft project. Because of its success and high regard among Java developers, GSoft would not depend on support from MComp in order to survive. At the time of the hiring, the project was thriving with over 500 downloads, 100 forum postings, and 15,000 page views per day. Thus, any arrangement would have to be beneficial for not only the acquirer but also the GSoft community as a whole.

4.6.3 Stress

As a result of the negotiation process, MCG hired Royal as a consultant along with GSoft developer Chuck Brown. In exchange, the two were offered a salary and stock options in MCG. Royal retained ownership and control of the GSoft trademark, website, and project. In exchange,

³⁰ last accessed 5/27/2007

MComp was able to upgrade the persistence technology in their existing platform. MCG also benefited by using the existing business infrastructure of the firm to sell services for GSoft, generating positive cash flows for the both the business and the two new employees.

The hiring was announced on the GSoft mailing lists, MComp-Dev mailing list, and several popular Java discussion websites (including TheServerSide.com). The posting on GSoft.org (see section) was written by Royal and detailed his rationale for joining MComp and the implications for everyone involved.

The vast majority of the comments were congratulatory in nature, especially from members of the GSoft community. However, some feared that even though there were assurances from both sides regarding the future changes planned, the association with a profit-motivated entity such as MComp (which had managed to ruffle a few feathers) would lead to stripped down or non-open versions of the software. Royal, Will Baker, and Chuck Brown refuted these changes, but inevitably a few dissenters arose.

4.6.3.1 Mr. Royal's Announcement

(Royal's email from the GSoft Administrative News mailing list, dated 9/17/2003)

Hi everyone,

We will be making a major announcement soon, and I would prefer that everyone here learns about this development here, rather than in the press, or on TSS.

As you must realise, GSoft and the GSoft project have been created entirely by people working in their spare time, using donated resources. Development of GSoft was never at any stage supported by any commercial (or nonprofit) organization, and the project never had any kind of income.

The people who have contributed code are all (I hope) listed in the changelog. I also need to single out Chuck Brown who, though his name does not appear there, has been essential to the success of the project due to his work on the website and documentation and many other thankless tasks.

Its also a good point at which to thank all our users for being one of the coolest developer communities on the Internet. Even

when I'm a rude grumpy bastard answering forum posts at 3am, I'm always happy to see people using GSoft.

The success of the project (and it is now a very successful project) has taken an enormous amount of time from my personal life. It is incredibly difficult to keep up with the huge amount of traffic in our forum, let alone find time for development, while at the same time holding down a "real" job.

Fortunately, we've now found a way to out.

MComp Group will support the development of GSoft, by hiring me to work full time on GSoft, and on MComp/GSoft integration. In addition, myself and other members of the GSoft team will now be able to provide commercial support and professional training through MComp Group. This is something that many people have emailed me about, and I simply havn't been in a position to be able to do.

What this means for GSoft users

=====

- * more resources for GSoft development
- * able to buy professional training / commercial support
- * assurance that the GSoft project continues to exist and grow

What the means for the GSoft team

=====

- * a chance to make some money :)
- * Royal gets his life back (maybe)
- * no longer have to beg and scrounge for money for things like domains

What this means for the GSoft project

=====

- * more developers
- * GSoft will be distributed with MComp application server
- * lots more users
- * an easier "sell" to management types
- * we get a marketing team!

What this means for the MComp project

=====

- * MComp will use GSoft as backbone of CMP layer
- * GSoft will complement MComp AOP, being a POJO-oriented persistence layer

What this means for MComp Group

=====

- * MComp gets a great persistence engine!
- * lends credibility to MComp.org as an umbrella for more than just the appserver project
- * MComp is able to sell GSoft training and support

What it does NOT mean

=====

- * GSoft will not become dependent upon MComp! It is a central goal of the project to remain platform independant!

- * you will not have to start paying for documentation
- * we will not stop giving great support in the forums
- * GSoft will not be "swallowed" into the MComp project; it remains a separate project, now affiliated with MComp.org and supported by MComp Group
- * our central goals do not change: we remain committed to building the killer ORM implementation for Java!

Just in case its not yet clear, this is great news, and is a huge coup for both GSoft and MComp! The future of this project is now guaranteed.

peace

Mr. Royal
<http://GSoft.org>

4.6.4 Adaptation

As a result of the hiring, Royal had significantly more time to devote to GSoft development. Instead of working on the software only in the evening, he was now able to work on GSoft as his primary job. Because of this support, the continued existence of the GSoft software was much more assured.

GSoft would be a historical footnote if it were not for MComp. I would have had to abandon the project several years ago, due to the incredible workload of developing this project and providing support to hundreds of thousands of users. (Mr. Royal, message board post, dated 5/27/2006) ³¹

In return, MCG recouped the salaries of the two GSoft employees within six months of the hiring. The MCG also have been able to utilize Royal's talent as he has worked on additional Java-related projects while working for MComp (i.e. Seam). By hiring the lead developers, MCG has claimed that it controls 95% of the codebase for GSoft and 45% of Thunder, which enables them to also ensure that the features of both software projects will integrate cleanly and efficiently with the other middleware products developed by the MComp Ecosystem. Similar effects were encountered in later months as MComp hired other successful developers.

Thus, the hiring of developers is in many respects an acquisition of the community which enables it to charge customers for support. This is one of the key aspects of MComp's

³¹ last accessed 5/27/2007.

professional open source business model in which talented open source developers are able to earn a living by continuing to develop and support the projects they create, but with the business support and infrastructure of a larger organization that generates revenues based on the developers' ability and effort. As seen in the GSoft scenario, these developers are often able to move from working on these projects part-time as a hobby to working on them full time as professional developers.

The acquisition of GSoft created several positive effects for MComp. The GSoft technology and the community surrounding it were very well-regarded within the Java community, thus its acquisition by MComp signaled that the company was intent on creating a wider platform of Java products than simply an application server.

[D]efinitely if you look at the responses from the developer community and all the users that GSoft brought with them and all that. It was definitely a big event technology wise for MComp and in terms of creating buzz and so on. (Ted Parker, personal interview, 3/4/2007)

The projects acquired by MCG are integrated into the MComp federation of projects. The functionality of several of the projects were integrated such that the various components could work together more efficiently. For instance, seven components were combined to form the MComp Stack, which was positioned as a full suite of middleware components for Service Oriented Architecture (SOA) customers. However, the projects are typically left intact, including the existing brand and reputation that they had established.

The whole key was in part of leveraging and acquiring these brands in these communities was letting the communities exist.... We let those brands remain intact. We didn't want to mess with what worked which was there brand. People knew GSoft. We didn't want to rename it MComp Object Relational Mapping. We let those brands exist. We let those communities exist. We kept the website intact but we just merged the MComp navigation system on it and brought them under the umbrella and it worked. (Ben Lewis, personal interview, 1/31/2007)

4.6.5 Analysis

4.6.5.1 Capital

By hiring the lead developers of these Java-based open source projects, MComp Group could accomplish several objectives. First, they gained the ability to charge customers [economic capital] for the training and support [human capital] provided by the developers, which was the core of the Professional Open Source business model at that time. Additionally, they were able to benefit from this knowledge [human capital] themselves as the developers integrated their applications into the middleware platform being developed by MComp [organizational capital]. The lead developers also utilized their expertise [human capital] to create new applications [organizational capital] which were subsequently introduced to the MComp Group product line.

By hiring these developers and granting them stock in MComp instead of merely retaining their services on an ad hoc consulting basis, MComp Group could establish stronger ties between the company and these developers [social capital]. As such, the probability of these developers leaving to form new firms to service their customers (as the RDT group had done) was significantly reduced. According to Mr. Royal, none of the developers hired since he arrived in 2003 had left the firm as of the OpenSoft acquisition.

The most attractive projects for MComp were those that had established credibility and legitimacy [symbolic capital] based on the activity and size of both developer and user community surrounding them [social capital]. By selecting those projects that had been successful in building projects that would attract relationships among Java middleware developers, the firm could take advantage of these relationships to push services on related products. It also strengthened the credibility [symbolic capital] of MComp Group to be associated with projects that had already been proven valuable by other end users and developers.

In return, the MComp Group business model [organizational capital] provided the wages [economic capital] for the lead developers to continue working on their projects. For example, Mr. Royal had been working to develop and support GSoft in the evenings and on weekends while his day job was developing web applications. After accepting the position with MComp, he was able to spend more hours working on GSoft related projects instead of being restricted to his personal “free” time.

Table 9: Capital Observations – Acquisition of GSoft

<i>Capital Type</i>	<i>Instance</i>
<i>Social</i>	Development Community Relationships User Community Relationships
<i>Organizational</i>	Business Model Software Architecture
<i>Symbolic</i>	Credibility Legitimacy
<i>Human</i>	SW Development Expertise
<i>Economic</i>	Personal Funds (wages) Working Funds (MComp Firm)

4.6.5.2 Mechanisms

The actual stress in this episode (the hiring of Mr. Royal) can be described as an *investment* in the future economic value of his human capital. By applying the existing routines and exchange pathways in the ecosystem, MComp was able to convert or exchange these human capital flows for other capital types in several ways as required to ensure that the needs of the ecosystem were being addressed. The MComp Group was able to monetize Royal’s expertise (or exchange it for financial capital) through the training and consulting services he was able to provide for GSoft customers. Royal also wrote software code which was converted to organizational capital (via *productivity mechanisms*) in the form of updates to the existing GSoft software and new software frameworks. Finally, Royal’s expertise provided an anticipated boost

in the level of Java persistence knowledge within the MComp developer community via *knowledge sharing* mechanisms. Clearly, this was an anticipated benefit and thus a key selling point for the hiring.

The expertise in persistence that Royal brings complements greatly the expertise of our CMP lead Alex Loubyansky. (Message board posting on discussion boards covering his hiring by MComp, dated 9/18/2003)

One of the biggest risks in the transaction was that the GSoft community of the Java community at large would cut their support of the GSoft product and development team. It was crucial that the GSoft community continue their *productivity* in developing source code for both MComp and GSoft, in addition to the *productivity* by the MComp developers as they wrote code for GSoft. By this point, Thomas Smith's flamboyant style had turned some members of the Java community against MComp. The association with MComp thus led some to be concerned about whether or not GSoft would be as open and cooperative as before. Others worried that MComp would steer Royal's agenda toward coding GSoft toward code that would require other MComp components to run efficiently. Royal communicated both personally and publicly with the existing GSoft users and developers in an attempt to build trust that he intended to keep things as much the same as possible. When this failed, he appealed to the trust that he had already established.

Our users trust us and know that we would make the right decisions, in the best interests of the GSoft project. In my email I -explicitly- laid out a bunch of stuff that will NOT happen - by everyone's complete agreement - and that stuff includes all the concerns that have been raised here. I'm not going to try and argue with anyone - its completely pointless. They are just going to have to trust me. I would like to think I've earned this trust. (Mr. Royal, posting on discussion boards covering his hiring by MComp, dated 9/18/2003)

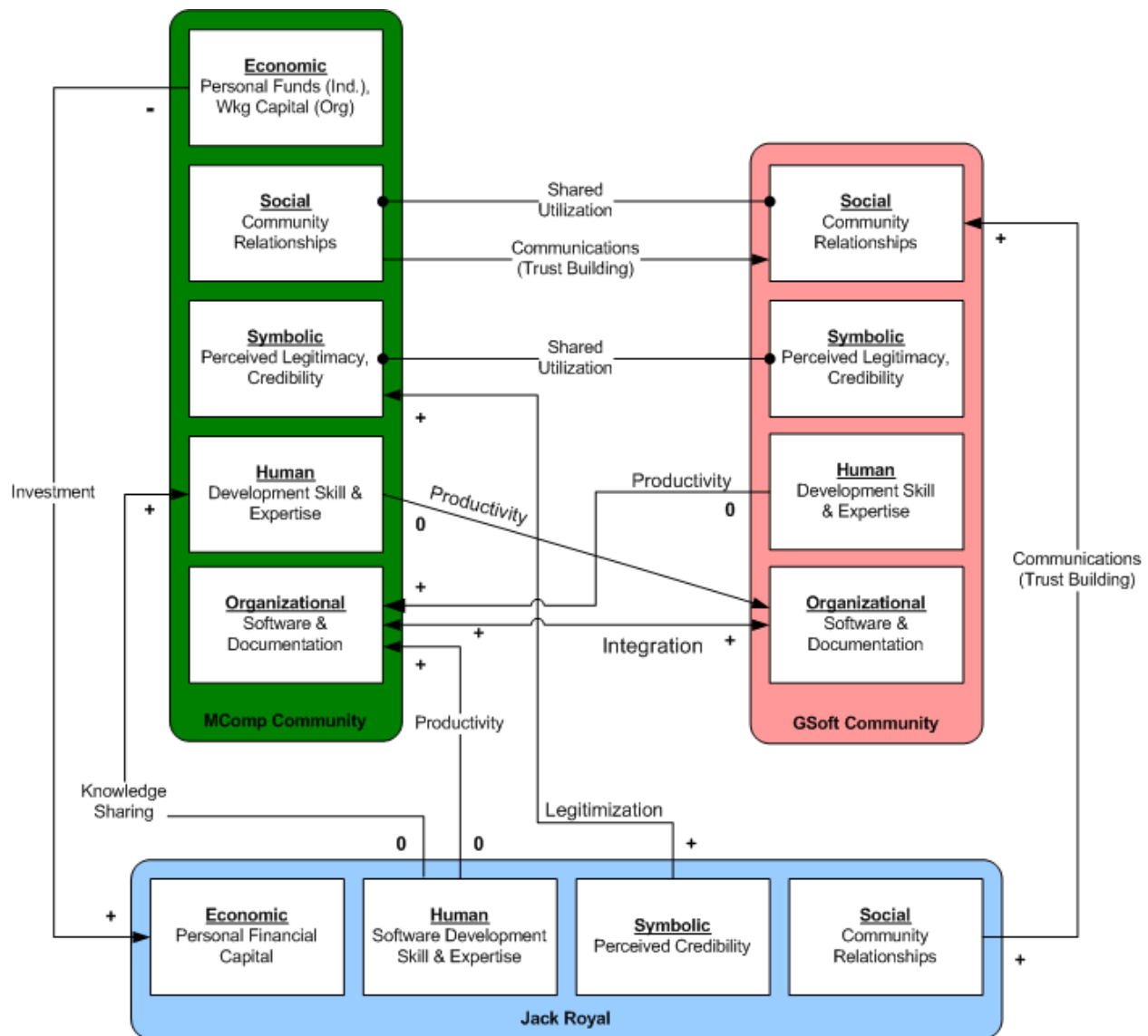


Figure 14: Capital Flow Diagram –GSoft Acquisition

This *trust building* communications went both ways as MComp officials attempted to communicate with the GSoft ecosystem that their intentions were not to change GSoft much and that Royal (not Smith or anyone else with MComp) was still the project leader for GSoft.

GSoft was kept mostly independent of the MComp ecosystem (except for the technical *integration* of the products), but there were obvious social ties linking both parties. MComp developers utilized this *shared utilization* of social capital to interact with the GSoft users and

developers, and the GSoft developers interacted with the MComp users and developers. Although these communities were not really merged, their credibility and legitimacy were shared between them (indicating the *shared utilization* of symbolic capital). For instance, if MComp had failed, GSoft would likely have lost some credibility as well. Fortunately for all parties concerned, GSoft went on to become a big success. Royal was able to parlay his expertise into stints on several industry standards committees. He was also responsible for developing new applications (such as Seam, which integrates the presentation and data layers of complex applications) which were then woven into the MComp application suite. As Royal has increased his visibility and his credibility as a highly successful and productive member of the Java community-at-large, the credibility of the MComp Group was increased as well via *legitimization*.

4.7 VC Funding

4.7.1 Antecedent

Largely due to the poor environment for venture capital in the post dot-com bust era, the development of MComp has been largely self-funded, beginning with the early revenues from the training classes in 2001. Because of his experiences with TCorp, Thomas Smith dictated that the operations of MComp Group needed to be handled in a conservative way that allowed the business to be cash-flow positive. By late 2003, Smith had built up a sizable amount of cash on the balance sheet by following this approach.

When Bill Coleman came on board, several things around MComp Group changed. The business model shifted from a less scalable personal services model to a more scalable partner- and support-based model. Informally dubbed “MComp v2.0”, this new model represented the attempt to move things to a more professional company that had the potential to meet the increasing demands of its customers in an efficient manner (Watson, Wynn, Boudreau 2005).

The changes in the business model would also benefit the adoption of the MComp software as well as the value of traditional MComp lines of business, including training and documentation, by creating a more stable business organization to back them. Making these changes would require adding capital to enable MComp Group to successfully go after the people and resources that execute the new plans.

4.7.2 Planning

Bill Coleman proposed to Thomas and the MCG board that they begin pursuing venture capital funding again. The benefits of VC funding include not only the financial resources but also the experience and expertise they gained by working with other entrepreneurial ventures. They also bring a number of contacts in the software industry and the managerial ranks that can prove very valuable when staffing the senior management of a new venture. Finally, signing with a top-tier venture capital firm can bring instant credibility to a business due to the perception that the VC firm has done its due diligence and believes that the business will in fact succeed.

MCG was looking for a highly reputable VC firm with experience in the middleware and Java business (instead of a pure finance type) that allow the current owners to retain ownership control. They did not want to work with a firm that wanted to change to a product model, which resembled the working business models of MySQL and OpenSoft at the time. Instead, they wanted to remain focused on services and support as the core of their business model, in keeping with the open source model they had started with.

Once they started to look for funding, MCG was “deluged with inquiries and interest”, largely because it was a profitable business with good products, people, and business plan.³² The VC firms were attracted to MComp because of the installed base of users, including the original equipment manufacturers (OEMs) and independent software vendors (ISVs) that bundle MComp

³² Bill Coleman’s blog, last accessed May 20, 2007

with their products, the predictable revenue streams afforded by the service and support subscriptions of the new business model, and the disruptive effect MComp was having on the application server market.

4.7.3 Stress

Because of the heavy interest, they were able to attract several offers that met their needs. In February of 2004, they decided to accept the funding terms from two VC funds. One of the VC investors was founder and CEO of a rival middleware and application server firm who had transitioned to a VC post. His experience and industry contacts would prove valuable assets as the company grew further following the funding round. The terms of the funding round called for MComp to receive \$10M at a pre-money valuation of \$30M. Thus, the VC firms owned 25% of the firm following the acquisition. In May of 2004, Intel Capital provided additional funding, largely aimed at MComp attempt to acquire J2EE certification from Sun for their application server software.

4.7.4 Adaptation

The acceptance of venture capital funding changed the dynamics of the company. From an operational standpoint, the venture capital enabled the company (and especially the CEO) to be more secure in its internal planning. Prior to the VC funding, the CEO had run the firm in a very conservative, cash-based manner, which was understandable given the previous business model's failure. As such, there was no spending done in advance of funds actually being received. After receiving the funding, there was a cushion to allow the company to spend money more confidently as the funds were received, instead of as the services were delivered. Essentially, the company pursued a cash flow zero policy in that it intended to spend the full

amount of the revenues that it received in sales and bookings.³³ The firm was still committed to not spending the money, instead allowing the money to remain in the bank and on the balance sheet. However, the funding gave them the confidence to execute in ways that were previously shunned because of the conservative, preservationist approach to financial management that had been followed.

You go from “well we can’t do that because it’s [Thomas’s] money” to “alright, maybe we could do that because it’s our money, the company money.” (Ben Lewis, personal interview, 1/31/2007)

Perhaps the three most significant impacts of the VC funding were the legitimacy that it brought, the management team that it attracted, and the relationships established with and through the venture capital partners. By having \$10M on the balance sheet, the company was able to validate its ability to stay in business.

The main reason was that it was done to basically say to the big customers that we have enough in the bank to run this business even if we get no more customers for two years. So, you don’t have to worry about if two months from now you call us and nobody answers because we don’t have any money left and everybody got fired. (MComp Developer, Personal Interview, 1/25/2007)

This anticipated stability allowed MComp to overcome customers’ concerns over the size and projected longevity of the firm. Open source software firms have an extra burden of proof with respect to their ability to provide support and maintenance services on demand. Large customers are less likely to deploy mission-critical software for which they are not able to get real-time support from a dedicated provider, the proverbial ‘one throat to choke’, instead of solely through discussion forums or internal support. Therefore, the venture funding enabled MComp to prove to enterprise customers that their size was not a problem and that it was a safe

³³ Services revenues are booked ahead of the actual delivery of the underlying services. For instance, a twelve month service contract is typically paid upfront with the revenues spread across the year. A company \$12M receiving on January 1 for a twelve month service contract would actually count revenues of \$3M per quarter although the money has long been received.

choice to deploy MComp products and depend on the services being around for the foreseeable future.

Again it goes back to where we wanted to come down in the spectrum of Open Source adoption. Did we want to build coding capability in house that we would actually contribute back to the community at one end of the spectrum or were we going to be seeking enterprise class support that's on the other end of the spectrum. And we fell down somewhere in the middle and so we were comfortable playing that smaller strategic partner but it would have to be someone with some staying power. The fact that [MComp] had backing gave us confidence in that staying power. (anonymous enterprise MComp customer, personal interview)

The VC funding also attracted more professional management team members. Following the funding, MComp, Inc. hired several executives for their management team, including a SVP of Sales and Marketing (later COO), Director of Marketing, VP of Business Development, VP of Customer Services, and a CFO, all of whom had experience from large proprietary software firms. This experience brought a very broad base of knowledge that was later used to build the sales and marketing model that enabled MComp to greatly accelerate its revenue streams. These executives joined the MComp team in part because the funding gave them a sense that the company was indeed legitimate and had a chance to survive and to succeed in the software industry.

Finally, the relationship it established with the venture capital partners proved to be very valuable as well. Steve Miller, general partner at one of the VC firms was an entrepreneur who had founded a middleware company himself in the recent past. His experience with this industry as well as the business contacts and relationships that he had established proved to be immensely beneficial to MComp in general and Thomas Smith in specific. It was through Miller's contacts that several of the management team members were hired. Additionally, Miller provided guidance which helped introduce the framework for the sales and marketing engine that MComp

later capitalized upon to build their revenue base through increased deal sizes and increased conversion of non-paying to paying customers.

4.7.5 Analysis

4.7.5.1 Capital

The VC firms were attracted by the existing success of the company, as evidenced by the size of the community [social capital] and the existing revenues to that point [economic capital]. They were also attracted to MComp because of the number of downloads that had been made (which are indicative of the credibility [symbolic capital] of the software), and the positive feedback they heard from existing MComp customers and users. One of the VC executives reported that several of the other companies in their portfolio of companies were reporting “surprising success and high satisfaction” with the MComp Application Server. Thus the VCs felt that the product and the company itself were sound and likely to continue succeeding.

Obviously, the venture capital funding [economic capital] provided to MComp, Inc. enabled the company to pursue several avenues that were unavailable to them before and shored up the balance sheet as well. But the money itself was not the primary benefit. At the time of the funding, the company had 11-12 employees and approximately \$3M in annual sales (and rising) and a successful, leading software product, which indicates that the company had become a comfortable small business that would have generated reasonable revenues for the immediate future.

Instead, the key capital flow was the increase in legitimacy [symbolic capital] and the increased industry and managerial expertise [human capital] that was acquired as a result of the funding. By getting funding from a top-tier VC firm with a positive reputation [symbolic capital] in the industry, MComp was able to project a more stable, dependable future that increased the confidence that potential customers and employees had in the legitimacy and credibility

[symbolic capital] of the business. This additional legitimacy attracted additional professional management expertise [human capital], which was largely lacking in the pre-funding actions. This managerial and industry knowledge, as well as that possessed by the VC firm itself, later proved to be very useful in establishing and growing the company from 11 employees to nearly 300 and increasing revenues 10-fold. The VC firm and management team brought additional business contacts [social capital] into the ecosystem where they could be utilized accordingly.

Table 10: Capital Observations – VC Funding

Capital Type	Instance
<i>Social</i>	Industry Contacts Community Relationships
<i>Organizational</i>	
<i>Symbolic</i>	Credibility Legitimacy
<i>Human</i>	Management Expertise Entrepreneurial Expertise
<i>Economic</i>	Revenues Venture Capital Funds

4.7.5.2 Mechanisms

Initially, the attraction VC firms had for MComp was because of the existing social and symbolic capital bases of the firm and ecosystem as described above, as well as the flows of economic capital it received. These capital stocks and flows were verified by the VC firm during due diligence, which proved that MComp, Inc. was successful at its current level of productivity and that there was room for growth and expansion in the ecosystem surrounding it. In exchange for this *investment* in MComp, the VC firms gained partial ownership of the firm from which they were expecting to receive greater returns of economic capital as this growth and expansion were realized.

On the other hand, MComp viewed the venture funding as a means of responding to *gap awareness* mechanisms by reducing the discrepancy between the existing financial structure and that expected by existing and potential members of the ecosystem, including customers, investors, and executive team members. In turn, the *legitimization* mechanisms enacted as a result of the additional financial capital added to its balance sheet improved the perceived credibility of the firm. MComp was also able to use the funding to improve the operational efficiency of its *coordination* mechanisms through a series of changes in its business routines.

In addition, MComp was able to take advantage of the venture capital firms' social capital and symbolic capital through *shared utilization*. By partnering with two well-respected VC firms, MComp was able to take advantage of their credibility to increase its own. MComp was also able to take advantage of the technological and managerial contacts that the VC firms had amassed over their existence. It is through these contacts that several members of the management team came to MComp.

MComp, Inc. also increased its level of human capital as a result of *knowledge sharing* mechanisms. These mechanisms enabled the company to acquire entrepreneurial and software industry knowledge and expertise from the members of the VC firm, particularly that of Steve Miller as a former entrepreneur and manager in the same segment of the industry in which MComp was focused. This knowledge was utilized by the management team of the firm as it dealt with the subsequent strategic and operational needs. Additionally, many of the members of the ecosystem were able to utilize this new shared knowledge in later positions with other firms upon their departure from MComp.

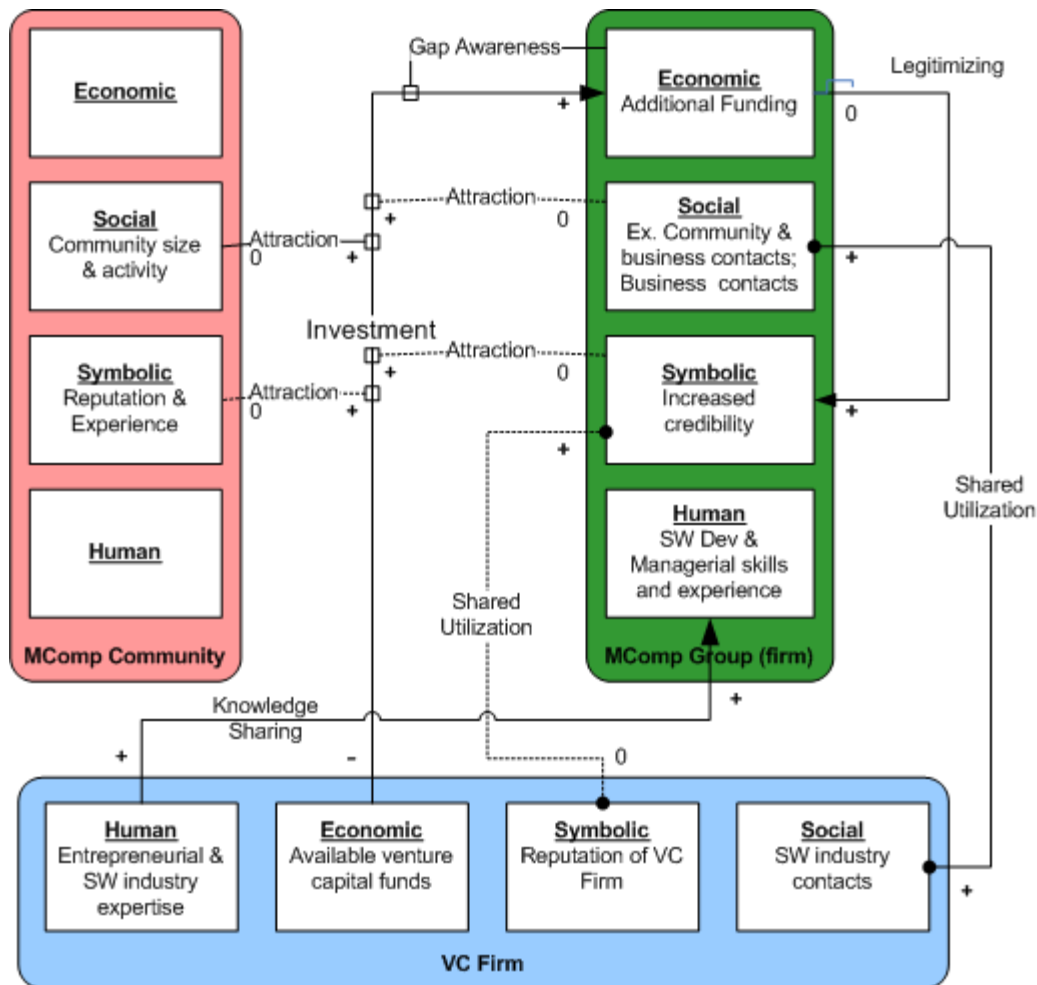


Figure 15: Capital Flow Diagram – MComp Group Venture Capital Funding

4.8 BigWare acquisition of CWare Software

4.8.1 Antecedent

As discussed in a previous episode, the Rival development team (RDT) founders were unsuccessful in their attempt to build a business that serviced the existing MComp customers. Instead, they found themselves to have essentially been cutoff from many of the capital flows and stores within the MComp ecosystem.

In order to continue developing software within the J2EE application server space, six of the RDT partners founded the Utopian Cigar project (along with a seventh developer) on August 5, 2003. Originally, the Cigar team intended to use portions of a forked copy of the MComp code as a placeholder and a revenue source while the Cigar server was being developed. However,

they eventually dumped the Elba code altogether because of the differences between the licenses used by MComp and the Utopian Software Foundation. Specifically, the LGPL-based MComp software could not be converted into the BSD-based Utopian license without the permission of every contributor who had developed portions of the MComp code. Since that included several members of the MComp development team, such permission would never be granted. As a result, the Cigar team set out to build a new J2EE-based application server from the ground up.

The development continued for several months with an active development community formed around the efforts of the 7 original founders. Several of these developers participated in support of the Utopian efforts – and in opposition to the overtly commercial intentions of MComp, Inc.

In early 2004, the team announced that the first version of the software would be available in August. In July 2004, CWare Software announced that they would add the Utopian Cigar server to the list of applications for which they provide paid support and maintenance. Additionally, CWare began hiring several members of the Cigar team, including several ex-RDT members. They also hired the project leader for a very early competitor for the MComp Application Server. CWare's support of the project allowed these developers to continue about the business of building an application server that could effectively compete with MComp and several proprietary vendors for new and existing customers.

4.8.2 Planning

There is little or no planning to be done for episodes such as this where the impact on our focal ecosystem, the MComp ecosystem, occurred as a result of actions that were largely outside its boundaries. Instead, the adjustments were made in the adaptation phase.

4.8.3 Stress

MComp had been successful at building market share for their server and middleware software, with one survey reporting MComp usage in 34.8% of respondents' companies, versus 33.9% and 28.7% for BigWare and OtherWare, respectively. It was obvious that BigWare would need to do something to defend its installed base of customers versus the growing number of MComp customers.

In May of 2005, BigWare acquired CWare Software, including the services of several ex-RDT developers. In so doing, BigWare was sponsoring the development and deployment of the Utopian Cigar server itself. This was familiar territory for BigWare, who had been a long-time sponsor of prominent open source projects such as the Utopian web server and Linux. In this case, the acquisition of CWare seemed to be an attempt to regain some of the market share lost to MComp and to a lesser degree other open source application servers.

4.8.4 Adaptation

For MComp, this was a different type of attack than the one initiated by the RDT defections. First, BigWare was certainly a larger, well-respected competitor with experience in the professional services industry, knowledgeable sales and development staffs in the middleware industry, and deep pockets. Second, there was little leverage that MComp could wield in an attempt to control the capital flows within the Cigar ecosystem. Third, although the Cigar server was (by most accounts) not as full-featured as the MComp server or the existing Bigsoftware application server, BigWare could devote a significant amount of resources to accelerate the development of features and performance in Cigar.

What we did know was what CWare did or didn't have versus us. They weren't anywhere, it was kind of like comparing a well house to the garage. It was just nowhere. We also knew, if we use that same analogy, BigWare is a tremendous builder and very efficient at it. So they can go take it from a well house to this house (snap) like that. (MComp COO, personal interview, 11/21/2006)

Thus, MComp was rightfully beginning to be concerned as to the state of their ecosystem and the customers in the not-to-distant future. In their deliberations regarding how to react or respond, they soon realized that since they had established a commanding lead in market share and a better product, MComp, Inc. did not feel as if they needed to do anything in the immediate timeframe.

From MComp' perspective, there were no significant responses immediately to the BigWare event, except for a few blog postings. MComp' CEO wrote a missive welcoming BigWare to the open source middleware business and acknowledging that BigWare's participation in this segment of the business must mean that open source middleware must be a legitimate competitor to proprietary software.

Today will go down as the day BigWare came out of the woods and declared its intentions against us. I want to welcome them to the party, open source is a difficult business model and terrain. On the competitive front, we are the established player and this is our turf. If they are ready for war on our turf, then fine, bring it on! (Thomas Smith blog posting, dated 5/10/2005)³⁴

Others questioned how BigWare was going to position the newly christened BCE (Bigsoftware Community Edition³⁵). Several commenters questioned whether it would be simply used as an 'onramp' to get customers to pay for licenses for the existing proprietary versions of the Bigsoftware product line, as the original remarks from BigWare seemed to indicate. If not, then the BCE product would cannibalize the license revenues BigWare was generating from their existing software products.

As a result of the CWare announcement, MComp officials noted that some purchases were delayed while customers sorted out the details between the two companies' software

³⁴ Thomas Smith's blog, last accessed 6/14/ 2007

³⁵ MComp CEO Thomas Smith chastised the software as BigSoft *Children's* Edition.

offerings. A few MComp partners switched to supporting and deploying Cigar instead of or in addition to MComp, but most remained with MComp.

BigWare's sponsorship of Cigar had two noticeable effects on the application server market, particularly the open source application server market. The interest in Cigar spiked upward as the credibility of the project spiked due to the BigWare involvement. As a result, the gap in functionality between MComp and Cigar has started to close. This interest in Cigar has been evident, including a recent survey that indicated that Cigar is growing at a rate which nearly 2.5 times larger than the comparable MComp growth rate. Also, BigWare's sponsorship added to the credibility of other OSS projects, particularly those in the application server market.

Business started booming, because what it said was to the industry, 'this open source thing is real and its legitimate. And you need to pay attention to it, Mr. or Ms. Customer, ISV, OEM. And you need to pay attention to it because it's real and we're behind it now.' (MComp COO, personal interview, 11/21/2006)

As such, MComp was viewed more favorably as potential users (that were previously wary of open source) undertook due diligence and discovered that among J2EE application servers, MComp was more useful than the current Cigar versions. These users often discovered that for their needs, MComp was a better product at the time, which boosted the sales and marketing efforts of the firm. However, it was likely that the Cigar/CWare acquisition would eventually lead to a product that was equivalent to the MComp application server products.

4.8.5 Analysis

4.8.5.1 Capital

The majority of the capital flows in this episode are largely external to the MComp ecosystem. BigWare's acquisition of CWare increased the levels of economic capital, credibility/legitimacy, and human capital available to the participants in the Cigar ecosystem. It also increased the social connections and relationships between the developers and users in the

Cigar ecosystem and those working on compatible technologies and products for BigWare (which is what BigWare is banking on in order to monetize their investment).

This episode had both positive and negative effect on the MComp ecosystem, especially on the MComp Corporation. The investment in an open source company signaled that BigWare believed that the open source phenomenon was more than just a passing fad, but instead a suitable way to build a profit center within their firm. This increased the legitimacy and credibility [symbolic capital] of open source companies across the board, including MComp. As a result, the business fortunes for MComp also improved, which increased the amount of software [organizational capital] adopted by customers and corresponding revenues [economic capital] brought into the firm.

At the same time, BigWare's move clearly was viewed as an attempt to both grow new markets and stem the growth and success of smaller players such as MComp . Within MComp, the move was interpreted with the latter goal in mind.

This clearly says "BigWare wants to kill MComp". After months of claiming that they don't see MComp on their radar, they go out and do a highly strategic deal that is squarely aimed at slowing our momentum down. (Thomas Smith blog posting, dated 5/10/2005)³⁶

Assuming the number of potential users for open source-based application server software is a constant, the zero-sum interpretation of BigWare's attempt to woo such users for their company means that fewer customers would pursue MComp services, lowering the revenues MComp would be able to collect. The primary obstacle that BigWare would have to contend with was the relative quality of MComp' software versus Cigar [organizational capital]. However, as MComp COO alluded to in an earlier quote, MComp respected BigWare's ability to convert and apply development resources [human capital] to the Cigar server software

³⁶Thomas Smith's blog, last accessed 6/14/ 2007

[organizational capital] in order to bring the quality up to par. At that point, the BigWare brand [symbolic capital] would certainly be a boost to the entire Cigar ecosystem. Thus, while the short-term impact of the acquisition would likely be a short-term gain for MComp, the long-term implications were not clear.

Table 11: Capital Observations – CWare Acquisition

<i>Capital Type</i>	<i>Instance</i>
<i>Social</i>	Community Relationships
<i>Organizational</i>	Software Documentation
<i>Symbolic</i>	Credibility Legitimacy
<i>Human</i>	
<i>Economic</i>	Revenues

4.8.5.2 Mechanisms

As stated in the previous section, the majority of the flows (and mechanisms) occurred outside the MComp ecosystem. The key mechanism from the MComp ecosystem’s perspective would depend on the amount of time elapsed and the amount of *productivity* applied by BigWare in the conversion of its embedded base of developer expertise into the Cigar software.

BigWare’s *legitimization* of Cigar, which resulted from their investment in Cigar, was shared by the entire open source software industry via *shared utilization* of the symbolic capital created. This legitimization was expected to benefit MComp more than Cigar initially. The quality of the software and the perceived credibility of both companies were expected to *attract* users to either MComp or Cigar (or one of the other OSS application. Because the MComp software was a more mature and robust application, the rate of *adoption* of MComp’ application server would increase more for MComp (based on relative advantage compared to Cigar).

However, once BigWare and the rest of the Cigar development community reached a level where the two applications were roughly equivalent, the differentiating factor shifts to the credibility and legitimacy of the MComp ecosystem versus that of BigWare.

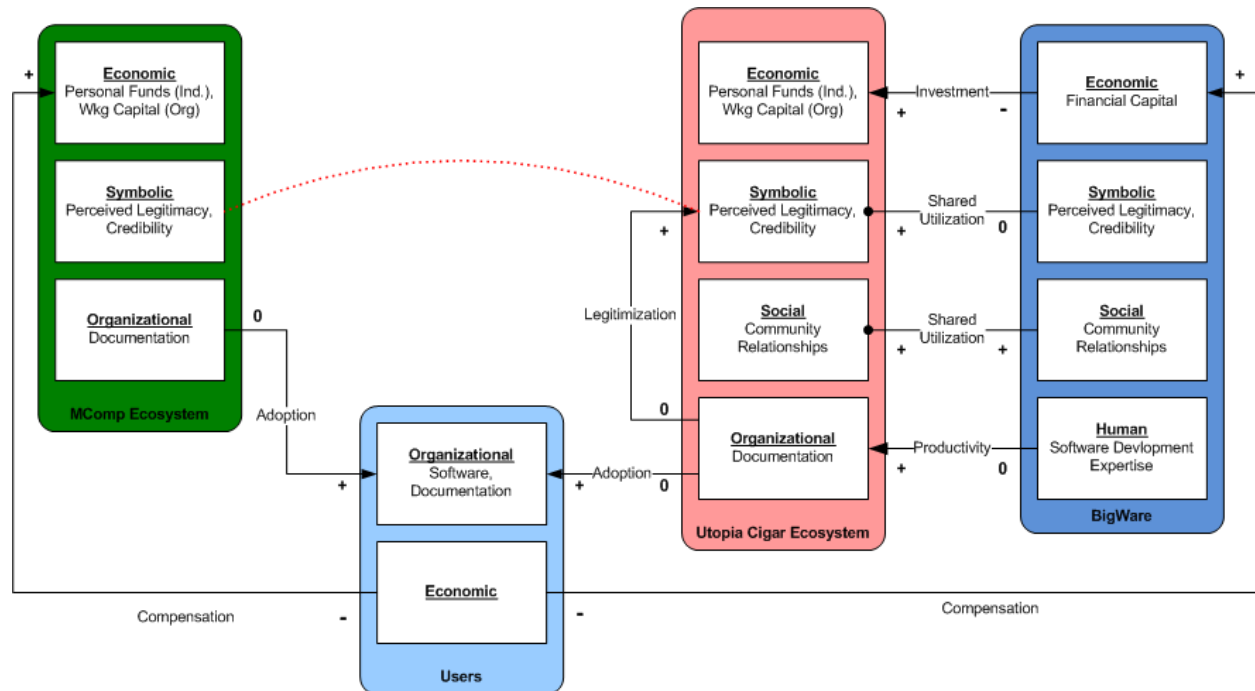


Figure 16: Capital Flow Diagram – CWare Acquisition by BigWare

Because the two products are standards compliant (J2EE) and roughly equivalent, the switching costs between the two applications are not as high as switching between two incompatible applications. If BigWare is successful in applying their considerable influence to this market, then as the installed base for Cigar increased, the *compensation* would flow to BigWare/Cigar rather than to MComp. Hence, it is entirely possible that MComp would need to either depend on their installed base to sustain their market share or find ways to increase their legitimacy and credibility to compete in this segment of the market effectively with BigWare in the future. Currently, the rate of *adoption* for Cigar is reportedly increasing more rapidly than for MComp so this shift seems to have begun, although there is no way to accurately predict how far

this trend will progress and which product will be more successful in the future. Therefore, this episode highlights not a change in the current capital flow or structure of the MComp ecosystem, but a potential shift in perceived credibility.

4.9 OpenSoft acquisition of MComp

4.9.1 Antecedent

MComp' goal, like most entrepreneurial efforts that receive venture capital funding, was either to pursue an initial public option or to be acquired by a larger company if that was not possible. Part of the shared vision instilled in MComp employees was the notion that going public in an IPO was part of its future plans, which was reinforced in many of the employees' minds by the issuance of options as part of their employment.

[W]e all share, very strongly, into the vision, which is a very ethereal claim.... some mix of short term goals, which is if we can go public with this company, let's go. Well actually, that's midterm. But very focused on the business day-to-day, but more importantly very ambitious about the end goal. (Thomas Smith, personal interview, 2004)

By 2006, MComp was executing on its business model effectively. Revenues had grown to a run rate of approximately \$40 million for the year (up from \$17 million in calendar year 2005³⁷), with bookings of service subscriptions at \$60 million. Sales had grown about 150% year over year for the March quarter.

However, the fortunes of the firm had begun to shift with BigWare's acquisition of CWare, which introduced a well-funded and dangerous competitor in the open source application server market. Although MComp' software was more mature than the Cigar server on which BigWare's offering was based, the lead was narrowing. The Utopian Software Foundation (USF) announced the release of the 1.0 version of Cigar in December of 2005, indicating that the partnership between the USF and BigWare was paying off.

³⁷ According to the Form 8-K/A filed by OpenSoft as part of the merger process.

4.9.2 Planning

In addition to the increasing competition within their market space, the MComp management team felt that the direction of middleware software was evolving into a ‘stack’ based sales model. Customers were looking at the purchase of entire stacks of enterprise software, starting at Linux at the operating system level and moving upward through open source middleware tools and, increasingly, applications as well. In order to meet this demand, the internal discussions among the MComp management camp centered around four options. In the first option, MComp would become the stack provider themselves. This would require the firm to acquire a large pool of financial resources, either via private equity or from an IPO, and use the money to acquire a number of open source components.

What we believed was our real opportunity was to go be the de facto provider of all open source stuff from the middleware up. And, with that you probably throw a database in there. You put in middleware and then you start throwing content management, CRM, you throw maybe BI at it, and you’d really be the complete provider of the open source complete stack. (MComp COO, personal interview, 11/21/2006)

The problem with this option was the availability of the funding to make these acquisitions. One anonymous estimate of the amount of money that would be required to accomplish this was \$250-500 million dollars, which would be nearly impossible to acquire.

Another option was to pull such a stack together through a set of loose partnerships, but the management team did not feel that this would work properly. The third option was to maintain the status quo and remain an independent entity. The chief objection with this was that this option ran the risk of not allowing the company to grow much beyond its existing levels.

We knew [customers’ receptiveness to stacks] was not going to go away. And so, you say, do you get boxed in sort of in a corner with a glass ceiling over you if you just remain ‘best of breed’? (MComp COO, personal interview, 11/21/2006)

The fourth option was to be acquired by another company that had the potential to become the stack provider that was being sought by customers. Eventually, the decision was made to put the company in play to see if it could be acquired by a larger company that met these criteria.

According to published comments by an official with OtherWare Systems, MComp had been “shopping themselves” for about a year prior to the actual acquisition.³⁸ The persistent rumor was that several large software corporations were potential suitors for acquiring MComp. The first real offer apparently came from one of these firms before talks broke down, supposedly over the MComp CEO’s position in the company as well as the financial terms themselves.

4.9.3 Stress

On April 10, 2006, MComp announced that it had entered into a definite agreement to be acquired by OpenSoft for \$350 million dollars (60% stock and 40% cash) plus \$70 million in revenue incentives. Under the agreement, Thomas Smith would become president of the MComp division of OpenSoft, which would become an independent division under the corporate umbrella. The deal was negotiated in Atlanta with the CEO, CFO, and COO on the MComp side, and both CEO and CFO on the OpenSoft side.

Both teams suggested that the synergy between the two companies was a key driver for their merger. Much of the subscription sales model that MComp employed was based on the OpenSoft subscription model. As such, there was a high degree of understanding between the two parties regarding the financial structures of the two firms. The firms (and various analysts) touted the additional resources that OpenSoft could provide in order for MComp to expand its sales internationally (where it had been weak but OpenSoft had done successfully) and to further

³⁸ Comments by Marge Brea, chief marketing officer at OtherWare Systems., last accessed 6/14/2007)

the development and innovation within the middleware applications that MComp produced. Customers would have a single point of contact for support and services on an open source stack consisting of both operating system and middleware.

According to the 424B7 filed with the Securities and Exchange Commission on September 2006³⁹, several people received sizable payouts from the proceeds of the acquisition. Thomas Smith and his family received over 41% of the proceeds, which was over \$144 million. The VC firms and other investors received over \$118 million. The management team, including those put in place following the VC funding, received approximately 8% (or \$27 million). Even three of the developer that went on to found or to be part of the Cigar project received a small part of the proceeds in return for the early work they had done on the server. Interestingly, there is a ‘long tail’ of 102 other recipients who shared approximately 4.38% of the proceeds. This is not necessarily surprising given the fact that the founders, management team, development team, and investors received over 94%.

4.9.4 Adaptation

The various members of the ecosystem have experienced varying impacts as a result of the acquisition. Many of these impacts are still being sorted out as OpenSoft moves forward with the technical and operational integration of the two companies.

Three months after the acquisition closed, OpenSoft introduced an integrated stack of open source programs, thus fulfilling one of the biggest expected benefits of the acquisition. Customers deploying this stack for web-based application development and deployment are able to get end-to-end support from one provider under a single subscription instead of having to work with multiple providers. The customer also benefits from the improved and tested

³⁹ The form specifically discusses the number of shares issued to the MComp beneficiaries. The numbers shown do not match the reported size of the acquisition due to debt repayments and stock fluctuations.

integration without having to be as concerned with incompatibilities between the products. OpenSoft offers support on these applications as a subscription service ranging from \$1999 to \$8500 per system. Customers can also purchase separate support subscriptions for OpenSoft Enterprise Linux or MComp Middleware products. This integration of MComp into the product line of OpenSoft was not lost on customers, many of whom were already using both OpenSoft and MComp products pre-acquisition. The acquisition provided the opportunity to simplify pricing and application support through a single vendor.

This product integration has forced some MComp partners to reconsider their affiliation with the combined firm. For instance, Novell is a prominent MComp partner, shipping MComp products with their SUSE Linux package. OpenSoft's Linux products are a direct competitor to Novell's SUSE Linux, which leads to a conflict between the company's lines of business. As a result, Novell continues to support for MComp Applications running on SUSE Linux but they have begun shipping Utopian Cigar with the latest version of its SUSE Linux package instead of MComp.⁴⁰ Similarly, OpenSoft and BigWare have partnered for Linux deployment initiatives but the deal with MComp makes them competitors in another market, potentially straining their relationships as well.

One of the biggest impacts was the integration of the sales models. MComp depended largely on a direct sales model that focused on identifying visitors to their website, including those that downloaded their software, and converting them into paying customers. This direct sales model utilized an automated process called demand generation that provided the sales staff with qualified leads from which they could pursue sales deals related to the customer's interest.

⁴⁰ Novell officially claims that the change was because of a conflict with several proprietary-licensed components in MComp suite. MComp claims that these components were licensed in the same manner as they were when the partnership was first signed.

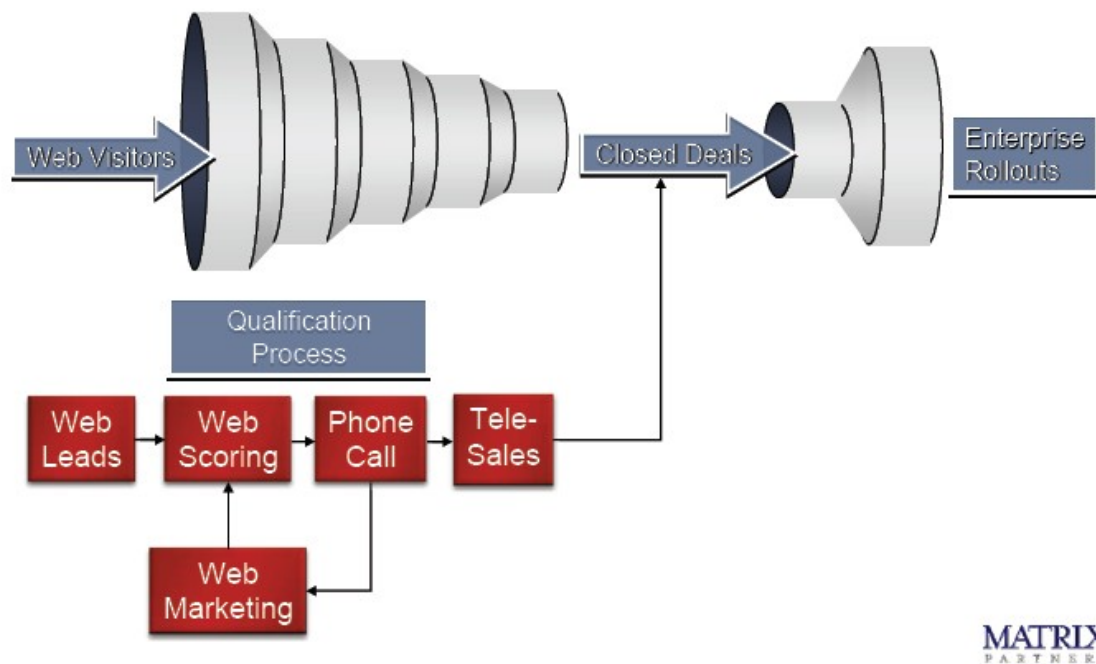


Figure 17: MComp Direct Sales Model

By contrast, OpenSoft receives the majority of their sales from resellers and OEM partners. Whereas direct sales requires a small army of sales reps and attorneys to handle each deal independently, a channel sale allows for a much larger piece of revenues to be handled by fewer transactions which makes the revenues much more efficient and scalable to achieve. It also enables OpenSoft to expand sales of MComp' software to a wider geographic area since OpenSoft already had a large global base of resellers and OEMs.

As a result of the change in the sales model and the overlap with the existing OpenSoft staff, several of the senior MComp marketing and sales team are no longer working for OpenSoft including the Director of Marketing, the Vice President of Services and Operations, the Vice President of Channels, and the Vice President for End User Sales for the Americas. In all, a rumored 60% of the sales staff resigned or was cut by OpenSoft.

There was a high degree of synergy between the two companies' development staffs despite the different product classes (Linux vs. middleware) and the difference between a large publicly owned company and a smaller privately owned firm. The developers have observed several differences stemming from the structures of the two firms. For instance, because OpenSoft is a larger public company, the amount of information that is free-flowing throughout the company, such as sales and partnership information, is not shared as readily as it had been within MComp. Despite these differences, the similarity of the development cultures came as a surprise to several developers on the MComp side following an online chat held between MComp CEO and the OpenSoft engineers.

I expected there would be difference somehow given that they're in the Linux land and traditionally they're not big into Java and we're doing Java and middleware. But it was very surprising to see that the developers in the chat were talking just like MComp developers would have done. (Ted Parker, personal interview, 3/4/2007)

Following the acquisition, the MComp developers encountered a significant increase in the amount of financial and developer resources to which they had access. OpenSoft has attempted to increase the number of support engineers available to work with MComp applications by 100 engineers per quarter. They have also begun efforts to double the amount of R&D funding available for MComp development. As a result, much of the development team has remained intact. As of May 15, the only developers that have left OpenSoft did so to start companies based on the projects they were working on while employed by MComp.

As would normally be expected, several members of the MComp management team left the firm, including the CFO, COO, and EVP. Perhaps most surprisingly, founder and CEO Thomas Smith left in February 2007 (with nearly \$100M in proceeds from the acquisition between him and his wife) following 2 months of paternity leave.

Many in the software industry credit Smith and the rest of the MComp Management team with creating a sustainable, repeatable business model for monetizing open source software projects. In fact, many of the newer firms based around open source software projects are emulating many of the features of the MComp model.⁴¹ Smith himself is also acknowledged as one of the more prominent (and loud) evangelists successfully carrying the message that open source software was a viable component in enterprise software deployments.

Love him or hate him [and there were plenty in each camp], Thomas Smith represented an important stage in the growth of Java open source. He generated a lot of attention to open source; he got people talking; and he deserves his financial success. (Rod Johnson, CEO of Interface21)

4.9.5 Analysis

4.9.5.1 Capital

Merging two ecosystems means synthesizing the two capital structures and existing capital flows along with new capital flows to create a new ecosystem. A successful synthesis of ecosystems results in a synergy of structures and flows that have capabilities and value that exceed those of the individual ecosystems. In other words, the whole is greater than the sum of the parts.

In the OpenSoft acquisition of MComp, several synergies were encountered. There were a number of relationships [social capital] that were created, strengthened, or made more efficient. The developers for both firms were able to find opportunities to forge new working relationships among themselves, which resulted in new ways of integrating their development expertise [human capital] to build new products.

Let's say the OpenSoft Conference comes along and you go to that and you happen to meet some OpenSoft folks and you guys go out to dinner. ... You

⁴¹ This includes most prominently BComp, the subject of the second case in this study, and another OSS firm. Both firms hired several of the executives who worked together at MComp to their management team in order to create similar models and hopefully similar degrees of success.

happen to be sitting at a table with one of the OS guys and say “Oh, man. I’ve been thinking about this. How about if we did this and can you guys do that? Can you provide an API?” They’re like “Yeah, sure, but it has to work this way. Is that okay with you?” and you’re off to the races. (MComp Developer, personal interview, 1/25/2007)

The integration of the two software code bases [organizational capital] into an integrated stack decreases the required skills [human capital] required by customers’ development staffs to manage the integration of the two products on customer premise. Instead, this integration and testing is handled by the OpenSoft and MComp engineers.

As discussed earlier, customers who deployed products and services by both firms are able to consolidate the two individual relationships into a single, more efficient relationship [social capital]. As such, the credibility (The combined product line also enables the combined firm sell support subscriptions to their existing customers, especially those that only had relationships with either MComp or OpenSoft prior to the acquisition.

Several relationships were lost following the acquisition, including members of the management team, developers, and some partners. The departure of the managers was largely due to the overlap in responsibilities between both companies’ staffs. While these defections⁴² may have cost the ecosystem some individual-specific expertise [human capital], much of the policies and practices they had previously established [organizational capital] remain as part of the ecosystem. Likewise, much of the previous code that the developers contributed to their respective software projects [organizational capital] remains available in the ecosystem except to the extent that there may be tacit portions of the code that cannot be read directly from the code. OpenSoft has subsequently attempted to expand the number of developers available to maintain and support [human capital] the existing code bases.

⁴² We can consider these as ‘departures’ since the managers abandoned their positions within MComp, some perhaps not voluntarily. Many of these managers did join other organizations subsequently, but that is beyond the scope of this discussion.

Several members of the MComp ecosystem received financial payouts [economic capital] in exchange for the ownership and control of the company. These benefits were made to current and former employees and consultants, investors, lawyers, directors, and other people who had made an impact in the development and growth of MComp Inc (and the MComp Group before that). These payments were made from the available capital in the OpenSoft ecosystem at the time of the acquisition. Since this economic capital is no longer available for use by the ecosystem at large, we no longer considered it to be part of the new OpenSoft ecosystem, even for those members who remained employed by the firm.

Table 12: Capital Observations – Acquisition by OpenSoft

<i>Capital Type</i>	<i>Instance</i>
<i>Social</i>	Partnership Relationships Community Relationships
<i>Organizational</i>	Source Code Documentation Codified Support Policies & Procedures Sales Model Business Model
<i>Symbolic</i>	Credibility
<i>Human</i>	Development Expertise Technical Skills
<i>Economic</i>	Working Capital (OpenSoft) Payouts (MComp Shareholders)

4.9.5.2 Mechanisms

The most immediately visible mechanism of the acquisition was the *compensation* paid to the MComp shareholders. As mentioned above, these payments reduced the amount of economic capital available within the remaining ecosystem. In exchange, the OpenSoft management acquired the ownership rights of MComp, Inc's resources, which includes most importantly the future value of all revenues and profits earned by the firm.

The *defection* of several of these shareholders from the ecosystem, including both developers and members of the management team, reduced the amount of expertise and business contacts available in the ecosystem. However, the contributions of most of these members had either already been codified into organizational capital or easily replaced.

The key mechanisms in this episode are those related to the merging and synthesis of the two ecosystems. This includes the *shared utilization* of the business and personal relationships that existed within both the OpenSoft and MComp ecosystems as well as the *shared utilization* of the credibility of both product lines, especially as they also are combined. However, the most significant mechanisms are the *coordination* and *integration* mechanisms which enable the meaningful synthesis of the organizational capital within the two ecosystems, including the business and sales models and the software projects. The implementation of new *coordination* mechanisms typified by the business models resulted in a number of new processes by which the firm could manage the capital flows and outputs of the ecosystem.

Likewise, the new products and service offerings such as the OpenSoft Application Stack are the result of this *integration* and of the *productivity* of the engineers on both sides as they contributed human capital to the creation and maintenance of these new products. These integration mechanisms enabled OpenSoft to meet the needs of other members of the ecosystem and to devise new means of generating revenues, thus meeting their own needs as a publicly-owned company.

In order to better facilitate stronger ties between members of the two ecosystems, several *communications* efforts were enacted. The CEO went on an attempt to talk to a number of the large customers to explain the synergies that could be expected from the move and to get feedback from these customers. Additionally, several chats had been held between various

members from the two ecosystems. For instance, there was a developer chat via IRC discussion board between the OpenSoft developers and the MComp CEO designed to dissuade any ill feelings that may have arisen between the two parties.

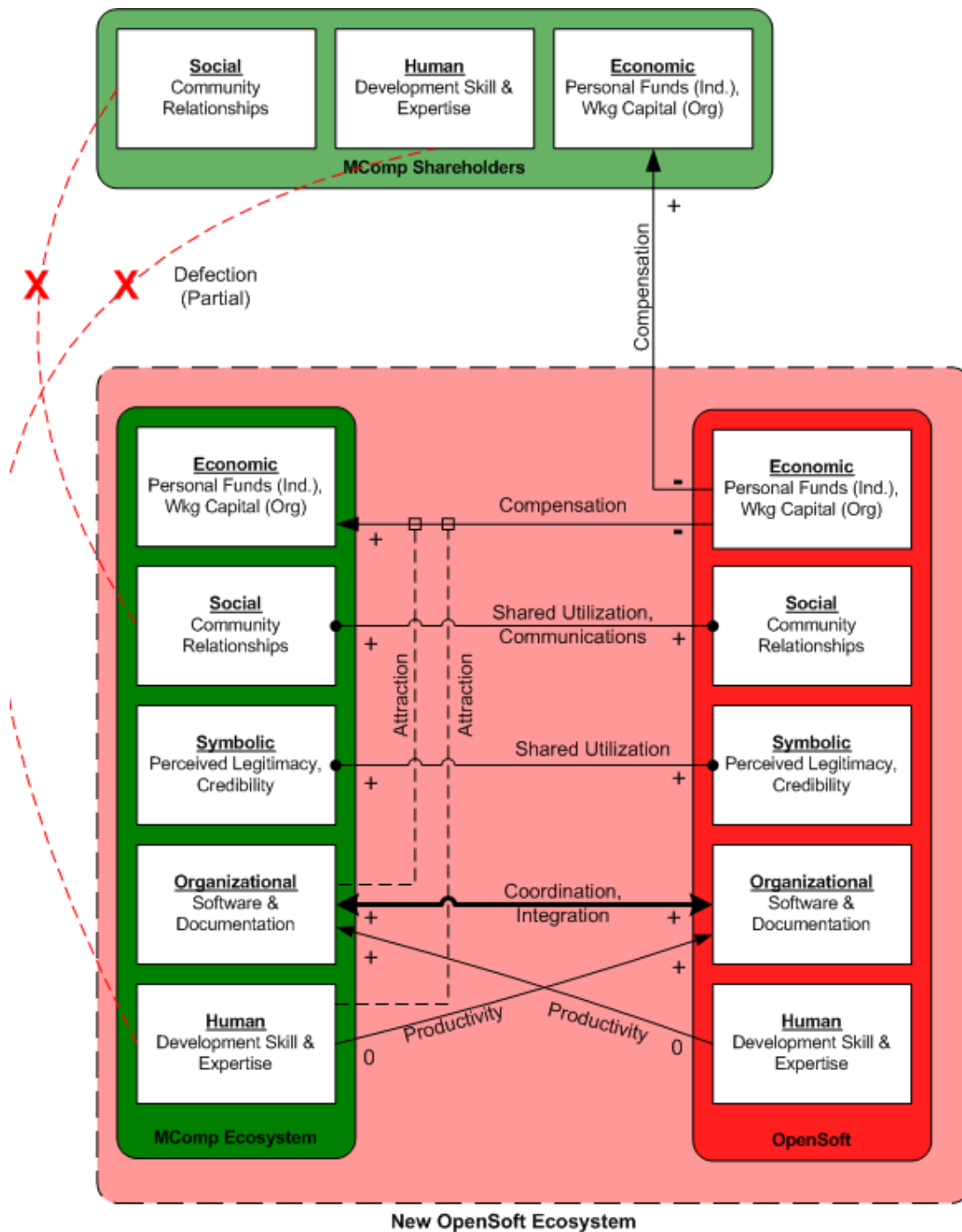


Figure 18: Capital Flow Diagram – OpenSoft Acquisition

4.10 Cross-episode analysis and discussion

4.10.1 Discussion of Mechanisms

We have identified a number of mechanisms from the analysis of capital flows and episodes in the MComp case (see Table 13). In all, 18 mechanisms (including two motivations, attraction and gap reduction) have been identified as being significant for the discussion of the 9 MComp episodes a total of 63 times.

It is important to note that neither these 18 mechanisms nor 63 occurrences are intended to be an exhaustive catalog of possible or enacted mechanisms within the ecosystem. In several episodes, mechanisms have been omitted that may have been identified previously but are not affected significantly by the changes introduced during the episode in question. In so doing, we have attempted to reduce the complexity of the diagrams or the resultant conversation. For instance, we have continuously and intentionally (after the first episode) omitted the coordination mechanisms inherent in the licensing structure or the various standards to which the software was written, not because they were no longer in place but because their effects were no changed in subsequent episodes.

The episodes discussed were those selected as important by the interviewees, supplemented by prior research into these episodes as covered in the contemporary news reports. Several other episodes were possible to discuss, but were not considered to be significant by multiple interviewees. For instance, the establishment of partnerships with Novell and Microsoft, while certainly significant for the creation of the sales model that propelled the bookings and revenues to the levels attained in the latter years of MComp' independent existence, were not mentioned often by interviewees and were therefore not examined in much depth. Similarly, we omitted discussion of an incident in which several MComp employees (including the CEO) were

caught posting messages to Java community discussion forums under false names, which cost the company some degree of credibility in the Java community.

We can make several observations from the progression of activities and the effects these episodes had on the capital structure and flows of the ecosystem revolving around MComp. First, the mechanisms available to the ecosystem at a given point in time result from the capital structure in existence. For instance, the founding of the MComp Group was only possible because of the community relationships (social capital), the software and documentation (organizational capital), and the productivity mechanisms that had been created during the earlier phases of eMComp and TCorp. Otherwise, there would have been no software in place around which to build the support services nor participants able to provide these services.

Second, some episodes are more significant with respect to creating the conditions under which subsequent mechanisms are enacted. It is difficult to make a direct line between Bill Coleman's hiring and BigWare's acquisition of CWare. However, we can validate a link between Coleman's hiring and the pursuit of venture capital funding.

By analyzing the reasons why certain mechanisms were enacted and the effect they had, we can make informed guesses as to how things might have occurred. For instance, we have analyzed one of the reasons for the acquisition of Mr. Royal and the GSoft folks as the departure of the RDT folks, who defected and took their expertise in persistence technologies with them. Thus, although it is possible that the company would have pursued Royal, we can safely assume that the felt need was more intense given MComp' desire to monetize the services that their consultants could provide.

Table 13: MComp Mechanisms By Episode

Mechanism	EMComp Founding	TCorp Failure	MComp Rebirth	Bill Coleman Hiring	RDT Fork	Acquisition	VC Funding	CWare / Cigar	OpenSoft Acquisition	Counts
<i>Attraction</i>	x	x		x	x		x		x	6
<i>Coordination</i>	x								x	2
<i>Productivity</i>	x	x	x		x	x		x	x	7
<i>Investment</i>	x	x				x	x	x	x	6
<i>Compensation</i>	x	x	x		x			x	x	6
<i>Legitimization</i>	x	x	x	x		x	x	x		7
<i>Knowledge Acquisition</i>	x	x								2
<i>Gap Reduction</i>			x				x			2
<i>Knowledge Transfer / Sharing</i>			x	x	x	x	x		x	6
<i>Codification</i>			x							1
<i>Adoption</i>			x		x			x		3
<i>Implementation</i>				x						1
<i>Shared Utilization</i>				x		x	x	x	x	5
<i>Defection</i>					x				x	2
<i>Control</i>					x					1
<i>Communication</i>					x	x			x	3
<i>Forking</i>					x					1
<i>Integration</i>						x			x	2
Counts	7	6	7	5	9	7	6	6	10	63

Third, the progression of episodes in the MComp case highlights the transformations that occurred in the ecosystem during the seven years covered in this research. In the analysis of each episode, we have been identified the impact each of the above mentioned mechanisms on the capital structures and flows within the ecosystem and sometimes external to the ecosystem. From this analysis, we can analyze the interactions between different capital types as encountered during the previous analysis.

As shown in Table 14 below, the specific mechanisms impact the capital in the ecosystem in multiple ways. For instance, *legitimization* results in a change in the symbolic capital of the ecosystem as other forms of capital are transformed. As an example, the addition of venture funding [economic capital] resulted in increased credibility [symbolic capital] in MComp, Inc and by extension, the entire ecosystem.

Table 14: Mechanisms by Capital Interactions

To From ->	Economic	Social	Symbolic	Human	Organizational
Economic	Investment; Compensation				
Social		Shared Utilization; Communications; Trust Building			
Symbolic	Legitimization	Legitimization	Shared Utilization; Legitimization	Legitimization	Legitimization
Human		Knowledge Acquisition		Knowledge Transfer / Sharing; Defection	
Organizational				Productivity; Codification; Implementation	Coordination; Integration; Adoption; Forking

Table 14 displays several potential uses for each types of capital. The possession of human capital in an ecosystem similar to MComp can be used to create symbolic capital, additional human capital, and organizational capital directly using the mechanisms shown in the appropriate column. As we stated above, this is not an exhaustive list of mechanisms or effects. It also does not discuss the indirect effects that can be accounted by concatenating several mechanisms in an exchange arrangement. For instance, it is commonplace among services-based business models (such as MComp) to essentially convert their human capital into economic capital by pairing a *knowledge transfer* mechanism embodied by the provisioning of support services with a *compensation* mechanism in the form of payments made by the recipient of these services. However, we identify these mechanisms as separate transactions as it is not necessary for these services to be provided only in exchange for financial compensation.

5.0 BCOMP EPISODE ANALYSIS

Table 15: BComp Episode Listing and Typology

	I. Founding	II. White Paper/ Website	III. Todd Mayweather Hiring	IV. JSoft Acquisitions	V. Venture Funding
Endo/Exogenous	Endogenous	Endogenous	Endogenous	Endogenous	Endogenous
Planned?	Planned	Planned	Planned	Planned	Planned
Eustress/Distress	Eustress	Eustress	Eustress	Eustress	Eustress
Date of stress:	May-05	July-05	Nov 2005	November-05	December-05

5.1 Founding

5.1.1 Antecedent

The company originated from the desire of the founding members to continue their work in the business intelligence industry. The five original founders had worked together previously in a string of established and startup business intelligence firms. These five had worked together at a previous startup, which went under. They soon founded another firm which was acquired and subsequently merged into a larger firm. During this time, they met several other current BComp employee. They soon left the merged firm to found a second startup at which point they met Allen King. Keyola was acquired by Lawson Software in April of 2002. All in all, the key members of the BComp startup team have been working together for approximately 10 years, mostly in the business intelligence industry.

In late 2004, the founders were ‘sitting around’ following the sale of Lawson. Much of the software they had written in their previous positions was owned by Hyperion and Lawson. As such, they realized that their entrepreneurial and development efforts had been rather inefficient since they would have to rebuild many of the same components from scratch in order to craft new BI applications or platforms.

We said wouldn't it be nice if what we created this time that somewhere down the road if we were ever acquired again or whatever ends up happening to us we could come back and actually reuse a bunch of the pieces that we already created. (CEO)

So in October of 2005 they began to form a new software company named 'BComp'

5.1.2 Planning

They decided to found yet another business intelligence company. The first decision was what software to build. Their previous firms focused on individual software components. This time, they would include all of the components in an integrated, next-generation platform. In other words, instead of focusing exclusively on reporting or OLAP, the BComp software would include in a single integrated application all of the necessary pieces that an organization would need for an end-to-end deployment.

So, the first thing we had to decide to do was what is it we wanted to build. And so what we decided to build was the next generation of software, so proactive software, realtime software. Once we did that, then we said how do we build this thing? (Chairman of the Board)

The next decision concerned how they would go about building this application. The original idea was to develop the platform around Microsoft's .NET framework along with their servers and other applications, but this proved to be problematic because of the difficulty in pricing the various components and getting them to work well together.

I tried doing an architecture with .Net stuff and there's a lot of components that you can't even run on the same server. I came up with a configuration it would require buying somewhere between eight and eleven servers from Microsoft. And I couldn't price it. I tried pricing it through Microsoft's website and it was a mess. Then we pretty much decided on Java before the whole open source idea came along. (CTO)

Because of these problems and the difficulty they were experiencing in putting together a Microsoft solution to build the new platform, the developers decided to begin using Java. This led the developers to realize that there is a wealth of existing components already available in the

open source market. For instance, they were able to identify several tools and components that were included in the product using a website such as manageability.org. The ‘catch’ is that their source code would likely be open source as well. However, the use of existing open source component would enable the new firm to get off the ground much more quickly than if they had to build these components by scratch.

The business model itself was also part of the decision to release the product as open source. The CEO felt that there were two advantages initially by using an open source business model. First, potential customers would be able to take advantage of the lower initial costs of obtaining and implementing the software. The traditional BI market requires customers to spend large amounts of money upfront before they are able to use the software. With open source, potential customers could download and try the software to see if it met their needs before sending money to do so. Secondly, because of this greater potential for getting potential BI customers to try it early in the process, an open source business model offered a greater opportunity for the company to be disruptive and capture a bigger piece of the business model.

As a small company, how do we go out there and challenge a lot of the larger, dominant players that have been out there for 10 years plus. You’ve got Hyperion, Cognos, Business Objects, Microstrategy, Oracle, and then you have Microsoft. So how does somebody dare to compete against people like that? Well, you’ve got to go down obviously a different business model. And that’s where open source made complete sense to us. (CEO)

Additionally, they reached out to knowledgeable people in the open source community via previous contacts. CEO Robert Dixon made contact with MComp CEO Thomas Smith and EVP Bill Coleman through their VC investor. From Smith and Coleman, Dixon had the opportunity to discuss many of the aspects of open source companies.

I said ‘give me some advice’, this and that so we chatted about a couple of things. And [Thomas Smith] said first of all open-source business models are completely horrible. That was his first quote that he gave me. Not a very inspirational quote as I had just started this company. But the fact is I think you have to do it right.

So really what I learned over some time and talking with him and Bill Coleman, also from MComp, is there are certain things you have to do. (CEO)

One of the biggest lessons Richard learned was to resist the urge to include license revenues in the business model, unlike the plans from previous enterprises.

When you come from commercial into an open-source business model, the first thing you start to do is run through your numbers at least from my perspective on the business side of things. ...And you keep wanting to plug in software license revenues. You try to plug it in and fortunately I had some good advice from those guys and we're going down the pure route of 100% open source. (CEO)

Thus, the decision was made to build the product and the company using an open source model that strongly resembled the MComp model. However, this decision was balanced by the original goal, which was to build a more complete software platform for business intelligence.

The truth be told is that the first thing that we wanted to do though, and still is, is that we wanted to build the next generation platform. We happened to use the open source business model to get there. Right? But we had a vision of what we wanted to do. And to be honest, if we couldn't have found what we needed in the open source community to give us a quick start, I don't know what we would have done. We probably would have built it in the proprietary world. (Allen King)

5.1.3 Stress

The business plan for BComp was finalized in October of 2004, with the initial funding handled by the founders themselves. The first employees were hired in February of 2005. Given the local proximity of the founding members at the time, the corporate offices were located in a metropolitan US city. The design and prototyping work continued throughout late 2004, with the first alpha code release posted to Sourceforge.net in July 2005.

In June, the company announced their intentions via a series of press releases and news coverage. The analysts quoted in these releases were generally positive in their assessment of the new company and its products, based on the level of experience brought to the project from the founders as well as the intent to provide an end-to-end suite of products instead of standalone applications.

5.1.4 Adaptation

Nearly immediately, the company saw a tremendous level of interest from users and developers even before the code was released. Many of these community members were reacting to the established plans for the software and the community as communicated on the website and through the white paper (see next episode). When the first versions of the software were released, there was a level of interest from the community as manifest by their use of the discussion forums and via downloads.

I think we released our first beta in September or October. A matter of a few months and we were looking at thousands of downloads and floods in the forums of ‘how do I get this installed, what do I do now?’ It was this great rush for getting... communicating information and documentation out to the community, but I was just so surprised at how quickly people adapted. We were just feeling like this has got to be the right thing. We have to be at the right place and the right time because people were waiting for this and told us, you know, we’ve been waiting for this integration. I was going to do it myself but look: you guys have this great plan. (Community Liaison)

Additionally, the community participated in the development of the project by providing services that the developers had not anticipated nor intended.

I was pretty surprised that we did get a lot of interest early on. A lot of people come to the community and contribute in a way that I hadn’t really thought of, especially the translation like immediately our first... as soon as we put stuff out there we had people from Brazil, China and the Netherlands asking to translate it. In the commercial side, that would always be the last thing. Somebody else’s problem, you know. That was kind of neat. Getting that international flavor right from the start. (Sr. VP)

5.1.5 Analysis

5.1.5.1 Capital

At the outset, BComp was little more than a collection of individuals who had experience working together [social capital] and relevant domain knowledge [human capital] of the BI industry, both of which were forged while they worked together in three successful startups since 1994. Because of this experience, the founding team entered into BComp with a significant

amount of legitimacy [symbolic capital] as a team that had successfully navigated the process of building a BI company several times over. They also had a very high degree of confidence in their ability to execute yet again.

During the entrepreneurial process which created the BComp organization and its surrounding ecosystem, several functions were carried out by the various members. The founders invested their personal funds [economic capital] to the general working funds [economic capital] of the BComp corporation. The skills and experience of the founding members were integrated and combined to create a set of development processes [organizational capital]. In turn, these processes were combined with open source software norms and the efforts of the community to craft a development methodology [organizational capital] for commercial open source projects. This methodology differs from commercial firms in the level of transparency and visibility which must exist in open source.

[I]t's more community involvement versus kind of sitting back in a closed up world with your own project managers and product managers determining every single feature that needs to be in the project and then waiting 12-18 months to develop it and release it. So this is more of a fast and furious and work with the community type of approach. (CEO)

However, the resulting model is different from a pure open source model in that enterprise customers expect more predictability [symbolic capital (credibility)] and timeliness from a software vendor. As such, many of the practices of open source are not designed to handle schedules and roadmaps as expected by most of the customers BComp expected to attract.

[For a true open source model], it could take six months to go from you know, code complete to being 1.0. And that's fine. If that's how long it takes, that's how long it takes. You put a professional model around it and you can't have a six month window. ... You know, you can't do that. So, you have to start setting targets and deadlines and schedules. And that makes it very hard for the community to participate. (CTO)

In order to integrate and coordinate the efforts of the community into the BComp structure and processes, a significant emphasis has been placed on communication [social capital] within the ecosystem. A community liaison was appointed to interface with the developers and contributors to ensure that their issues are being heard and addressed within the company.

From the smallest contribution, which could be they reported a bug, you know, on our website to the largest where they've given us code. I make sure I contact them personally. I manually and personally manage all contributions, all attribution to contributors. (community liaison)

To date, this level of communication and attention has been successful in getting the community more organized and efficient with respect to the development and testing of source code. Through such functions as personal recognition, awards, forum communications, and personal communications, the focus of the liaison has been on attracting and retaining the involvement of these contributors.

Getting community connection up and running was the single biggest thing we did to take the community from something small and kind of fragmented to something that it's much more easily scaled. (Sr. Developer/Founder)

Additionally, the company has been adept at communicating a common vision, including a set of goals and a shared language [social capital] to the rest of the ecosystem. During this founding period, the company issued several press releases and other marketing efforts to help spread the word about BComp throughout the BI industry.

There have been several net outcomes of these antecedent conditions and processes. First and foremost, the founders were able to devise and implement business plans [organizational capital] and an effective software architecture which attracted a significant amount of interest, participation, and feedback [human capital] from the users, developers, and other ecosystem members. They were also able to establish software development methodologies that matched

their internal plans and the multifaceted needs of the other members of the ecosystem. Additionally, the company was able to build upon the reputations of the founders and the established plans to establish some legitimacy [symbolic capital] for the ecosystem as a whole.

Table 16: Capital Observations - BComp Founding

Capital Type	Instance
<i>Social</i>	Mgmt Team Tenure Social/Business Acquaintances Shared Language Community Communications
<i>Organizational</i>	Development Methodology & Processes Software Architecture
<i>Symbolic</i>	Credibility Legitimacy
<i>Human</i>	Domain Knowledge Feedback Entrepreneurial Expertise
<i>Economic</i>	Personal Funds Working Funds (BComp Firm)

5.1.5.2 Mechanisms

There are several mechanisms that can be identified in the founding of BComp (See Figure 19). The initial operations of the firm were funded by a direct *investment* of economic capital from several of the founders themselves, who also worked without a salary until revenues and other funding could take over. This funding enabled the company to have sufficient working capital in its initial stages to pay for the necessary upfront expenditures and prototyping costs.

The ecosystem benefited from the founders' individual capital in several other ways. Unlike financial capital, it is not necessary to transfer other forms of capital to another party in order for them to utilize it. Instead, the multiple parties connected through some sort of social relationship are both able to take advantage of *shared capital utilization*, which enables each party to leverage the capital without being required to transfer or devalue the capital in the

process. Certainly, it is possible to transfer some non-pecuniary forms of capital between parties, such as when there is a change in the power or administrative structure or patents are sold to another party, but it is not mandatory for the capital to be transferred in order for an additional party to utilize it. In this case, BComp Corporation and the BComp ecosystem both take advantage of the shared utilization of the symbolic capital in the form of the credibility held by the founders as a result of their previous entrepreneurial success. Similarly, their relationship as a team is a form of relational social capital that is replicable across the ecosystem as these existing relationships are utilized and new ones are formed.

In order to attract participation from outside the firm, the culture, values, and expected benefits must be specified for potential participants, including developers, users, investors, and partners. Additionally, feedback paths need to be established to enable information from even distant members of the ecosystem to have a say in the goal setting and attainment of the ecosystem. These feedback mechanisms are a vital means of enabling the vision and goals for the entire ecosystem to be included in the plans established by the core development team. As BComp was getting started, the company issued a number of press releases, newsletters, mailing lists, discussion forums, and other communications to reach existing and potential contributors, largely using the tools provided by Sourceforge. On an ongoing basis, the company has continued to use these and other *communications* mechanisms for *marketing* and *feedback* to attract and retain contributors, such as direct communications from a dedicated community liaison, training classes, conferences, and meetings.

Several forms of organizational capital are initially created in this phase as the result of the combination and integration of the human capital contributed by the founding team and the development community. Two different mechanisms are enacted to yield these outputs.

Productivity mechanisms are those activities which convert human capital to other forms through labor and effort. These mechanisms are responsible for converting these contributions into the desired outputs, in the form of the software, services, and documentation that are needed by the customers. A primary use of these mechanisms is the development of both the software architecture and resultant application. The BComp management team also used their existing human capital in this episode to produce a suitable business plan and organizational routines for the development and marketing of software.

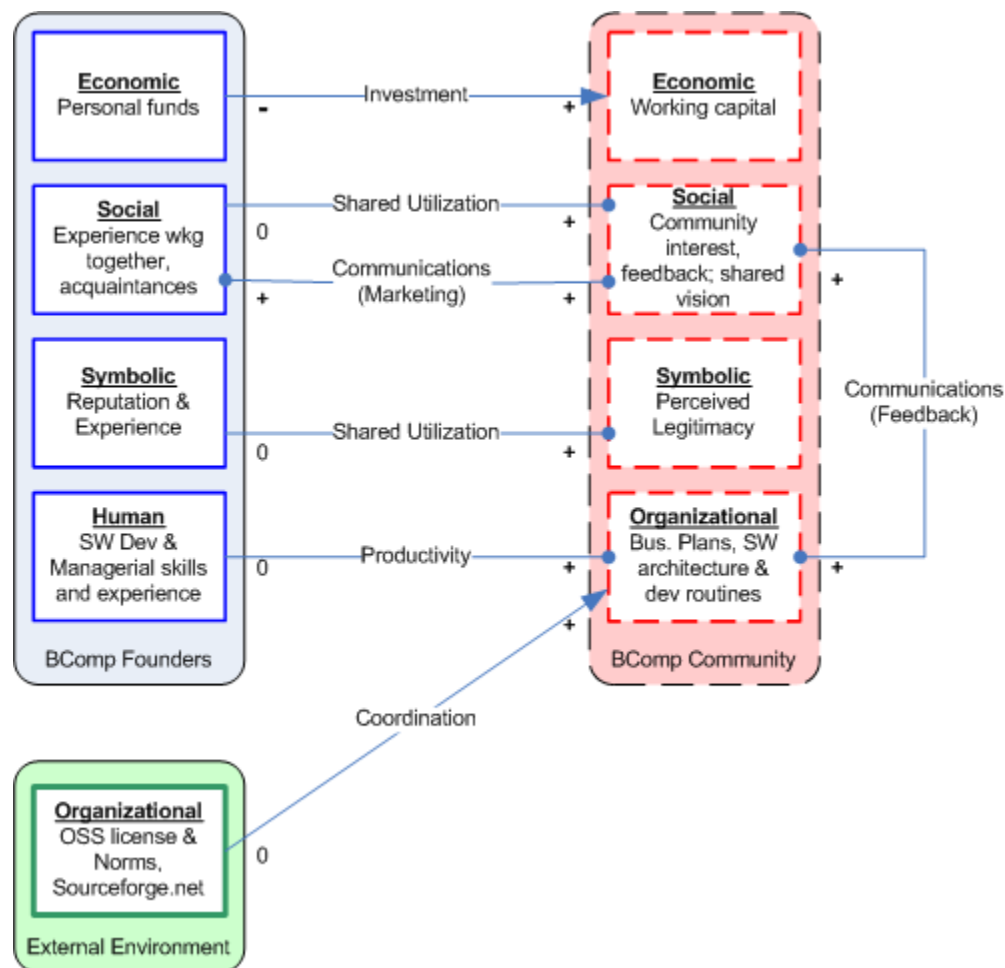


Figure 19: Capital Flow Diagram – BComp Founding

Coordination mechanisms establish and maintain procedures and guidelines for integrating the contributed capital and resources in order to efficiently produce the necessary outputs. The software architecture, development methodologies, and other documents and

procedures are instances of tools used to manage these processes in the BComp case. The initial design of many of these mechanisms was constrained and enabled by the norms of open source software, the covenants of the particular open source license chosen, and the availability of tools and resources on Sourceforge.net.

5.2 Website and White Paper

5.2.1 Antecedent

Once the company had been started and the business plans written, the next step was to share this information with the rest of the community. In other words, the business and technical vision for BComp needed to be communicated to other potential stakeholders including developers, investors, partners, and users in order for them to be able to participate in the ecosystem as it had been designed.

5.2.2 Planning

Probably the smartest and best move we could have done was spending that week down on the beach (Sr. Developer)

During a weeklong retreat, the founding members of BComp spent time not only planning the basic product architecture but also developing the detailed message. There were several key outputs of this retreat, including the initial website and a white paper explaining the company's technical infrastructure and business plan.⁴³ Both items have been recognized as being key factors in the early success of the project and of the company itself.

[O]ne of the key things that made us immediately recognizable and immediately interesting was we had a wonderful business plan and we put it out on this really great website and we really received a lot of feedback, positive feedback on our website. (Community Liaison)

⁴³ BComp technical whitepaper, dated July 8, 2005.

5.2.3 Stress

When first published, the website contained information for both potential adopters and potential developers, including product information sheets, development roadmaps, FAQs, and other information. It was designed to explain the BComp story and to detail on BComp's behalf "what we were trying to do, how we were going to do it."⁴⁴ An early version of the website from April 20, 2005⁴⁵ includes detailed information on the product line (though it had not been released yet), including five product information sheets that contained a list of the proposed features for the BComp platform. It also contained information on the intended means for generating revenues.

There are no end-user license fees. We finance our activities through charges for optional services – such as support plans and consulting – that organizations can choose whether or not to utilize, depending on their needs. (BComp.org website, 4/20/05)

Subsequent versions of the website included a roadmap that listed key features for upcoming releases of the software. Additionally, CTO Todd Williams wrote a technical whitepaper that further elaborated on this point. The whitepaper, which was released in July 2005, is primarily concerned with the more technical aspects of the platform, including the basic schematic of the intended infrastructure, as well as communicating BComp's role in providing source code, personnel, and project management services.

5.2.4 Adaptation

The information presented in the whitepaper and on the website was a key component of the firm's early success, as it enabled the company to attract many initial customers and partners based on the articulated vision for the company.

We're at LinuxWorld and the xxxx guys came over, the director of marketing and he asked us to come up to one of the parties that they were having and wanted to

⁴⁴ Interview quote, Founder & Sr. Architect.

⁴⁵ Accessed from the Internet archive, April 14, 2007

talk to me and work with us. He said that we had... this is my favorite quote I think that we've had, that we have the best-articulated message that he's ever seen whether they were open source or not. That's why they wanted to work with us because it was no doubt as to, you know, what we wanted to do, how we planned to do it. (Sr. Architect.)

There have been at least two other advantages of having this information posted for public review. First, it enabled the development team to clearly communicate the intended plans to potential customers and developers, which encouraged these members of the ecosystem to provide feedback on the current platform and the feature set for subsequent versions.

That really jump-started the community because people would surf in, they'd start looking through that and we'd get tons of initial feedback on, you know I hope you guys can do this. This is really what we need. There was no confusion. (Sr. Architect)

Second, BComp's commercial intentions were made clear in the early documentation, which cut down on later confusion over other business moves, including the acquisitions and venture capital funding.

So we were upfront. This is not a charity type of event. We're going to do a lot of stuff and put it out there for free but we are also going to come back and monetize some of it. (CEO)

As the company has matured, the information on the early website has proven to be remarkably prescient. As one respondent stated, much of this early information, which was created before much of the code was written, has remained relevant.

The funny thing was as stuff started showing up, we did not change much because, you know, we had gone through it. So, I think that is probably, in my opinion, probably one of the best, smartest things we did. That really jump-started the community because people would surf in, they'd start looking through that and we'd get tons of initial feedback on, you know I hope you guys can do this. This is really what we need. (Sr. Architect)

5.2.5 Analysis

5.2.5.1 Capital

Once the business plan and basic software architecture were developed, it was necessary to share it with the remainder of the potential ecosystem participants in order for them to be able to figure out how to participate. The development of a website and white paper [organizational capital] to enable the efficient dissemination of this information was crucial in allowing the participants to not only gain a shared mental model [social capital] for the ecosystem (particularly in the ways in which it differed from traditional open source) but also to provide a reference for the early participants to provide feedback and suggestions [human capital] to the BComp team.

The development of these resources was made possible by the skills and experience [human capital] of the founding team in the areas of software development, marketing, and management. Early contributors would not be able to download and try the software because it had not been made available. Instead, the detailed design documentation [organizational capital] written by the development team (based on the prototyping work that had been done to that point) both attracted contributions and explained where they were needed (particularly in the roadmap). It also helped structure the coordination of effort among the external participants. Additionally, the motives and business models were included in these initial materials to avoid any misunderstandings that may arise as the company went about its mission of generating profits.

From the outset, the materials were directed at both communities (user and developer).

We attacked it from a kind of product and marketing side. [The marketing] part of the website gave the user facts and that sort of information. And then we had the developer side. For each silo the reporting, analysis, and dashboards there was a complete story as to what we wanted to do. (Sr. Architect)

In doing so, both communities would hopefully be drawn into exchange relationships within the larger ecosystem, which was a necessity in order for it to survive.

The establishment and sharing of these documents were key factors in establishing the expectations of participants and thus gaining their acceptance of the relationships and activities that were anticipated within the BComp ecosystem. By clearly laying out the model to be followed, BComp was able to establish a baseline for this legitimacy⁴⁶ [symbolic capital] in terms of both its business practices and its product development goals.

Table 17: Capital Observations – BComp Website and White Paper

<i>Capital Type</i>	<i>Instance</i>
<i>Social</i>	Shared Vision Community Relationships
<i>Organizational</i>	Website White Paper Documentation
<i>Symbolic</i>	Legitimacy
<i>Human</i>	SW Dev Expertise Mgmt Expertise

5.2.5.2 Mechanisms

The information contained in the technical documentation produced by the firm result from mechanisms utilizing the domain-specific and technical human capital from the development team as they built and selected from a number of early prototypes. This conversion of capital was the result of *codification* of the chosen plans for both the software and the firm into the whitepaper, website and development roadmap. Still, this capital needed to be communicated efficiently throughout the rest of the ecosystem in order it to be useful. These documents and particularly the website are vital *communications mechanisms* for disseminating technical and business information throughout the ecosystem.

⁴⁶ Legitimacy can be defined as “the generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate.”

In order to continue to attract and retain participation from outside the firm, the culture, values, and expected benefits were specified for potential participants, including developers, users, investors, and partners. This specification was a tremendous help in the *legitimization* of BComp's goals and actions by ensuring that participants knew what to expect from the firm. As such, these documents mitigate future dissention that may arise as the ecosystem grows and the roles of key participants become more clearly understood. For BComp, the expectations spelled out in the website and white paper also provided the means for *acculturation*, which enabled the new participants to understand their roles and fit into the existing structure of the ecosystem. By putting these plans into a more tacit form that other participants can reference in order to frame their actions, the founders and development team were able to use these materials as *coordination* mechanisms to help participants identify specific ways they can coordinate their contributions and expected appropriations within the framework and functional goals of the entire ecosystem.

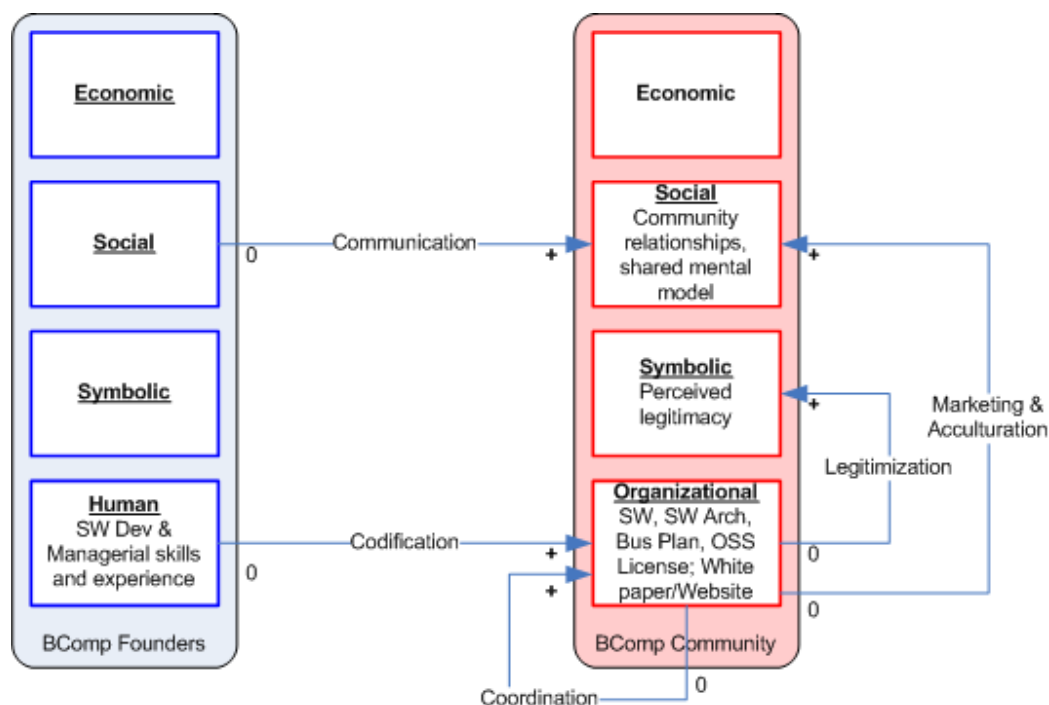


Figure 20: Capital Flow Diagram – BComp Whitepaper / Website deployment

5.3 Todd Mayweather

5.3.1 Antecedent

Todd Mayweather has been among the most influential people in open source software for many years. He was also part of the group that first proposed the use of ‘open source’ in 1998 to contrast with the term ‘free software. He was also co-founder of an early open source company. Today, he serves on the board of directors of several commercial open source software firms (including BComp) and is a part-time venture partner.

5.3.2 Planning

It was at the early open source software company that Mayweather met BComp co-founder Allen King, who joined their Board of Directors in March of 2002. King and Robert Dixon approached Mayweather about investing in BComp and joining the board of directors. At this point (early 2005), the company had not released any software, nor had it developed much community. Typically, an investor in an open source company (which Mayweather would become) would wait for the project to prove its utility for its intended user base.

The rule of thumb in general around an Open Source investment...is let the Open Source project get some traction, let's see if people are going to accept it, watch the early results of downloads and acceptance and if it takes off in traction then you know you have something and you try to invest as early in that curve as possible. (Todd Mayweather)

At this stage, traction was largely non-existent for BComp at this point. Instead, the selling point was not only the design of the product architecture, but also the business and domain experience of the BComp team.

[I]f you have been successful as an entrepreneur and worked with a top tier VC firm and shown that you can make the money, the second time you walk into that office and all you need is an idea and you can get funded. Okay. And that's essentially what these guys did with me. (Todd Mayweather)

5.3.3 Stress

Ultimately, Mayweather became involved with BComp very early in the company's history and formalized his relationship by officially joining the board of directors in November of 2005. His decision to get involved was based on several reasons. Perhaps the most significant was because of his existing relationship with King and his trust in the management team's ability to execute. He also based his decision at least partly based on his assessment of the product placement and positioning within the industry, as he expressed in the announcement of his board membership on his blog:

BComp is a company that I'm obviously very excited about. It fits the thesis for Open Source business models in the current economic environment that I've been developing:

1. A well-known application that is traditionally big and expensive. This gives BComp a lot of aircover in setting pricing.
2. A large, neglected SMB market opportunity. The software would be useful to many SMB businesses out there, but they can't afford the current solutions. This gives BComp a way to enter the market below the entrenched big boys.
3. A large enterprise market. Even though there's a broad SMB market, the BComp platform can scale up into the enterprise market, further increasing the market opportunity and putting continued pressure on the incumbents.
4. Incumbents can't move down market. Companies like X, Y, and Z can't offer entry level solutions to compete with BComp Open Source without breaking their business model.

5.3.4 Adaptation

Having been successful in the software industry, and specifically the open source software industry, Mayweather's involvement included several benefits for the BComp ecosystem. His experience enabled him to provide the BComp management team insight into the open source software business, which is a key strength for him.

What I typically do is work with entrepreneurs in the early stage of a company, help them figure out the business (Todd Mayweather, from an online magazine article)

He also advised the company on several key strategic actions, including the significance of the development community surrounding BComp or setting up the development community.

Todd would say, ‘listen, you’re not gonna get a lot of people out there developing all of your code for you. You’re going to get a lot of good QA and a lot of good distribution and things like that, but don’t expect that you’re going to have 900 developers sign up and just start creating your product for you.’ (CEO)

He also introduced the BComp Corporation to several VC firms early in 2005 (see next episode). Mayweather’s reputation provided BComp with a perceived degree of legitimacy and status through his association with them. This legitimacy in turn attracted the VC firms. In short, his association with BComp has had a significant impact on the young firm.

5.3.5 Analysis

5.3.5.1 Capital

Under normal circumstances, Mayweather would not have been a part of an open source software company until after the software had been released and it had established both a significant download rate [symbolic capital (credibility)] and a large development community [social capital]. For instance, MComp was able to attract top-tier management personnel and venture capital after it had established a track record of both development productivity and download/usage metrics. Instead, he joined the BComp board of directors at an earlier stage, based on his assessment of the quality of the management team [human capital], his personal relationships [social capital] with them, and the relative positioning of the software within the BI industry [symbolic capital (credibility)].

In joining, he brought a number of resources and capabilities to the ecosystem. Arguably, there is no one with more experience in commercial open source software firms, owing to his

founding of an earlier company, the stints he served as CEO of several OSS firms, and his experience on several commercial OSS boards. This experience and expertise [human capital] was a benefit to the BComp ecosystem in several ways. For example, the BComp CEO pointed out in an early interview with the research team that he had received valuable advice and guidance from people that were already familiar with the open source business model, including specifically Todd Mayweather. Additionally, he was able to arrange several meetings with venture capital firms based on his previous relationships [social capital] with several firms.

Finally, his participation can be viewed as a watershed episode in the history of BComp because of the credibility [symbolic capital] he is able to contribute based on his reputation [symbolic capital] in the open source software industry. It is important to note that Allen King, the chairman of the board, has a significant amount of experience in the software industry [human capital] based on his former roles, including Sr. VP of Marketing and CEO with two large firms. Certainly, BComp has benefited greatly from King's participation as a founder and officer. However, King's experience at the time was not as well regarded in the greater open source community as Mayweather's. In combination with the professional experience of the founders, BComp was able to draw upon a high level of symbolic capital when dealing with other potential ecosystem members, especially at an early stage.

So, as intangibles at the very beginning when we're just five guys and a dog out there looking to start something, I'd say [King and Mayweather's participation] is probably huge because without that, you know, you don't get much further. These guys blend in that credibility so that these guys [VC firms] will give you money. These guys give you money then you know a lot of the other potential customers and just the community in general kind of gives you an okay. (Sr. Architect)

Table 18: Capital Observations – Todd Mayweather joining BComp

Capital Type	Instance
<i>Social</i>	Community Relationships Personal Relationships
<i>Symbolic</i>	Personal reputation Download Counts (credibility)
<i>Human</i>	OSS Expertise Management Team Expertise
<i>Economic</i>	Personal Funds Working Funds (BComp)

5.3.5.2 Mechanisms

BComp attracted Todd Mayweather based on the presence of several characteristics of the existing capital structure, mainly the reputation and expertise of the founding team and his personal relationship with the chairman of the board, Allen King. We thus posit that the capital structure these factors represent possessed an *attraction* mechanism, which is manifest as the capacity or tendency to induce participants to join the ecosystem. Similarly, Mayweather's personal capital structure has its own attraction mechanisms that result from his reputation expertise in the open source industry (human capital), his social contacts in the industry and with potential outside investors (social capital).

Certainly, when Mayweather joined the BComp ecosystem, there were several advantages that resulted. Mayweather made a direct *investment* in BComp, which provided additional financial capital to the company. The ecosystem and BComp were able to benefit from the *shared utilization* both of Mayweather's aforementioned social and symbolic capital to increase their collective capital levels accordingly. Finally, the relationship with Mayweather has resulted in the enactment of a *knowledge sharing* mechanism as the BComp management team has benefited from his vast expertise via several pieces of key advice and counsel.

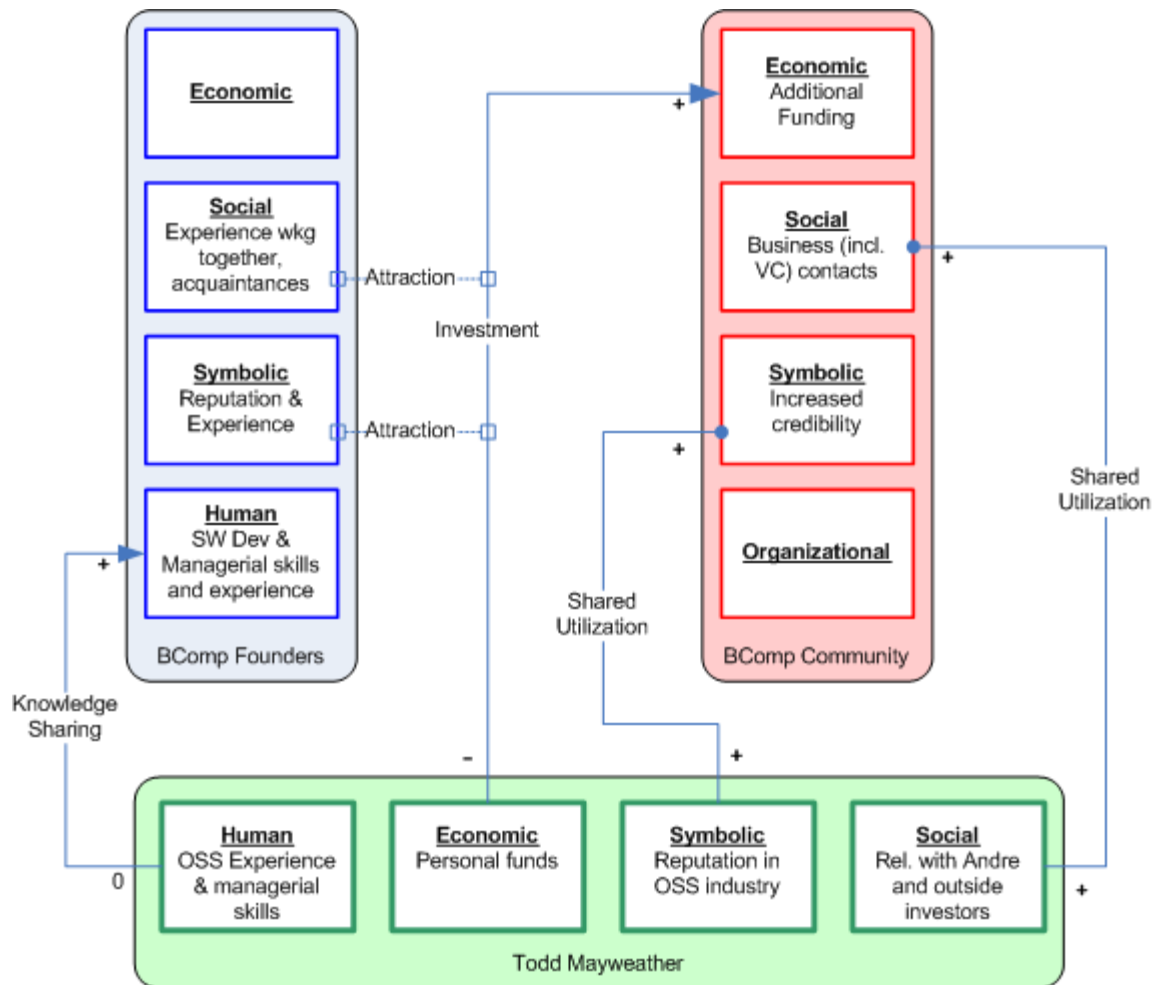


Figure 21: Capital Flow Diagram – Todd Mayweather joining BComp

5.4 Venture Capital Funding

5.4.1 Antecedent

In the summer of 2005, BComp had begun to ramp up its operations and realized that it would take a few years to build both product and community effectively. In order to do so, they would need additional financial capital in order to execute correctly.

If we're going to go through and build an entire BI suite we weren't going to do that with four guys and a dog. It's going to have to be 20, 30, 40 people, et cetera and growing. So we did have to go out and get the venture money. (Richard, CEO)

Fortunately, there was plenty of venture capital available for open source firms that seemed to have a chance to make money for the VC firms. BComp was able to approach these firms with the credibility of having a management team that has worked together for over ten years and built three previous profitable firms in the BI industry. They also could point to the work they had already carried out in selecting top-of-the-line, established components and integrating them into a broad platform, as well as the detailed plans for future development efforts. These factors combined with analysts' predictions regarding the business intelligence software industry made BComp an attractive candidate for VC funding.

5.4.2 Planning

In order to receive this VC funding, the BComp team could take advantage of contacts that were available to them through Todd Mayweather and Allen King. Through these contacts, the CEO and the Chairman of the Board were able to set up road shows on both coasts to present their business plan in hopes of getting VC funding to help grow the business. Subsequently, they received several offers for funding and were able to be selective about choosing a VC. They were able to choose two firms who had both funded several open source companies in the past. From the VC's perspective, these previous investments were crucial for enabling them to correctly evaluate BComp.

These companies have given us the confidence that even though it may take some time to scale, that the revenue model can actually work quite well. If we hadn't seen this firsthand we may have been a little bit more shy about pulling the trigger but we've seen it work in a couple of instances which I think has made us a little bit more aggressive than some other venture funds as far as investing in Open Source software companies.(Partner, VC firm)

5.4.3 Stress

BComp was able to be selective in choosing a venture capital firm. The firm had several attractive funding options in addition to the ones chosen, including a buyout offer from a

competing firm and a persistent venture offer from a corporate venture fund. Ultimately, the two VC firms were chosen as venture partners based in large part on their track records. Firm A was an investor in other OSS firms, while Firm B had been an investor in another successful set of OSS firm (where they first established a relationship with Todd Mayweather). In retrospect, based on their execution since then, several firms may slightly regret their decision not to have made an offer.

Yeah. I think that a lot of guys now look back and say ‘wow, how did we miss that, right?’ And in their defense, it clearly in my mind was not a slam dunk when we took a gamble on this company. (Todd Mayweather)

Once they agreed to terms, BComp received a \$5 million Series A funding round from the two firms. The terms were closed in August, 2005 but were not final until later in the year.

5.4.4 Adaptation

The JSoft acquisition (see next episode) was finalized before the venture capital funding was made public in a series of press releases. The additional funding would enable BComp to acquire several other projects in order to carry out the previously established plans. However, the financial capital is not the only benefit from the VC funding. The mere fact that a company has been able to get funding can increase its perceived likelihood of survival and perceived legitimacy.

[E]verybody in the VC community [knows] what everybody else is doing. Therefore, you get somebody like NEA and then all of a sudden everybody else kind of wants to get in. (Sr. Architect)

Additionally, the VCs are able to share the expertise and guidance with respect to strategic issues they have experienced with other firms, which explains why having a VC with experience in the open source industry is desirable. VCs can also be an additional source of social contacts and information.

However, the financial aspects of getting VC funding are a significant benefit to the entire ecosystem. Following the funding, the firm was able to commence with trying to making other acquisitions (see next episode) to further strength the current system. In addition, the series A investors were so impressed by BComp's execution that they approached the firm's management team about a second round of funding, which was completed in July, 2006.

5.4.5 Analysis

5.4.5.1 Capital

The initial funding [economic capital] was provided by Richard and Allen (CEO and Chairman of the Board, respectively), but they were fully aware that there was no way they would be able to fund the company's growth. The need for venture capital funding [economic capital] arose from the realization that this growth would depend on their ability to hire additional developers and staff members as needed, in addition to funding the continuing operations of the firm. As previously noted, the typical model for funding open source software firms (much like any other software firm) is to wait until the firm has proven its ability to attract community relationships [social capital] and to develop software [organizational capital] that generates downloads from its targeted user base.

So, the VC model there has been identify projects, get good at identifying projects early on in their adoption cycle and then go out and do an investment in a company on it as soon as you can identify that curve. So people have gotten really good at sort of identifying early uptake of Open Source software. (Todd Mayweather)

There were a number of venture capital firms that were looking to invest in open source software companies in 2005. One news article from that year stated that the amount of venture funding for OSS firms through September was at \$144 million, double the amount from all of

2004.⁴⁷ The article went on to lament that several of these firms were getting funding before they had achieved a balance in commercial success and community development.

BComp went after funding before it had fully achieved these milestones. Its core product had been released in a beta format and was approaching 10,000 downloads per month in the Summer of 2005, which is a respectable number but not necessarily a sufficient enough level to guarantee that the company would be able to achieve the scale desired by the VC firms [symbolic capital (credibility)].

Frankly, we had that kind of reaction from most firms which was ‘Gosh, you guys are really early. You have no evidence that you’re going to get any Open Source traction. You have no evidence you understand the Open Source model. We know you’ve got a history of software industry background but look come back to us in a year when you’ve shown you understand the Open Source model.’ (Todd Mayweather)

Instead, the venture capital firms that were attracted to BComp based their decisions on the tenure and cohesiveness of the management team’s relationships [social capital] through multiple successful startups, their domain expertise [human capital], and the VC’s opinion of the relative prospects of the BI industry. They were also attracted by the fact that the product itself was designed as a full suite and included proven components developed by established communities, a characteristic that was also mentioned by some VC firms as a potential risk along with the risk of competing against industry heavyweights including Microsoft.

Funding from a top-tier VC firm provides a number of benefits that resonates throughout the ecosystem beyond the legitimacy [symbolic capital] and stability that additional financial capital provides. This funding also provides some credibility and reputation [symbolic capital]

⁴⁷ See http://news.com.com/Open+source,+open+wallet/2100-7344_3-5934144.html, last accessed April 23, 2007. Additionally, the funding rose to \$404M for 2006, according to another article (see http://www.businessreviewonline.com/os/archives/2006/12/open_source_fun_1.html, last accessed April 23, 2007)

resulting from the perception that since these firms only choose to invest their money in quality OSS firms. Based on their experience with OSS, the VC firms possess added social contacts [social capital], business knowledge, and strategic expertise [human capital] that are valuable to the ecosystem in general and to the BComp Corporation specifically.

They can do a lot of introductions... getting into CIO conferences and even industry analyst conferences, different things like that. They're influential in getting us into places. Then on occasion they can help us from a recruiting standpoint but right now mostly guidance. ... They can also say 'hey, here's what we did over at XYZ company or here's what we did at ABC Open Source company and here's how priced or did this.' So there's a lot of information exchange so that's very valuable that they bring to the table as well. (Robert, CEO)

Interestingly, the funding did not seem to significantly change the opinions or viewpoints of participants from across the ecosystem outside of the firm itself. When asked whether the VC funding influenced their usage or opinions of the project or the company, several responses noted the acknowledgments of the importance to the company but none indicated that it led to any changes on their part. This is likely due to the fact that many participants expected the funding to occur based on the communications from the firm and the high levels of available venture funding for open source firms. Thus, any decision to join prior to the funding would have taken this possibility into account. Another possibility is that the decisions by most stakeholders are largely product based, which is unaffected by strategic moves on the company's part.

The first round of capital enabled the firm to pursue the acquisitions discussed in the next episode, whereas the second round (which was initiated by the VC firms themselves) would enable the firm to build up the sales organization to increase the monetization efforts from the user community.

Table 19: Capital Observations – BComp VC Funding

Capital Type	Instance
<i>Social</i>	Community Relationships Social Contacts Management Team Tenure
<i>Organizational</i>	Software
<i>Symbolic</i>	Reputation Legitimacy Credibility
<i>Human</i>	Domain Knowledge/Expertise
<i>Economic</i>	Personal Funds Org Working Capital (BComp)

5.4.5.2 Mechanisms

The need for funding arose initially because of a perceived gap between the existing level of economic capital and the level required to achieve the goals of BComp Corporation, and thus the ecosystem as a whole. In an effort to close this gap, the firm began to pursue *discrepancy reduction* actions to increase the level of economic capital available for the ongoing operations and strategic maneuvers. The software industry at that point was awash with the available capacity for funding open source software firms, but the preference was for firms with some track record for execution. As discussed in the previous episode, BComp's capital structure possessed several *attraction* mechanisms, including the product legitimacy, the existing social capital indicated by the growing community, and the now familiar reputation of the management team. Thus, the firm was able to attract additional *investment* to increase the level of economic capital available and thus reduce the aforementioned financial discrepancies. As such, we note that the antecedent levels of capital were not sources for the resulting mechanisms that brought in the additional capital, but instead were motivations for both sides to enact the investment mechanism.

Obviously, the resulting investment by the venture capital funding resulted in an increase in the economic capital and created an expected future financial return for the venture capital firm. However, there were several other benefits for the ecosystem from this investment beyond the simple financial terms. The increased financial liquidity enabled the firm to pursue other strategic opportunities (eg. subsequent acquisitions) and business changes (e.g. increasing the sales organization). This increased capital and the association with the VC firms also had a *legitimization* effect through which the ecosystem gained additional credibility (symbolic capital) due to the greater perceived chances of survival (since there would be sufficient financial capital to keep the firm in business) and perceived credibility (based on the apparent vote of confidence by the highly selective nature of VC firms).

The selection process utilized by the BComp management team resulted in offers from (at least) two venture capital firms, both of whom possessed expertise (human capital), a positive reputation, and business contacts (social capital) in commercial open source and software industry in general. Following the investment, the *shared utilization* of these capital resources allowed the company to benefit from increased contacts (social capital) and reputational effects (symbolic capital). The ecosystem also benefited through the *knowledge sharing* mechanisms which enabled the management team to take advantage of the VC firms' strategic expertise (human capital), which in turn enables a wider range of strategic opportunities and mechanisms in response to future stresses.

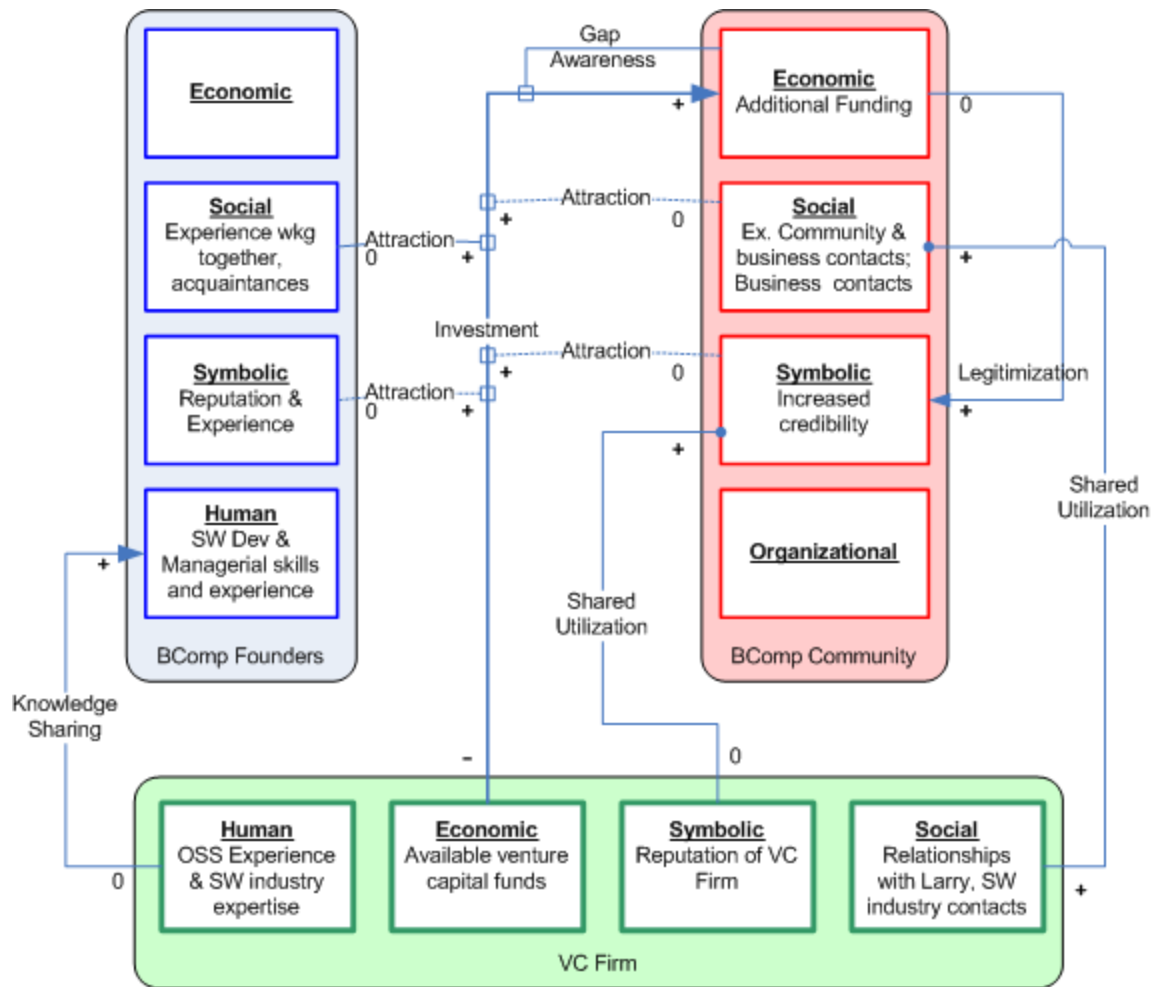


Figure 22: Capital Flow Diagram – BComp VC Funding

5.5 Acquisitions

5.5.1 Antecedent

As the founders were still trying to decide how to build a platform to meet their technological needs, the components that would one day become a part of this platform were already in existence. JSoft had been in existence since approximately 2001 and had established a thriving community around it. Similarly, several other related communities had attracted a community of contributors and users surrounding their efforts. It was apparent to the BComp founders that as part of their planned architecture, several existing open source components

would need to be integrated into the new platform. Fortunately, the use of J2EE and open source made this an easier thing to accomplish.

5.5.2 Anticipatory Stage

As the developer team built the application, they identified the components that would be needed. The initial stages in evaluating each project were focused on the functionality they provided and the architectural compatibility. Then, the team took a look at the level of activity within the community surrounding the component, including the number of people working on it, forum posts, downloads, etc. Then they downloaded the application and took a deeper look at the source code to ensure that it could be effectively integrated. Many of these components, including the Utopian Software Foundation's server, were mature projects with existing communities to provide support for the BComp Development team if needed. However, some of the other components were chosen because they did *not* have existing support and service organizations. These components would eventually be slotted for acquisition. As such, the lack of existing support was a key indicator that BComp would be able to craft profits based on the offering of support arrangements

“We weren't looking for components to acquire to have their own support and services because that's what we wanted to provide.” (CTO)

None of the plans to acquire these components were disclosed, not even to the VC firms. This was done essentially to minimize the price inflation that would have resulted had the word gotten out to other investors or companies.

“So if anyone knew we had gotten funding and were out buying properties, all the prices would have gone up.” (CEO)

Meanwhile, the project leaders were busy attempting to maintain and grow their components largely as a side business. This included not only managing the daily technical support and development efforts, but also attempting to build larger communities around them.

Joining up with a similar community, particularly one with a corporate staff and structure behind it, was a way to grow their communities as well as take advantage of the larger communities resources and administrative services. As KSoft project leader posted in an early post to the BComp forums:

“I would like to convince you to include a powerfull [sic] ETL tool that allows users to quickly build and maintain a full data warehouse... Please feel free to consider including KSoft. KSoft is an ETL tool that turned LGPL about 10 days ago.” (Forum post, 12-12-2005)

Similarly, Marvin Hill (lead developer for JSoft) began trying to find a way to partner with a larger company with the resources to increase JSoft’s stability and growth. Although he believed that community-based open source projects can be very successful in areas such as software development, bug-fixing, and QA, his goal was to enable the community to have access to several other functions that such projects did not particularly do well, such as support, project management, and marketing.

5.5.3 Stress

So as BComp grew and became more established, the management team set out to begin the acquisitions. Since the projects had already been incorporated into the BComp application, there was little to do technologically in terms of integrating the software. Both sets of developers had already been working together, so there were few surprises in terms of their ability to work together.

None of the four projects we’ve done are out of the blue. We’d worked with them before. We liked working with them and vice versa. They value us and we value them.⁴⁸

Robert Dixon negotiated the contracts via several face to face and electronic communications with the lead developers in an attempt to gain their confidence and explain

⁴⁸ Robert Dixon, from a news article, last accessed 4/19/2007)

BComp's business model and intentions. The lead developers were typically offered cash and equity in exchange for the trademarks of the software and (in every case except Weka) the lead developer's time as a new employee of BComp.

There's no science to putting a number to [the price]. It's what's fair, based on the momentum of the project, the community built around it, how much work do we have to do and turn it into a commercial offering.⁴⁹

However, the strongest selling point was not money, but more about matching philosophies and offering to help them become more successful as part of an integrated product rather than a stand-alone component.

One of the things we provide the projects that we acquire is a larger community. They *want* more people to use their software and to be exposed to it, which we provide for them. They want money, but that is not their primary objective. Once we come in, we offer to pay a salary, let them continue, and try to build product and community. And they went for it. That said, the cost of acquiring these projects is going to go straight up and the number of projects started as engineering projects is going to go down. We live in a capitalistic society of course. (Richard, CEO)

The structure of the deals was designed to ensure that these developers would continue to both grow their communities and to collaborate with the other BComp development team. As the VP of Marketing stated:

“When you acquire the project though, you get the person or people behind it on your team which is really, really important. And then the other thing is you have more control over the direction of that project. So, in terms of what's the big picture strategy for BComp we have much more of an ability to help drive where those products go in a way that's advantageous to the broader BComp community and best fits with our strategy.” (Lance, VP of Marketing)

5.5.4 Adaptation

The acquisition brought questions from dedicated users regarding the source control, committer rights, continued contributions, and other issues. Many of these stem from experiences or anecdotal knowledge of changes where a gradual process was not followed after

⁴⁹ Robert Dixon, from a news article, last accessed 4/19/2007)

an acquisition of an open source project. Some projects restrict the ability of non-employed developers to continue to contribute to, and thus have some influence into, the code base of the application. In so doing, the acquiring firm appears to violate many of the ‘purist’ views of open source, especially the community development and open governance aspects. There are several examples of communities that have rebelled against a commercial open source firm when the participants’ desire to remain non-commercial conflicts with the firm’s commercial intentions.

If you look at the situation with CompanyT and Project T: Company T is a commercial company, and Project T is the open source project. They are having big issues. Company T will not take contributions that cross over into their commercial offering. That is a big concern with this vocal minority that, you know, what if I want to contribute something to BComp that BComp is selling, you know, or what if, you know, are they going to accept our contributions? Are they going to continue to honor this community? (Community Liaison)

This represented an opportunity for BComp to either alienate or include the contributors, depending on the way the communities were merged.

In the immediate days following the JSoft acquisition, BComp executed several actions in an attempt to garner continued support and participation from the existing communities. Each acquisition was accompanied by a news release, a similar announcement within the prime discussion forum and/or mailing list, and a FAQ detailing the rationale and immediate plans for the acquisition. The lead developer, Marvin Hill, contacted several of the key contributors individually to explain his reasons for doing it and the benefits he expected as a result.

If you don’t handle it right, you can get negative comments in public forums and just generally sour the atmosphere around the project. So I took pains to contact the contributors individually and explain to them why I was doing it and my reasons were to have some kind of support organization, some predictability of release schedules. (Marvin, JSoft Lead Developer)

The BComp-employed developers also attempted to contribute something significant back to the acquired community. Included in the enhancements and contributions made since the

acquisition are a graphical design tool, interfaces with Microsoft Excel and BComp's own components, and improved scalability and performance. The purpose of these improvements was not only the need to integrate JSoft into the full platform but also to assuage any fears or concerns that the existing JSoft community may have had about BComp's intentions and motives.

“[The contributions were] partly due to integration and partly so that the community sees hey, BComp acquiring [us] is a good thing for us. We're going to get more stuff faster.” (VP of Marketing)

Additionally, they were careful to keep the communities separated to some extent, including not changing the name, structure, or existing installed base to focus exclusively on BComp. While they certainly encouraged the new users to interface and use the other projects within BComp, they left it open for existing contributors to continue to focus only on the single project they were working with prior to the acquisition.

“[I]f they just want to stay and play in the playground that they're in, that we don't interfere with that. All you want to do is use KSoft and be happy with it and contribute with it, you don't really have to deal with much else from BComp.” (VP of Marketing)

Several changes were made gradually, including consolidating all of the forums onto the BComp site and rebranding the products to reflect their integration into the overarching platform. However, these changes were not done until several months after the community had absorbed the acquisition. Ultimately, the plan of action was simply to attempt to treat both sides fairly within the constraints of the open source model, the expectations of the community, and the commercial intentions of the acquiring firm.

And so you get pretty sensitive to stepping on people's toes and ultimately it comes down to we do something that we're comfortable with that we think is fair and is good in the aggregate. If there's a couple guys out there who say we're pissed off that you did this, we can probably live with that. (VP of Marketing)

Following the JSoft acquisition in November 2005, which was acquired using personal funds from the CEO and the chairman of the board prior to the VC funding, BComp acquired a reports module (JFreeReport, January 2006), an ETL tool (KSoft, 4/06), and a data mining tool (Weka, 9/06) to further round out the platform. The experiences gained by this acquisition enabled the management team to figure out how to structure these arrangements.

[W]e knew how to make the agreements because we had learned on the acquisition we had made with JSoft. Right? So, we knew how to do them and we just went and did them with one fell swoop. (Allen, Chairman of the Board)

To continue supporting the lead developers, there is a weekly progress meeting where the roadmap and features for the various components are discussed. Additionally, they are flown to the headquarters every quarter to meet face to face with the development team and with each other. During these meetings, the developers get a chance to bond and work together toward integrating their products into the BComp platform.

To date, the JSoft acquisition seems to have been beneficial for all involved parties. BComp has been able to incorporate the product into its platform and guide several of the features accordingly. The accelerated download counts and forum messages would indicate some degree of acceptance by the community. Hill has been able to capitalize on the income stability to provide a more consistent development time to JSoft development instead of self-managed consulting work. Hill claims that the acquisition has afforded a much higher level of visibility and acceptance among corporate BI users, in addition to the providing the other functions he intended at the outset.

So, I wanted all of those functions that a for-profit company can bring to the table and that's largely happened. (Marvin Hill)

5.5.5 Analysis

5.5.5.1 Capital

The acquisition of the existing components is an important feature of the BComp ecosystem. Unlike acquisitions of proprietary software, when a firm acquires an open source software community, they are not typically gaining the full control of the code and the developers that maintain it. Instead, the code is available for others to use free of charge and the developers are not exclusively controlled by the acquiring firm.

By including a project such as JSoft that already had developed a successful product [organizational capital] and established a critical mass of user and developer relationships [social capital], BComp was able to capitalize on the existing attributes and resources of JSoft rather than having to develop its own software engine. This included not only acquiring the trademarks and source code [organizational capital], but also the goodwill [symbolic capital] that was built up around these applications.

I think [the fact that JSoft was an established community before BComp acquired them] was critical especially given that they did not have a good database reporting engine. To get something where they had really nice OLAP and you know it pretty much worked...that's what dazzles people. (Steve M, end user)

By acquiring the intellectual property and other rights to these components, BComp effectively increased its market value in exchange for a portion of the money [economic capital] that had previously been invested in the BComp Corporation. Additionally, these mature products represent additional opportunities for revenue generation based on their individual merits and their value to the integrated platform. This was evident in the response by the VCs, who were very aggressive in trying to invest more money in BComp at a significantly higher valuation. Therefore, the personal funds [economic capital] the JSoft project leader received in exchange for the efforts he spent developing the community relationships [social capital] could

be justified based on the impact it would have on BComp's market value as well as the future revenue streams [economic capital] that could result from the integrated products.

I knew that JSoft was going to improve the valuation of BComp and you know basically bring extra money from the VC's. So, you know BComp got a good deal out of it as well. You know, it was a synergy. But you know I have a considerable asset that I've been working on for you know weekends and evenings for five years. And it's reasonable I should get money out of that asset. (Marvin)

The existing JSoft community consisted of the lead developer, Marvin Hill, plus a number of regular contributors that had been supportive of his efforts to grow the software over the preceding years. The existing relationships [social capital] among these participants were crucial in maintaining JSoft's operations and existence. Establishing closer ties between BComp and JSoft meant that members of both ecosystems (including developers, users, partners, and other roles) would be able to more efficiently utilize these relationships to transfer capital and resources among themselves.

However, the acquisition brought risks of alienating the existing base of JSoft contributors who may have feared that by "going corporate", Hill and the BComp team would be less receptive to their needs and concerns. If the existing community's needs were not addressed satisfactorily, they could fight back with a range of actions including negative publicity (which would affect BComp's reputation), refusing to participate further, or even forking the project to create a new version of JSoft. Clearly then, a significant portion of the value of acquiring open source projects depend greatly on the ability for the two projects to work together, from the BComp management team to the development team to the project leaders to the contributors on both sides.

Communications with the JSoft community from both Hill and the BComp staff were crucial in alleviating much of the uncertainty that existed as a result of the acquisition. Hill's personal contacts with the key contributors [social capital] helped to reduce the chances of these

key influencers being dissatisfied. The initial press releases and accompanying FAQs [organizational capital] attempted to resolve several of the immediate issues that parties on both sides may have felt. By being available in the forums to answer questions and resolve problems, the development team and marketing staff helped to ease the transition for the new BComp community members without offending or alarming them.

It's so imperative that we don't look like this big company coming to chew up their project. And so, our marketing department being a regular marketing department can come across as flashy and big and scary or they can come across as accommodating and helpful and encouraging and we put out the FAQs and we put out the right press releases and I give all the credit to them. I mean it was a combination of the community pushing out the right information, making sure we were accessible and available. (Community Liaison, personal interview)

BComp was able to take advantage of the existing community's reputation [symbolic capital] and social relationships [social capital] to increase its credibility among potential BI customers, several of whom may have already been aware of JSoft or even using it already. Although the components could have been used (and in fact, were being used) without acquiring the trademarks and Marvin's services, this acquisition increased the legitimacy [symbolic capital] of the product across the BI space. As one of the founders stated regarding the acquisition of JSoft and Marvin Hill:

So him coming with us...was another big boost because the people that were already using the open source pieces see us come along with these, you know, big pie in the sky claims and then immediately grab the top open source BI project. Then they figure well Marvin's a smart guy. If he's going with them they must know what they're doing. (Sr. Architect)

Additionally, the legitimacy and credibility [symbolic capital] earned and developed by BComp prior to the acquisition boosted the credibility of JSoft after the ecosystem. The JSoft project leader noticed the effect of this legitimization process.

I get a feeling that it's now the mainstream companies are considering her, investing on it, building applications on it. And the extra publicity and the

perception of being backed up by a company has really helped to move that on.
(Marvin Hill)

Certainly there was a significant amount of knowledge in each community prior to the acquisition. Before the acquisition, JSoft users and developers were more experienced with OLAP technology and BComp members were well-versed in several different aspects of BI software in general but lacked the level of OLAP technical knowledge [human capital] possessed in the JSoft community.

After the acquisition, BComp was able to benefit from those members that were previously only involved with JSoft. Several of these new members contributed their knowledge [human capital] to contribute code, testing, and suggestions/feedback to the larger ecosystem. Additionally, the BComp development team provided additional services and contributions to the JSoft community. By contributing this knowledge to the combined entity, the aggregate level of human capital available to the community was enhanced.

BComp also increased its influence in JSoft's roadmap and development methodologies [organizational capital]. This enabled it to have more control over the integration of the OLAP engine into the BComp BI software as future releases were developed. Tools such as the Cube Design Wizard, which enables users to build JSoft schemas without having to write XML, have been developed primarily outside the JSoft community but benefit both BComp and JSoft users tremendously.

The acquisition led to stronger relationships [social capital] between the BComp team and the members of the acquired community, including developers, users, and other contributors. The lead developers establish stronger relationships among themselves and the rest of the development team. They also establish relationships with members of other components' communities as issues and opportunities arise. This stronger set of relationships and synergies

was noticed by several members not just as a result of the JSoft acquisition, but across several of the acquisitions.

When [KSoft] was brought into the BComp community, I did notice a much larger increase in activity on the KSoft boards, which was one of the main attractions to bring KSoft into BComp (independent developer)

A chart of the download figures for two of the acquired communities indicates that the communications activity within the community associated with the individual components has increased steadily since the acquisitions. The increased activity and participation benefits both parties as the contributions lead to improvements in the creation and integration of both software packages.

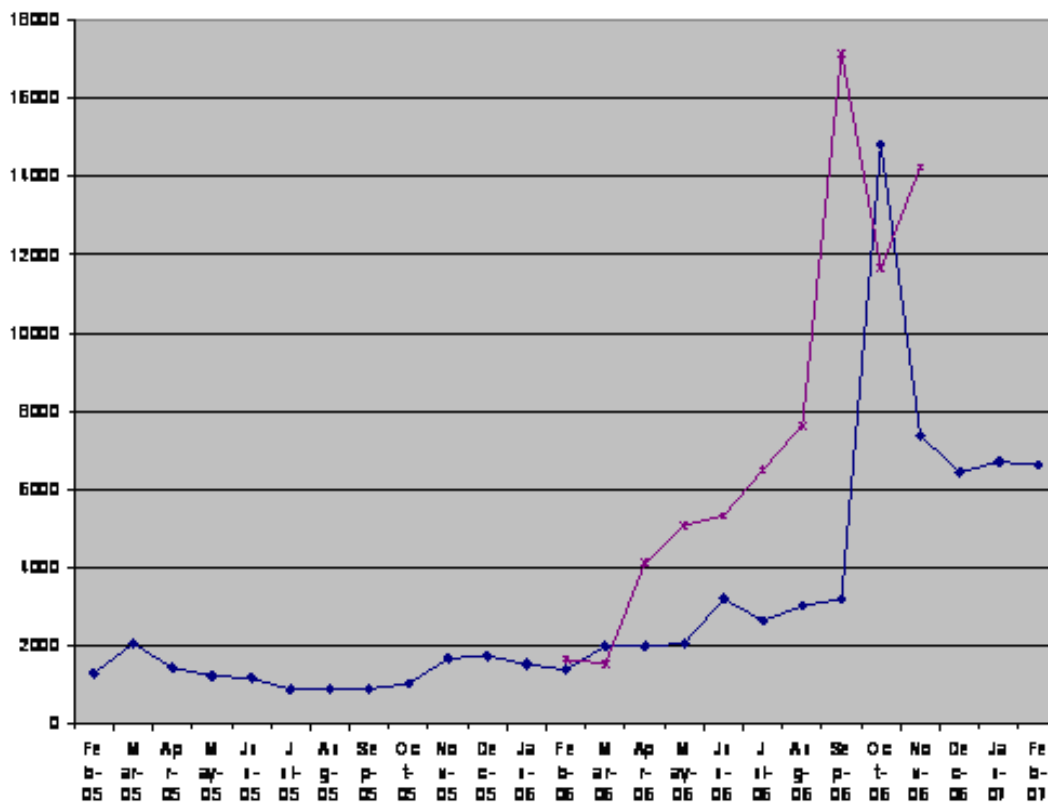


Figure 23: Download history – KSoft and JSoft

Table 20: Capital Observations – BComp Acquisition of JSoft

Capital Type	Instance
<i>Social</i>	Community Relationships Social Contacts Management Team Tenure
<i>Organizational</i>	Software
<i>Symbolic</i>	Reputation Legitimacy Credibility
<i>Human</i>	Domain Knowledge/Expertise
<i>Economic</i>	Personal Funds Org Working Capital (BComp)

5.5.5.2 Mechanisms

Several themes are associated with the flows of capital due to the *integration* of the software and the community resulting from the acquisition process. Unlike traditional software acquisitions, both the technical integration of the software application and the social integration of the acquired contributors (including employees) are conducted prior to the actual financial transaction. Additionally, the social integration of the acquired community into the acquiring firm continues well beyond the acquisition date and takes on more significance due to the largely informal relationships and limited legal controls that exist.

Initially, the focus is on the technical integration of the software components themselves into the platform. The BComp development team had built each of the components into the integrated BI platform and was satisfied with their performance and utility as well as the capacity and ability of the component developers prior to the acquisition. Since these components were largely based on open standards, this integration was relatively simple. Once the components were integrated into the larger platform, the firm could assess the potential value of a direct *investment* of financial capital in the acquired components based on the value of the existing organizational capital (e.g. trademarks, code bases, goodwill, etc.) and the perceived opportunities that may exist for future capital accumulation.

The expectation is that this capital accumulation will result largely from the application of the *productivity* efforts of the project leader (Hill), the key JSoft contributors, and the BComp development team as they apply their skills and expertise toward innovation in the form of new applications and tighter integration with the BComp platform. This depends on the *knowledge sharing mechanisms* between the project leader and the rest of the ecosystem as the new component is integrated. As these innovations (organizational capital) are released, they become part of the revenue generating or *monetization* processes of the firm.

This capital accumulation is not completely due to these monetization processes. In addition, the ecosystem benefits from the *shared utilization* of the existing symbolic capital vested in the component communities and in BComp (in terms of the legitimization and credibility they both possessed pre-acquisition). The *shared utilization* also enabled the ecosystem to benefit from the relationships or social capital they both possessed. This effect is magnified through *synergy* as the combination and shared utilization of the two capital bases reinforce and magnify each other's value.

Following the acquisition, a key focus on both sides must be on the social integration or *acculturation* of the acquired community's contributors into the larger ecosystem. The acculturation process ensures that the newly acquired members are brought into the existing social patterns and structures of the new environment. In order to avoid discouraging the continued participation on the part of the acquired community, BComp embarked on a *communications* program designed around *uncertainty reduction* and *trust building* between the two communities. Failure to bring the new contributors into the ecosystem successfully would result in either a forked project (which would reduce or eliminate the potential value of shared capital utilization) or reduced knowledge sharing within the ecosystem.

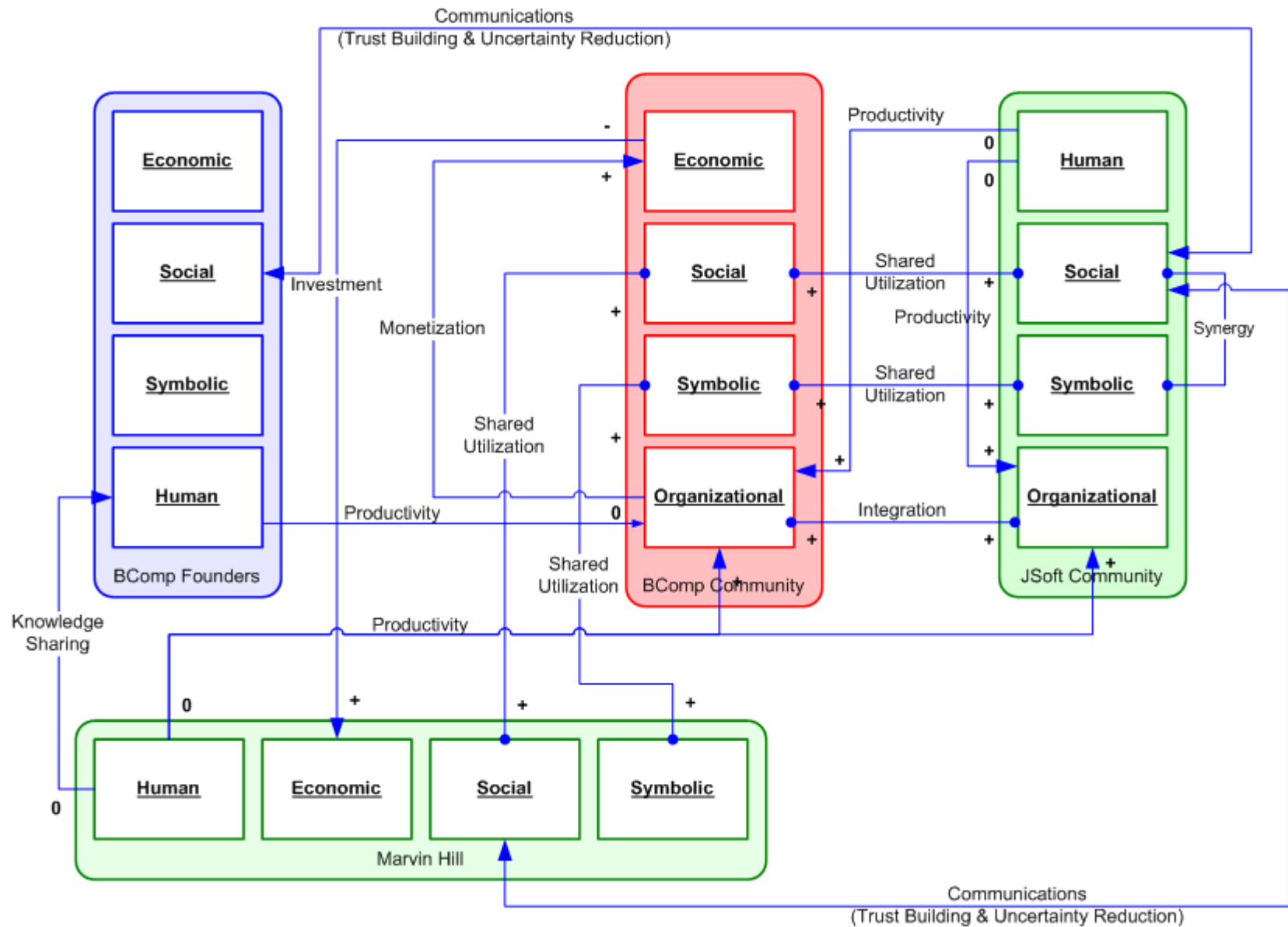


Figure 24: Capital Flow Diagram – BComp Acquisition of JSoft

Therefore, the BComp team was very deliberate in applying *change management* toward those aspects of the JSoft culture that were absolutely necessary to benefit the entire ecosystem, especially when the changes would alter the social structures in the existing JSoft community in a significant and possibly negative manner. To some extent, the communities were allowed to remain separate such that a given user can contribute to JSoft without being required to participate in the larger BComp ecosystem. For those aspects that would strongly benefit the ecosystem as a whole (such as the combined discussion forums), the changes were incorporated gradually and with a variety of communications to explain and validate the purpose for the changes, including the expected value to the participants themselves.

5.6 Cross-Episode Analysis

5.6.1 Discussion of Mechanisms

Table 21: Mechanisms by Episode

Mechanism	Founding	Whitepaper/ Website	Todd Mayweather	VC Funding	JSoft Acquisition	Counts
<i>Investment</i>	x		x	x	x	4
<i>Shared Utilization</i>	x		x	x	x	4
<i>Communications (Marketing)</i>	x	x				2
<i>Communications (Feedback)</i>	x					1
<i>Productivity</i>	x				x	2
<i>Coordination</i>	x	x				2
<i>Acculturation</i>		x				1
<i>Codification</i>		x				1
<i>Legitimization</i>		x		x		2
<i>Knowledge Sharing</i>			x	x	x	3
<i>Attraction *</i>			x	x	x	3
<i>Gap Awareness *</i>				x		1
<i>Integration</i>					x	1
<i>Monetization</i>					x	1
<i>Synergy</i>					x	1
<i>Trust Building</i>					x	1
<i>Uncertainty Reduction</i>					x	1
Counts	6	5	4	6	10	31

We have identified a number of mechanisms from the analysis of the capital flows and episodes in the BComp case (see Table 21). Several mechanisms have been identified in multiple episodes, which is to be expected.

Compared to MComp, BComp's history is fairly short (see Figure 25), consisting of only 5 nodes over an 8 month period. The episodes since that time have been fairly straightforward and largely inconsequential with respect to sudden changes in the health of the ecosystem. Unlike the MComp case, there are few points at which to engage in 'what if' analyses. The most obvious critical juncture in the firm is the participation of Todd Mayweather, which led to the social relationships with VC firms. However, it is entirely possible that the VC round would have been funded without Larry's assistance based on the solid managerial experience and other capital bases in place at the time.

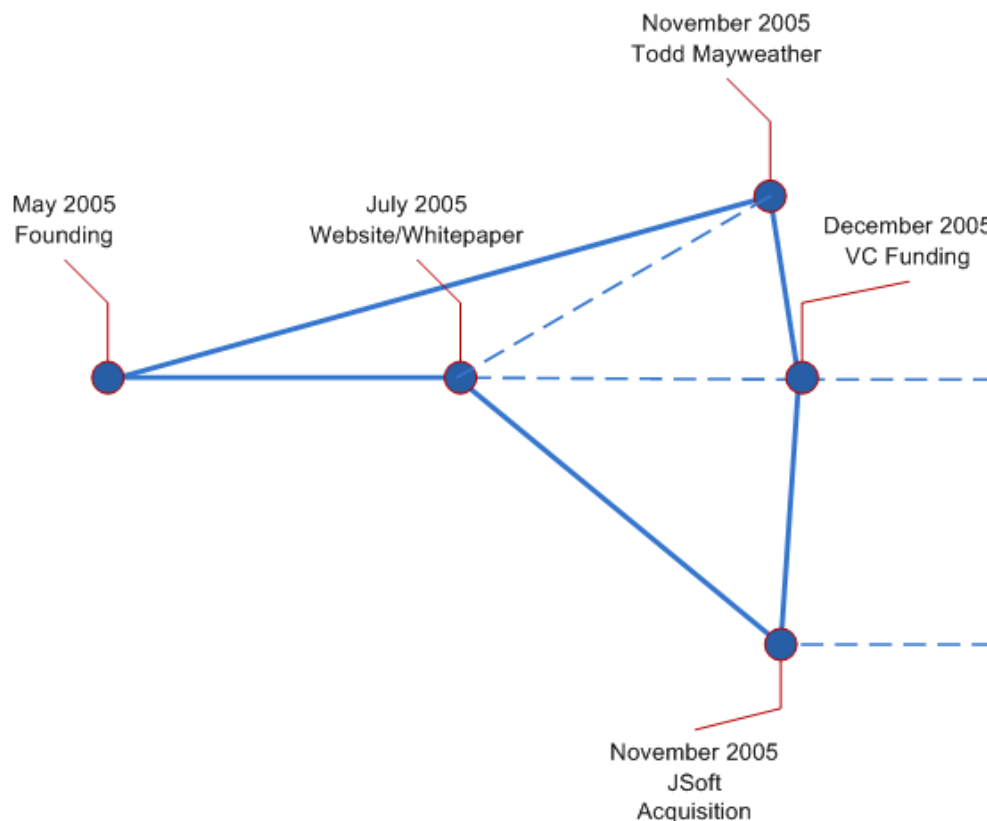


Figure 25: Episode Progression for BComp

As shown in Table 22, the specific mechanisms impact the interaction of the capital types in different ways. For instance, the legitimization mechanisms transform capital from economic, social, or human capital into symbolic capital. As such we can see that there were but two ways observed in this data to attain economic capital: direct investment or monetization of products and services. There was no way indicated that would enable the ecosystem to directly progress from their reputation or legitimacy to increased working capital. Note that this neglects the attraction mechanisms which influence another party to invest in the ecosystem, but as we discussed, they do not directly perform any actions that affect the capital.

Table 22: Mechanisms by Capital Interaction

To ->	From	Economic	Social	Symbolic	Human	Organizational
Economic		Investment				Monetization
Social			Shared Utilization; Marketing; Uncertainty; Trust Building	Synergy		Feedback
Symbolic		Legitimization	Legitimization; Synergy	Shared Utilization	Legitimization	
Human					Knowledge Sharing	
Organizational			Feedback		Productivity; Codification	Coordination; Integration

In the next chapter, we will combine the insights from the capital analysis of the BComp case with those of the MComp case to further discuss these results. In a subsequent chapter we will attempt to fit these mechanisms into a framework to classify their effect and utility to the health of the ecosystem.

6.0 CROSS-SITE ANALYSIS

In this chapter, we will compare and extend the insights from the two cases analyzed in the preceding two chapters. Specifically, we will compare the structure and goals for both ecosystems, followed by comparing similar episodes from the preceding analysis. We will also discuss the accumulation of capital, the enactment of mechanisms in the ecosystem, and the interaction between capital and mechanisms. Finally, we discuss how these relate to the health of a professional open source ecosystem.

6.1 Capital

In this section, we discuss the instances of capital that were found in the preceding two chapters. Within our conceptualization of open source ecosystems, the participants contribute capital via participation, sharing, or investment. Participation denotes the active, recurrent exchange of capital within the ecosystem. Active participants contribute capital while expecting to receive some capital in return. Sharing is the mutual control and access to the capital in question. For instance, if two parties are sharing symbolic capital between them, both parties have access to this capital. Investment is the contribution of capital in exchange for additional capital to be returned in the future.

The capital that flows among the members of the ecosystem can be classified as one of five types: economic, human, social, symbolic, or organizational capital. In the analysis of the MComp and BComp ecosystems, we have identified numerous examples of each of these types. In this section, we will discuss the capital that has been experienced in these ecosystems.

6.1.1 Economic Capital

Economic capital consists of the financial and physical resources of the ecosystem.

Owing to the intrinsic nature of financial capital, money cannot be shared with multiple owners. Instead, money is typically possessed and controlled by a single actor at a time, whether that is an individual or organization. In order to be able to access and control the use of financial capital, these resources must be transferred to their ownership or to another actor's possession on their behalf. Examples of this transferability were observed in the venture capital investment and wages paid to developers within both ecosystems.

The possession of said capital (or the lack thereof) may attract additional flows of capital or encourage certain mechanisms to be enacted in order to meet specific individual, organizational, or ecosystem goals. For instance, BComp's management team had a goal of acquiring additional component communities to complement their platform, which would require more economic capital than they possessed. Thus, they sought an infusion of money from the venture capital market in order to meet their additional goals.

For the two ecosystems in this study, economic capital has been manifest primarily in terms of financial resources, or money, possessed and controlled by various members of the ecosystem. Initially, the financial capital used as working capital during the early years of the two firms at the center of both ecosystems has come from the personal funds of the founding members. In the MComp case, the initial economic capital was used to create a fledgling development community in the hopes that a loosely affiliated commercial entity (TCorp) would be able to use the software produced by this community to generate financial returns without having to pay for more expensive commercial app servers. This commercialization was ultimately unsuccessful as the company was unable to attain sufficient financial capital to sustain the company.

Table 23: Economic Capital observed in the present study

<i>Economic</i>	<i>Level</i>
Payouts (MComp Shareholders)	individual
Personal Funds	individual
Revenues	organization
Venture Capital Funds	organization
Wages	individual
Working Funds (POS Firm)	organization

Economic capital is the most versatile of the five types of capital studied here, based on its fungibility and ease of transfer among partners. The economic capital possessed by an actor can be easily converted or exchanged for other forms of capital fairly easily. In many cases, markets exist for the exchange of these capital types to economic capital and back. Thus, it is possible to consider an actor's stores of other types of capital as *potential* economic capital that can be converted at some value when needed. Our study found examples of exchange relationships in which economic capital was offered as at least partial compensation for human capital (revenues from training services) and organizational capital (revenues from software licenses or documentation sales). A significant portion of the rationale behind the acquisition episodes in both ecosystems (i.e. OpenSoft, GSoft, or JSoft) was the access the acquiring firm would gain to the community relationships (social capital) as well as the credibility and trademarks (symbolic capital) of the developers being hired.

6.1.2 Social Capital

Social capital consists of the ability of an individual or group to capitalize on the social connections that are available. Unlike economic capital, social capital can be shared by multiple partners. One view is that social capital does not exist unless it is shared between two or more actors, actually possessed by the link between the actors instead of the actors themselves. As such, social capital is difficult to transfer between parties. Instead, it is most often utilized as a shared resource.

There are three dimensions of social capital: structural, cognitive, and relational dimensions . Each of the three dimensions of social capital have been encountered in the current study and will be reviewed here.

The structural dimension consists of the overall patterns of connections between actors, including the means of communicating and transacting between them. In each case, we observed the impact of these contacts on the subsequent activities and the level of capital available to the actors.

Table 24: Structural Social Capital observed in the present study

<i>Social – Structural dimension</i>	<i>Level</i>
Industry Contacts	individual
Personal Contacts	individual
Social Contacts	individual
Community Communications	ecosystem
Community Participation	ecosystem

The cognitive dimension includes those resources that provide shared meaning and interpretation among the participants of the ecosystem. To some degree, this is encountered in both ecosystems as the primary firms built sets of language and meaning that were used to facilitate the interpretation of events that occurred. These meanings were set in the early communication patterns among the members and perpetuated over time.

Table 25: Cognitive Social Capital observed in the present study

<i>Social – Cognitive Dimension</i>	<i>Level</i>
Shared Language	organizational, ecosystem

The relational dimension includes predominantly the assets that are created and leveraged through the relationships established by the members of the firm. Also called relational capital⁵⁰, the assets leveraged through these relationships (such as trust, norms, and expectations) are based on the long-term associations between members. This dimension is a significant element in

⁵⁰ Relational capital is “the value of a firm’s network of relationships with its customers, suppliers, alliance partners, and employees. (Gulati, Huffman, and Nielsen 1998)

the operation of both ecosystems. As such, we observed several examples of this dimension in both ecosystems. In its early years, MComp leveraged its existing relationships with the user community surrounding the project to identify their needs, which they could meet in an attempt to generate the financial from which they built the rest of the firm. Similarly, the long-term relationships between the founding management team of BComp were forged over years working together in previous entrepreneurial ventures and subsequently leveraged to create the current business and software. Within the MComp firm, there was a culture that could be described as ‘us against the world’, especially in relation to the larger proprietary vendors and other detractors. There was also the shared goals and expectations regarding the goal of building an open source firm that could rival these larger firms and ultimately create economic worth for the investors, employees, and other significant contributors. BComp also seeks to build a successful BI software firm with similar goals.

Table 26: Relational Social Capital observed in the present study

<i>Social – Relational Dimension</i>	<i>Level</i>
Client Relationships	organizational
Community Relationships	ecosystem
Expectations	organizational
Management Team Tenure	organizational
Partnership Relationships	organizational
Relationships between ecosystems	ecosystem

While it is difficult to transfer human capital, it can be leveraged to generate other forms of capital. For instance, the existing relationships between the BComp and JSoft development communities, as well as between the MComp and OpenSoft development communities was used to share knowledge with members of both sides on their existing products, opening the way for future integration and product development.

Additionally, these relationships and contacts were found to attract other capital flows and mechanisms. One of the main purposes for MComp to enter into a venture capital

arrangement was the social contacts and relationships that the venture capital firms possessed. As such, we can see that social capital is more likely to be utilized for subsequent capital flows instead of being the end goal of an actor.

6.1.3 Human Capital

Human capital is defined as the skills, knowledge, and abilities of an individual that can be used to generate income or other useful outputs (Becker, 1993). There are two dimensions of human capital typically defined in the literature: well-being and human ability. Well-being includes traits such as health, self-esteem, and happiness. Although these are certainly included in the operations of both ecosystems, especially with regards to the volunteer developers and users of the software, we omit them in the current study. Instead, we focus on the ability and knowledge possessed by the individuals in the ecosystem. This includes such sub-dimensions as skills, experience, education, and knowledge.

By definition, human capital is an individual construct. Once human capital is converted for possession at a higher level of abstraction, it is more appropriately classified as a form of organizational capital. In the cases under study, as would be expected of any knowledge-based product or service such as software development, the conversion of human capital converted into organizational capital is the primary capital transaction within the ecosystem.

Table 27: Human Capital observed in the present study

<i>Human</i>	<i>Level</i>
Domain Knowledge	individual
EJB Expertise	individual
Entrepreneurial Expertise	individual
Management Expertise	individual
OSS Expertise	individual
Product Expertise	individual
SW Development Expertise	individual
Technical Knowledge	individual
Technical Skills	individual

6.1.4 Organizational Capital

Organizational capital is conceptualized as the institutionalized knowledge and codified experience stored in the organization and ecosystem. Similarly to other capital types, we propose a new set of dimensions for organizational capital as we have conceptualized it in this study.

[expand this section later today]

The procedural (or coordination) dimension defines the routines and procedures that the actors are expected to follow in order to coordinate operations within the ecosystem. For business concerns such as the professional open source ecosystems studied here, these are largely controlled by the firm at the center of the ecosystem.

Table 28: Procedural Organizational Capital observed in the present study

Organizational	Level
Business Model	organizational
CVS access	organizational, ecosystem
Development Methodology & Processes	organizational, ecosystem
Policies & Procedures	organizational, ecosystem
Sales Model	organizational
License	organizational
Roadmap	organizational, ecosystem
Software Architecture	organizational, ecosystem

Referential dimension refers to those forms of organizational capital that are used as reference materials by which actors can guide their actions and efforts.

Table 29: Referential Organizational Capital observed in the present study

Organizational	Level
EJB Standard	industry
Website	organizational
White Paper	organizational, ecosystem

Codified knowledge is the outputs of human capital, particularly for the creation of products and services by which knowledge-based firms can generate revenue. These are different from physical products in that they are not zero-based transfers. For instance, a car manufacturer produces a single car for a single customer. For software firms, the software produced can be distributed and transferred to multiple end users.

Table 30: Codified Knowledge - Organizational Capital observed in the present study

Organizational	Level
Codified Support	organizational, ecosystem
Documentation	organizational, ecosystem
Software	organizational, ecosystem
Source Code	organizational, ecosystem

6.1.5 Symbolic Capital

The amount of honor or prestige possessed within a given social structure; includes aspects such as reputation, credibility, legitimacy, authority, status, and rank (Bourdieu 1985). In general it consists of the relative distinction between members of a given class. Symbolic capital represents the perception that a given ecosystem or a member within the ecosystem is positively distinct from its rivals. As it is observed, we focus on those instances in which a given unit or ecosystem is more likely to succeed or to meet the expected needs of members who interact with them.

The instances of symbolic capital encountered in this study are shown in Table 31. We observe that credibility and legitimacy were affected in nearly every episode studied. Credibility can be defined as “the extent to which consumers feel that the firm has the knowledge or ability to fulfill its claims and whether the firm can be trusted to tell the truth or not” . Legitimacy is “the generalized perception or assumption that the actions of an entity are desirable proper, or appropriate” .

Because the episodes were selected based on their impact on their importance to the firm and the significance on the existence and viability of the ecosystem, it should be perhaps expected that we would encounter these attributes on a consistent basis.

Table 31: Symbolic Capital observed in the present study

Symbolic	Level
Credibility (incl. Accumulated Goodwill)	All
Download Counts (credibility)	All

Legitimacy	All
Personal reputation	All
Reputation	All
Trademarks	All

6.2 Mechanisms

We have identified a number of mechanisms from the analysis of the capital flows and episodes in the two cases (see Table 34 and Table 35). Several mechanisms have been identified in multiple episodes, which is to be expected given the relatively general way in which they were specified. In this section, we define each of the mechanisms identified in the analysis of BComp and MComp episodes.

Investment is the provisioning of capital in exchange for ownership in a given enterprise, including deferred returns, typically the return of financial capital. The founders, Todd Mayweather, and the VC firms invested economic capital in BComp Corporation with the expectation of receiving higher financial returns at a later date. In return, BComp received additional working capital which enabled them to pursue future opportunities and the engage in a number of activities where financial capital was required. One of these opportunities was the acquisition of JSoft, in which economic capital was paid to the project leader in order to secure his services and the trademarks and reputation of the JSoft product and community. This investment also seeks additional revenues later as the product is integrated into the platform.

Compensation differs from investment in that the capital transfer is carried out in return (or exchange) for products and services that have been received. This compensation is often a significant part of the inducements that our framework posits to be a determining factor in an actor's continued participation in the ecosystem.

As the products and services are created in the ecosystem, the consuming actors (users) enact *adoption* mechanisms to select, deploy, and use them according to their own needs. The users' desired adoption often generates the demand which drives much of the production process within the ecosystem. As an example, users need for documentation and services to complement their prior adoption of the MComp Application Server led to the establishment of processes to create these products and services for these users to adopt. From the perspective of the commercial firms in the ecosystem, *monetization* is a form of economic transaction in which they receive financial compensation from another party in exchange for their adoption of the goods or services (organizational or human capital, respectively, for the two cases in this study) produced by the firm. In other words, monetization is a combination of adoption and compensation tied together in an exchange relationship or agreement. This is a key function of any commercial entity as the ability to ultimately earn and retain cash earnings is a significant factor in their survival. BComp exchanges software goods and services in exchange for financial gains. However much of their product line is available free of charge, so their business plan must include converting non-paying users that download the software into paying customers.

When social or symbolic capital is involved, the original bearer of the capital is often the conduit or reference point through which another party can access the desired capital. In other words, the capital is utilized only when the original party agrees to share it. In the BComp case, the venture capital firms' social contacts within the software industry are useless if the VC firm is unwilling or unable to share with the BComp team. This *shared utilization* of capital is a function of the capital itself. Social capital is meaningless for an isolated individual or organization. There must be some other party in the relationship. Similarly, symbolic capital can be shared with another party through some relationship with them. For instance, if an unknown

newcomer had been part of the BComp management team, his reputation and credibility (symbolic capital) would have been increased because of their success. In contrast, physical goods and economic capital are typically not sharable because only one person can use (i.e. spend) the money at a time. Thus, the BComp ecosystem was able to gain social and symbolic capital through their relationships with existing entities with sufficient levels of each capital.

These two capital types may also benefit from *synergy* in working together for the purpose of generating and accumulating additional capital beyond the mere sum of the capital deployed. It is not a coincidental factor that the size and activity of the surrounding community (i.e. number of relationships) is often a measure of the strength of an open source software firm. In other words, the number of members in a given ecosystem is a measure of the credibility and legitimacy of the ecosystem, which helps retain and generate additional relationships –increasing the social capital in turn.

The software and documentation is generated from human capital through its *productivity* of the contributors and employees of the ecosystem. More specifically, productivity mechanisms are those which convert, exchange, transform, or use the available resources in order to satisfy the needs of the members of the ecosystem. The primary example of productivity in the two cases studied is the conversion of human capital contributed by the community and developers to generate source code or documentation which is stored as organizational capital.

Productivity mechanisms include knowledge sharing, legitimization, and codification. (*Knowledge sharing* is the transfer of human capital between individuals). An example of this mechanism is when Todd Mayweather shares the expertise that has built up over his tenure in the software industry with the BComp board. As Mayweather offers his perspective and advice on a given topic, then the BComp management team then has access to this expertise even if

Mayweather disassociates himself from BComp, but Larry does not lose an equivalent amount of expertise. The *legitimization* of an ecosystem (or specific entity) results from the creation of symbolic capital based on the existence, growth, or perceived value of another form of capital. For example, the ecosystem improved its credibility when the venture capital firm agreed to invest in the BComp Corporation because of both the reputation of the VC firm and the simple fact that the company had more money to survive a downturn. Another form of productivity mechanism is the *codification* of knowledge (or human capital) into organizational capital such as documentation or other reference materials that make it easier for other parties to access and utilize this knowledge.

Implementation is the process through which an entity converts the ambiguous or tacit plans and ideas into more tangible forms, typically as another form of organizational capital such as business plans or sales models. Specifically, implementation refers to the realization and execution of a standard, plan, idea, or specification, which typically results in a set of guidelines by which certain participants can structure their contributions and expected appropriations. As such, the organizational capital that is created is useful for the coordination of the ecosystem in the sense that it guides everyone's actions to hopefully benefit the ecosystem as a whole and the various participants themselves. Other forms of organizational capital also provide guidelines for the *integration* of the various technical components into the larger platform or system. When the individual open source software components that comprised the BComp application were selected, the first criteria they had to meet was applicability with the plans that had been developed during the founding of the company. Components and communities that did not fit the proposed architecture were not included, but the selected components could be quickly integrated into the platform because of the previously developed integration plans.

There are several *communications* mechanisms that exist to disseminate various types of information for the purpose of impacting the social capital in the ecosystem, particularly the relational and cognitive dimensions (Nahapiet & Ghoshal, 1998). *Marketing* communications disseminate information about the products, services, and other information to interested parties. *Acculturation* mechanisms communicate information about the structure and norms within the ecosystem (from the organizational capital) both to indoctrinate new members and to resolve any disputes or other issues which may arise within the ecosystem. *Feedback* communications mechanisms use the social relationships within the ecosystem to help develop organizational capital. For example, BComp has a dedicated community liaison to ensure that the needs and wishes of the ecosystem are heard and incorporated into future releases and roadmaps. Additional communications mechanisms were established to hopefully increase trust and reduce uncertainty within the ecosystem. *Trust building* mechanisms attempt to establish and maintain the perceived honesty, benevolence, and competence in the ecosystem, particularly between the developer and user communities. *Uncertainty reduction* mechanisms attempt to minimize the variance between what the members of the ecosystem expect and the actual results. The latter two played a significant role in integrating the acquired communities into the BComp ecosystem without losing many of the former participants. These two mechanisms were also significant components in the change management process, which is enacted to perform an orderly transition in the structure and patterns in the ecosystem from one state to another.

Where a participant exercises some form of power to coerce or restrict the enactment of specific mechanisms and capital flows in an ecosystem, often due to their position within the flow of capital acquisition or distribution, we can consider these as exertions of *control* mechanisms. French and Raven (1959) proposed five types of power, including reward,

legitimate, coercive, referential (or connectional), or expert power, all of which could conceivably be found in an open source ecosystem. MComp, Inc. and BComp Corp. both exerted power based on a combination of their connectional power (through the relationships they had established), reward power (through their ability to compensate their employees and other partners), and expert power (based on their relatively superior knowledge of the platforms they had developed) in attempting to control the flows within the ecosystem to their advantage. This is extremely evident in the MComp Group's efforts to squelch the RDT partners' attempted fork.

In addition, two mechanisms (attraction and gap awareness) have been identified as motivations that influence the occurrence of other mechanisms or events. The *attraction* mechanisms do not perform any actions per se, but have influenced the actions themselves. For instance, the venture capital firms and Todd Mayweather were profoundly attracted to the expertise and tenure of the founding team, which was a significant factor leading to both investments. Similarly, the *gap awareness* mechanisms were triggered by the difference between needed and current economic capital (in the opinion of the BComp management team) and were a significant factor in making the decision to pursue venture capital.

6.3 Health

Ecosystem health is concerned with the overall capacity and state of well-being of a given ecosystem. As conceptualized earlier, ecosystem health has three dimensions which we have focused upon in this study: organization, vigor, and resilience. In this section, we examine these dimensions in the context of the two ecosystems and the mechanisms encountered during the analysis. Specifically, we classify the mechanisms described above into four categories based on their impact on the three dimensions of ecosystem health. These categories are integration, resource control and accumulation, productivity, and resilience and stabilization.

Table 32: Classification of Mechanisms

Class	Mechanisms	Case
Integration	<i>Coordination</i>	Both
	<i>Defection</i>	MComp
	<i>Forking</i>	MComp
	<i>Implementation</i>	MComp
	<i>Integration</i>	Both
Resource Control & Accumulation	<i>Control</i>	MComp
	<i>Investment</i>	Both
	<i>Knowledge Acquisition</i>	Both
	<i>Shared Utilization</i>	Both
Resource Motivation	<i>Attraction</i>	Both
	<i>Gap Reduction</i>	MComp
Productivity	<i>Adoption</i>	MComp
	<i>Codification</i>	Both
	<i>Compensation</i>	MComp
	<i>Knowledge Transfer / Sharing</i>	Both
	<i>Legitimization</i>	Both
	<i>Monetization</i>	BComp
	<i>Productivity</i>	Both
	<i>Synergy</i>	BComp
Stabilization	<i>Acculturation</i>	BComp
	<i>Communications</i>	MComp
	<i>Communications (Feedback)</i>	BComp
	<i>Communications (Marketing)</i>	BComp
	<i>Trust Building</i>	BComp
	<i>Uncertainty Reduction</i>	BComp

6.3.1 Organization

The organization of an ecosystem is concerned with the ability of the ecosystem to act in ways which satisfy the needs of the system as a whole and the specific participants themselves. Thus, mechanisms affecting the organization of the ecosystem are those mechanisms which influence the roles, norms, contracts, coordination, and licensing affecting the relationships between the participants. Specific mechanisms such as coordination and integration control the actions associated with the role and position of the various participants in order to ensure that the ecosystem as a whole is functionally complete and stable.

Integration – mechanisms which control and coordinate the actions of the members of the ecosystem to benefit the ecosystem as a whole. These include:

- a. *Coordination*
Guiding or directing the actions and contributions of the various components in order to satisfy the needs of the ecosystem and the various participants
- b. *Integration*
Incorporating the functionality and utility of the various human, social, or technical components into a larger platform or system
- c. *Defection*
The act of abandoning a position or association, often to join an opposing group. (negative mechanism)
- d. *Forking*
An open source software specific term for copying the source code for redistribution under a different organizational structure (negative mechanism)
- e. *Implementation*
The realization and execution of a plan, idea, specification, or standard.

6.3.2 *Vigor*

Our definition for vigor is the aggregate throughput of the ecosystem which consists of the full range of outputs produced by the members of the ecosystem and the capital resources contributed to produce them. This includes the ability to procure and accumulate these resources as well as the conversion and transformation of these resources as they are transmitted and exchanged throughout the ecosystem. The two mechanism categories below, resource control and accumulation and productivity, provide the vigor of an ecosystem.

Resource control and accumulation – those mechanisms which motivate and secure resources for utilization throughout the ecosystem. These include:

- a. *Direct investment*
The provisioning of capital in exchange for future financial returns
- b. *Attraction*
The tendency of a given capital structure or characteristic to draw interest or attention by other participants
- c. *Gap Awareness*
Recognition of a perceived shortfall between the existing levels of capital or resources and the level required to satisfy individual or ecosystem needs
- d. *Shared Utilization*
The capacity for mutual access and utilization to a given capital resource
- e. *Control*
The use of power to coerce or restrict specific mechanisms or capital flows.

f. *Knowledge Acquisition*

The establishment of pathways by which knowledge transfer can occur.

Productivity – those mechanisms which convert, exchange, transform, and use the available resources in order to satisfy the needs of the members of the ecosystem. These include:

a. *Productivity*

The conversion, exchange, or transformation of resources/capital from one form into a given output or a different capital form as needed

b. *Knowledge sharing*

The transfer of knowledge or other human capital between parties (typically individuals)

c. *Codification*

The conversion of ambiguous or tacit resources into more tangible, accessible forms; typically into organizational capital

d. *Monetization*

The generation of financial returns in exchange for a given product or service. (Can be considered a form of productivity)

e. *Adoption*

The selection, deployment, and use of a given technology or asset

f. *Compensation*

Capital offered in return or exchange for products or services received.

g. *Legitimization*

The increasing perception of legitimacy or credibility for a given party.

h. *Synergy*

An interaction between two or more parties or units that results in an effect greater than the sum of the individual components

6.3.3 Resilience

An ecosystem can be resilient to the extent that it is able to maintain its vigor and organization (or productivity and structure) in order to continue to exist and operate following perturbations or changes in the system. Mechanisms which support the resilience of an ecosystem are those which can be enacted to adjust to changes in the operational or structural patterns of the ecosystem or those which attempt to maintain the existing patterns by eliminating these changes. These mechanisms include several processes and actions identified in our analysis such as

disseminating information to bring parties in line with the system's existing patterns and reinforcing participants' beliefs that their actions are leading to the desired results which in turn minimizes their motivation to introduce changes.

Resilience and Stabilization – mechanisms that maintain the cultural and structural patterns within the ecosystem or resolve differences or changes that arise, including:

- a. *Acculturation*
Mechanisms which allow the creation, maintenance, and transmission of the existing or desired culture, values, and goals throughout the ecosystem
- b. *Communications*
Dissemination of information and values throughout the ecosystem or between members within the ecosystem (includes Marketing and Feedback communications)
- c. *Trust Building*
The establishment and maintenance of belief in the honesty, benevolence, and competence in a given relationship
- d. *Uncertainty Reduction*
The elimination or mitigation of variance between actual and expected results

6.4 Comparing MComp and BComp

6.4.1 Organizational Structure

MComp was initially composed of a few key administrative staff members and developers with the majority of the development and service provisioning being handled by a set of contracted consultants. As the company matured, more of these consultants were hired by the company to ensure the long-term productivity of the developers. The majority of the product development was conducted by those engineers and developers that were hired by the firm, with a large degree of the testing and QA being performed by the community.

At the center of the ecosystem was MComp, Inc. (formerly the MComp Group), which was a professional open source software company founded by Thomas Smith. As we will discuss below, the purpose of the firm was to build and license middleware tools as open source software, but also to make a profit and create wealth for the developers and managers of the firm

who were responsible for its success. As the keystone , MComp and its management team had a high degree of control over the interactions among the participants of the ecosystem, which it exerted. This differs from most community-based open source ecosystems (Utopian or PostgreSQL, for instance) where there typically there is not a dominant keystone at the center of the ecosystem and thus there is less control over the interactions among the participants.

BComp was initially composed of five founders who had worked together in a series of similar enterprises in the same industry as the new venture, including experienced management and developers. These developers had created similar applications to those that they were now attempting to recreate, so their expertise had already been established. This differs from MComp, where the management and development expertise was being created as the project developed.

Much like MComp, BComp sits at the center of the ecosystem they have created. BComp development is largely conducted in-house. As additional developers were needed for BComp, they were hired largely from those developers that were already known to the founders and other employees. The company has begun actively recruiting developers from online job hunting services in addition to personal referrals. Very few developers were hired directly from the pool of developers already working with the software and contributing to the forums. Additionally, some developers were hired as project leaders for components that were acquired.

6.4.2 Goals and Destiny

An argument can be made from classical economic theory that professional open source companies have as their goal the creation of a capital portfolio that maximizes the amount of financial capital they can create, acquire, and accumulate. This maximization may come from the dissolution of the firm via acquisition or the establishment of resources and routines which exploit the capital bases for maximizing perpetual financial returns. Classifying the organizations

on the basis of *cui bono*⁵¹, both MComp, Inc. and BComp, Inc. can be classified as “business concerns” where the owners and shareholders are the prime beneficiaries of the firms’ operations within the ecosystem. Alternatively, one could argue that community open source ecosystems are ‘mutual benefit associations’ in which the members themselves are the prime beneficiaries, and sponsored open source project ecosystems are ‘service organizations’ in which the chief concern is the welfare or benefit of the users of the software. The Utopian Software Foundation is an example of a mutual benefit association, whereas the Evergreen project (in which the state of Georgia sponsored the development and implementation of an integrated library system for the 250+ library systems around the state) is a service organization focused on the benefits of the libraries and their patrons.

As the dominant actors or keystones of the ecosystems in which they operate, the two firms have a high degree of control over the flows of capital, thus focusing the entire ecosystems primarily on the attainment of profits and maximizing current and potential economic capital, even to the detriment of other participants’ concerns. MComp’ defense of its revenue flows in response to the RDT fork is an example of the control keystones possess and the motivations they have to exercise it. However, both firms make a point to receive feedback and other input from the other participants in order to ensure their continued participation.

For MComp, the ultimate goal was to either go public in an IPO or to be acquired by a larger firm. In either case, the intermediate goal was to increase the financial value of the capital portfolio that it possessed or controlled. The valuation of the payout that the shareholders received from OpenSoft was based on the accumulated value of each of the capital stores acquired during the seven years of its existence. In other words, the \$350 million buyout was based on the expectation that OpenSoft would be able to accumulate a greater rate of return for

⁵¹ Literally, “who benefits”.

the portfolio of capital in the MComp ecosystem, including (not exhaustively) the source code (organizational capital), community relationships (social), developer expertise (human), and reputation (symbolic).

It is open to debate whether the acquisition by OpenSoft and the resultant integration of the development and sales functions signals the ‘end’ of the MComp ecosystem or if it is an ongoing ecosystem, albeit in a different environment. A similar debate has been raised regarding the identification of an ecosystem when a foreign species is added to a given bio-ecosystem.⁵² In my opinion, the degree to which the ecosystem changes in terms of its participants and functions is the deciding factor in deciding whether to brand a modified ecosystem as a new conception. The majority of the episodes discussed in this study are relatively minor in that the majority of the relationships and structures remain very similar to those at the outset of the episode. Even the RDT fork resulted in a set of relationships and processes that were largely the same as before the developers decided to leave MComp. However, the acquisition by OpenSoft resulted in a change in the number of participants in the ecosystem and the relationships between them. Several other major changes were made as well, including the installation of a new sales model, an increase in the munificence of the surrounding environment, and a change in the keystone firm at the center of the ecosystem (and its overarching goals). Thus, we argue that the acquisition by OpenSoft signals a radical change in the MComp ecosystem that we define as an endpoint in the timeline of the firm.

Similar to MComp, BComp will likely be acquired by a larger firm or issue an IPO, although the former is clearly more likely than going public. The focus of the company has been on building a firm with the size and revenue stream to do either. However, there are several key

⁵² In a critique of ecosystem theory and concepts in ecology, one author asks “If a river is deprived of half its species – or if it takes on as many again “invaders” – does it remain the “same” system?”

differences that may affect BComp's growth. The business intelligence market has several large, well-established competitors (Cognos, Business Objects, Hyperion, and even Microsoft). For MComp, there were only two key competitors (BigWare and OtherWare) to contend with. Additionally, the products are not based on established standards, making the switch from one company's products to another more difficult than switching J2EE servers, which are based on an established independent standard. Customers wishing to switch to MComp from OtherWare's OtherLogic can do so without having to rewrite the applications to fit the new server, unlike customers switching to BComp from their installed BI platform.

6.4.3 Bricolage and Interpretation vs. Planned Change

From its founding, MComp was not sure where it was heading as a company and as an ecosystem. Clearly, Thomas Smith (founder and CEO) had goals for the company, but he did not have a clear picture in mind of how to achieve them. We characterize MComp's experiences as *bricolage*, which is defined as "using whatever resources and repertoire one has to perform whatever task one faces." As they encountered a stress or a situation that they needed to address, the members of the ecosystem, particularly the keystone firm itself, adapted to the new conditions using the capital that was present in the firm at the time. In several cases, the task to be performed was the acquisition of additional capital (i.e. VC funding or acquisition). However, the resultant configuration of capital was the base from which the various mechanisms were enacted.

BComp's experiences to date have been based on preexisting plans and planned change, rather than bricolage. In many respects, this is due to the relative youth of BComp, which is less than three years old. Another possible explanation is the fact that BComp CEO Robert Dixon had experienced open source managers and advisors to consult about potential roadblocks that may

have arisen. Alternatively, Dixon and the other founders had prior experience that has enabled them to anticipate and prevent negative stresses that otherwise may have affected the ecosystem. For instance, the acquisition of JSoft was planned very early in the firm's existence. It is not clear whether that was due to the vicarious experiences of MComp's acquisitions or due to good planning by the CEOs. Either way, there has been little reason for significant bricolage to date.

6.4.4 Specific Episode Comparisons

In analyzing both MComp and BComp episodes, several are comparable between the two ecosystems. In this section, we discuss those episodes that have similar purposes. Namely, we discuss the founding, acquisitions, and venture capital funding episodes for both ecosystems and their keystone organizations.

6.4.4.1 Founding

MComp originally operated under a business model that is much different than the one in place at the time of the acquisition by OpenSoft. The original intent of the MComp open source software project was to develop an application server that could be used by an accompanying commercial firm, TCorp, to provide ASP services for companies not wanting to install and manage servers in-house. Founder Smith was the CTO, but had no real management experience, while his partner's experience was primarily in the financing arena.

When the commercial firm went out of business due to a shift in financing environment, which led to a reduction in the amount of economic capital available, the open source software and the accompanying community survived. At this point, a second business model was evolved from the needs of this community. The MComp Group provided documentation, training, and support for users who had deployed the software. These services were provided by contractors

that were selected from the OSS community itself. As compensation, the contractors and the MComp Group split the revenues that resulted from these servicing arrangements.

As problems arose from this model, largely based on the loosely connected contracting arrangements, and as professional management joined the firm (via Coleman and the VC firms), the business model was changed yet again to a variant of the model that it held until the acquisition. In this model, the number of employees skyrocketed from 11 in late 2003 to nearly 300 in April 2006. These employees provided the human capital required for the subscription service contracts that were the primary source of the firm's revenues.

MComp was successful because of two factors. First, the early focus was on developing an ecosystem of users and developers to support the product. This set of relationships or social capital enabled the product to survive even though the earliest version of the firm failed. If the development had been conducted within the auspices of TCorp, MComp would possibly be nothing more than a historical footnote. Second, the later success of the firm was built on the solid foundation provided by the product (organizational capital) and the surrounding relationships (social capital) in the ecosystem but was boosted greatly by the inclusion of professional management and expertise.

Although the BComp business model has been tweaked several times, much of the same strategic plan devised during the earliest meetings of the founders remain in effect. The original business model included the integration and acquisition of other smaller open source components into a larger platform around which the company could sell services in much the same manner as MComp had done. Unlike MComp, the original management team had significant prior experience building companies in the BI industry. The founders drew upon this experience and industry knowledge as they devised the earliest models and plans for the firm.

As the firm progressed, many elements of the MComp business model were incorporated into the BComp business model. This is no coincidence, as the founders spoke briefly with MComp CEO Smith and hired MComp director Todd Mayweather to its board of directors. In later years, they hired several other ex-MComp managers in an attempt to gain from their experiences. As a result, many of the lessons and experiences that the MComp people had to gain by trial and error were incorporated into BComp without the improvisation by which they were originally created.

We can see three differences between the founding of MComp and BComp that shape the different evolutionary paths of the firms and their ecosystems. As discussed earlier, MComp was devised out of the bricolage and improvisation necessary to meet the challenges they faced as the firm evolved its business model and strategic plans. BComp had the advantage of being able to duplicate the operational and strategic elements of existing OSS firms such as MComp while avoiding many of the pitfalls. BComp benefited from this knowledge first hand by hiring some of the actors who helped put these elements into place originally.

Second, BComp was able to utilize professional management from the outset of the project. The founding team had built and sold three other similar companies before, so it was able to anticipate many of the obstacles it would face and build the business model around them. To date, much of the design of the firm has proceeded along the path engineered originally. Thirdly, BComp was able to capitalize on the established reputation of the founding team among VC firms and industry contacts based on their prior experiences.

We also observe a difference in the order by which the key aspects of the ecosystem were developed in both firms. MComp developed a product and community first, then built a company to take advantage of them. Because MComp was started without the necessary level of

technological expertise, the inflow of development skills and contributions from the community was crucial for MComp' success. On the other hand, BComp was founded and had employees before the product was developed or the community built around it. The early developers had created similar applications and thus had less need for external development talent initially. It is not clear that either path is more advantageous than the other, but both have been successful to date in establishing both product and community.

6.4.4.2 Acquisitions

The purpose for MComp to make acquisitions was to retain the services of the lead developers of successful Java-based middleware projects. By hiring these developers, MComp could generate service revenues via training and support services by these developers. MComp could also ensure that the software it was creating would work well with its products, including integrating several components into the JEMS suite.

By securing the exclusive services of these developers, MComp could claim a competitive advantage over potential rivals based on the superior knowledge bases it possessed. As the RDT partnership proved, a loose federation of developers provided little protection from competition in its ecosystem. The lucrative salary and equity offered to these developers was sufficient to retain their services and knowledge for the long term. According to one of the MComp developers, none of the acquired developers left the firm before the acquisition of OpenSoft.

For BComp, the four acquired projects were selected based on the degree of integration into the core BI software platform. For instance, the JFreeReports acquisition filled BComp's need for a report generator to be integrated into the platform. In that respect, BComp was a user or an OEM client of the projects it acquired. The number of projects that BComp acquired was a

subset of the number of projects that were included in the platform. Other applications, such as Enhydra Shark, were included and distributed with the core product without being acquired by BComp.

In hiring these developers, BComp gained access to the communities that grew the size of its ecosystem immediately. This larger size was a tremendous attractant for the venture capital firms, who were initially concerned about BComp's initial lack of a significant community around the products. Like MComp, it was able to derive support revenues from the support and training services of the hired developers. It also gained the ability to control the direction and features of the component project, which affected the future of the software platform itself.

6.4.4.3 Venture Capital Funding

Following the earlier failure (as TCorp) to attract venture funding, MComp founder and the rest of the management team resisted venture funding. Instead, they relied on the gradual accumulation of financial capital from operations combined with a conservative financial management practice. By 2003 when VC funding was being considered, money was no longer a major issue for the firm. Additionally, the firm had succeeded in building a community and Coleman convinced the management team that money was not the only reason to acquire VC funding. Instead, the association with the venture capital firm would bring management and entrepreneurial expertise, social connections, and credibility, all of which were attained after the funding was received. In fact, CEO Smith is on record as saying the VC firm's general partner, Steve Miller, was a mentor through whom he learned much about running his business.

BComp's management team knew all along that it would need to acquire VC funding in order to expand the firm and achieve its goals. Funding would enable it to approach and acquire the components upon which the firm's primary product is based. Most of the same benefits that

were most important to MComp – namely credibility, expertise, and contacts – were attained along with the funding. However, these were side benefits (or “lagniappe”) rather than the primary reason for entering into the transaction.

The VC firms were attracted to MComp based on its success in the Java application server community. The company had in excess of one million downloads to date for its flagship product, which was still gaining traction among its targeted user population. For BComp, the funding was based largely on the legitimacy that resulted from being managed by a team that had successfully generated a positive return for VC firms in previous entrepreneurial ventures. There was little community and comparatively few downloads to date.

For both firms, the extra funding enabled component acquisitions and later, changes in the sales model of the firm. The relationship with the VC firms brought other benefits such as reputation, contacts, and managerial expertise that played a role in later episodes. As such, the capital that was received in and following the funding round produced similar effects in both ecosystems even though both had different motivations or attractants for seeking VC funding.

6.5 Observed Capital and Mechanisms

In this section, we discuss the interrelationships between capital and mechanisms in the 14 combined episodes from the two ecosystems studied. These effects are noted in the tables found in the next section, particularly Table 36 and Table 37.

There are 58 effects on the capital portfolios of MComp and BComp that were analyzed from the preceding two chapters (see Table 36 and Table 37), 45 of which have been increases in the level of capital available following the exercise of mechanisms in the given episode. The 13 negative effects were observed largely in relation to two specific episodes in the MComp ecosystem (TCorp failure and RDT fork). Perhaps not surprisingly because of its age and its

apparent ability to execute its plans, BComp has not experienced any significantly negative events to date.

We also observe that there is an ongoing effect on the capital within the ecosystems based on their business models and organizational structures. For both MComp, Inc. and BComp Corp, the primary goal of generating revenues leads to a (hopefully) constant positive effect on the economic capital available within the ecosystem as users are converted to paying customers. Similarly, the inertial effects of the ecosystem tend toward increases in the size of the development community (or relational social capital), the amount of human capital available due to this increase in community size, and the amount of organizational capital available due to productivity and codification mechanisms using this human capital. In addition, the credibility and legitimacy of the organization increases as the firm gains more experience and continues to meet the needs of participants. These life cycle effects would likely taper off eventually, were it not for events (such as the ones analyzed in this study) that introduce revolutionary changes in these inertial tendencies, which resembles the punctuated equilibrium paradigm .

The most commonly observed effects involved social and symbolic capital. Social capital was shown in the two tables as being affected in every relationship except BigWare's acquisition of CWare, but this is misleading since the social capital in the CWare ecosystem was obviously affected, triggering the effects on the MComp ecosystem. It is possible to interpret nearly every episode as having been initiated by a change in the relationships in the ecosystem, or a change in the social capital. The sole clear exceptions are the creation of the website/white paper for BComp (which was a change in the organizational capital) and the failure of TCorp (which was initiated by an environmental change in the economic capital available but became a significant episode within the ecosystem mainly because of the lost relationships with key contributors).

Other episodes include other capital changes in addition to the social capital (i.e. the venture capital funding which obviously carries an increase in the economic capital available), but in these episodes the change in the social capital is a key component of the episode. As such, it appears to validate the notion that relationships in an ecosystem are of premium importance. The establishment and maintenance of these pathways for transferring capital among the members of the ecosystem has a clear and positive effect on the health of the ecosystem.

Symbolic capital was affected in every episode except the initial founding of MComp, when there was arguably no legitimacy, reputation, or credibility present because of the lack of known development expertise or managerial experience of the founders. For BComp, this expertise was present at the outset due to the prior experiences of the five founding members. In each of the other episodes, the impact upon the symbolic capital was observable. In several episodes, most notably the CWare acquisition and both venture capital funding episodes, the effect on the symbolic capital was highly significant for determining the net impact of the episode.

Consequently, this symbolic capital affects the future flow of capital and the initiation of subsequent episodes because its presence signals the perceived odds that the ecosystem or an actor within the ecosystem will continue to exist and thrive. It is far less likely that a top-tier venture capital firm would invest in a firm that has little or no symbolic capital, even if it is not mentioned explicitly as a determining factor. Similarly, top managers and developers with some degree of significant experience and reputation are often attracted to situations in which there is already a store of symbolic capital that they can use to increase their own symbolic capital. Users also factor in the reputation, credibility, and legitimacy of a product or service when evaluating options for adopting these outputs. Thus, we argue that symbolic capital is another key factor

that successful ecosystems must manage in order to be able to attract and retain other forms of capital, including human, social, and economic capital.

Human capital was built in the ecosystems based on the establishment of social capital between members and influenced by the level of other forms of capital available. The ecosystem also depends on the level of human capital available in order to create the organizational capital necessary for continued existence. One of the key attributes of open source software is the reliance on external human capital (relative to the firm and its employees) for varying amounts of the coding and testing of source code. Professional open source firms depend on this expertise but tend to hire developers and managers in order to formalize the relationships and thus increase the likelihood of their continued productivity. The hiring of Bill Coleman and the acquisition of JSoft and GSoft are key examples of episodes that highlight the formalization of previously loose relationships within the ecosystem. Without being able to rely on the existence of this human capital, episodes such as the RDT fork may occur in which the level of human capital available is diminished or otherwise compromised. On an ongoing basis, this human capital is exchanged for economic capital via the delivery of services to users in the ecosystem. Thus we can see from the episodes studied in the current research that the level of human capital available in the ecosystem is a key component in the level of capital produced and circulated within the ecosystem (hence, its vigor).

The episodes studied in this research were least concerned with the effect on the organizational capital of the ecosystem. However, this is a misleading observation in that the effect is likely to be a secondary one based on the downstream effect of additional human capital from which the organizational capital is generated. Procedural organizational capital (i.e. business plans, licenses, etc.) was affected by episodes such as the initial founding of the

ecosystems and MComp' hiring of Bill Coleman. Codified knowledge is generated continuously via the efforts of developers and other contributors, but it was also affected significantly by the integration of the source code and components in the three acquisition episodes studied. It is the circulation, creation, and accumulation of this capital, particularly the adoption of source code and documentation, which arguably forms the primary basis around which the ecosystem is formed. Referential organizational capital is also created on an ongoing basis. The only episode that highlights this dimension of organizational capital was the creation of the initial website and white paper in the BComp case, which led to increases in symbolic and social capital as a result. We can thus conclude that the creation and accumulation of organizational capital is crucial for attracting and carrying out subsequent exchange relationships and capital flows within the ecosystem.

Finally, economic capital is the intended acquisition of many of the parties in the ecosystem other than the end users. Developers are compensated for the human capital that they contribute and apply to productivity mechanisms in both ecosystems. Companies in the ecosystem, including MComp, BComp, and support partners, are focused on the delivery of products and services in return for compensation that they depend on for their individual survival. Venture capital funds and other investors contribute economic capital in exchange for partial ownership and a share of future revenues or investment activities such as acquisitions. The focus on episodes obscures the fact that the ecosystem requires a continuous outflow of non-wage related operating expenses such as office space, hosting and communications services, and advertising/marketing expenditures. One of the benefits of open source companies is that much of the marketing expenditures and wages are lower compared to comparable proprietary firms,

but there are expenses that remain part of the operations of most of the members in the ecosystem.

A couple years before the acquisition of MComp by OpenSoft, Bill Coleman, then-EVP of MComp, developed an in-house spreadsheet of the ecosystem surrounding MComp, including the various members of the ecosystem and the revenues they generated as a result of their participation, including partners, system integrators, software vendors, and hardware vendors. His calculations added up to around twelve billion dollars in revenues generated as a result of the various interactions in the MComp ecosystem, indicating the level of financial viability of the ecosystem.⁵³ Thus, we can see that although many of the advantages of open source software are based on the low potential cost of adoption (mainly from reduced marketing and licensing costs), there is a significant amount of economic capital (mostly financial capital for knowledge-based goods such as open source software) being circulated throughout the ecosystem.

We can also observe from Tables 13 and 14 that there is a significantly higher number of vigor-related mechanisms, using the typology developed above. Of the 97 mechanisms observed in the 14 episodes, 74 (76.3%) are related to the accumulation, flow control, and production of capital in the ecosystem. There are 12 (12.4%) organization-related mechanisms and 11 (11.3%) resilience-related mechanisms.

Table 33: Summary of Events by Mechanism Table

Classification	MComp		BComp		Total	
	#	%	#	%	#	%
Organization	9	13.64%	3	9.68%	12	12.37%
Vigor - Resource Cntrl/Accum	22	33.33%	12	38.71%	34	35.05%
Vigor - Productivity	30	45.45%	10	32.26%	40	41.24%
Resilience	5	7.58%	6	19.35%	11	11.34%
Total	66	100.00%	31	100.00%	97	100.00%
<i>Vigor Combined</i>	52	78.79%	22	70.97%	74	76.29%

⁵³ This information was based on his personal recollection of the spreadsheet. Unfortunately, he was unable to share this spreadsheet, citing privacy concerns.

These results provide several insights. However, it is important to understand that the number of mechanisms enacted is not a direct indicator of the effectiveness of the action and thus should not be interpreted quantitatively. In other words, if there are two negative mechanisms and two positive mechanisms for a given episode, this does not necessarily indicate a neutral net effect. Either mechanism may be significantly more negative or positive, leading to a net negative or net positive effect. Rather, the net effect must be analyzed qualitatively. Similarly, the net effect of one resilience mechanism may be equivalent to 10 vigor mechanisms (for example).

Most of the episodes that we studied (and the attention of the researcher) were focused on the capital flows, which are weighted heavily in the vigor classification. The only episodes to have more mechanisms observed in the other classifications other than vigor were the founding of BComp and the creation of the website and white paper. However, the founding benefits from a split of communications into marketing and feedback, without which it would have been more focused on vigor as well. This is not a contradiction of the methodology, in my opinion. Rather, it is expected given our earlier theorizing about resilience (see chapter 2) as being based on the ability to release stored up capital in an effort to counteract the effects of the new stress. Much of the resilience, in other words depends upon the previous efforts to establish routines (or procedural organizational capital) to counteract potential stresses before they occur and to store other capital resources to deploy once the need occurs. For example, the RDT fork was counteracted primarily by exercising control mechanisms that restricted the flow of needed capital to the defecting members. In other words, the ‘resilience’ mechanisms are not the only means of maintaining organization and vigor in the ecosystem.

This heavy focus on capital flow as opposed to resilience mechanisms is also consistent given the overweighting of positive episodes (eustresses) that were focused on growth and expansion of the ecosystem. As such, many of the counteracting mechanisms may not have been needed. It is possible that had other negative episodes occurred, more mechanisms focused on resilience would have been encountered.

Within our data and considering our sample of predominantly positive stresses in successful ecosystems, we can conclude that the capital portfolio available in a professional open source ecosystem is the result of mechanisms that encourage the acquisition, creation, accumulation, and distribution of the existing capital. In return, the mechanisms that are enacted are the consequence of the capital available at a given point. For example, the rebirth of MComp depended on the ability to leverage organizational capital that had been previously developed. It also depended on the ability to leverage the existing community relationships (or social capital) to provide services (or human capital) that could be exchanged for financial resources (economic capital). We can also conclude that many of the actions in the ecosystem are focused on the creation and distribution of capital in order to meet the needs of the various members, including needs that arise in response to positive or negative stresses.

6.6 Episode Tables

Table 34: BComp Mechanisms by Episode

Mechanism	Founding	Whitepaper/ Website	Todd Mayweat her	VC Funding	JSoft Acquisition	Counts
<i>Coordination</i>	x	x				2
<i>Integration</i>					x	1
<i>Attraction</i>			x	x	x	3
<i>Gap Awareness</i>				x		1
<i>Investment</i>	x		x	x	x	4
<i>Shared Utilization</i>	x		x	x	x	4
<i>Codification</i>		x				1
<i>Knowledge Sharing</i>			x	x	x	3
<i>Legitimization</i>		x		x		2
<i>Monetization</i>					x	1
<i>Productivity</i>	x				x	2
<i>Synergy</i>					x	1
<i>Acculturation</i>		x				1
<i>Communications (Feedback)</i>	x					1
<i>Communications (Marketing)</i>	x	x				2
<i>Trust Building</i>					x	1
<i>Uncertainty Reduction</i>					x	1
Counts	6	5	4	6	10	31
Organization	1	1	0	0	1	3
Vigor - Resource Control/Accum	2	0	3	4	3	12
Vigor – Productivity	1	2	1	2	4	10
Resilience	2	2	0	0	2	6

Table 35: MComp Mechanisms by Episode

Mechanism	EMComp Founding	TCorp Failure	MComp Rebirth	Bill Coleman Hiring	RDT Fork	Acquisition	VC Funding	CWare / Cigar	OpenSoft Acquisition	Counts
<i>Coordination</i>	x		x						x	3
<i>Defection (-)</i>					x				x	2
<i>Forking (-)</i>					x					1
<i>Implementation</i>				x						1
<i>Integration</i>						x			x	2
<i>Attraction</i>	x	x		x	x		x		x	6
<i>Control</i>					x					1
<i>Gap Awareness</i>			x				x			2
<i>Investment</i>	x	x				x	x	x	x	6
<i>Knowledge Acquisition</i>	x	x								2
<i>Shared Utilization</i>				x		x	x	x	x	5
<i>Adoption</i>			x		x			x		3
<i>Codification</i>			x							1
<i>Compensation</i>	x	x	x		x			x	x	6
<i>Knowledge Transfer / Sharing</i>			x	x	x	x	x		x	6
<i>Legitimization</i>	x	x	x	x		x	x	x		7
<i>Productivity</i>	x	x	x		x	x		x	x	7
<i>Communication</i>					x	x		x	x	4
Counts	7	6	8	5	9	7	6	7	10	65
Organization	1	0	1	1	2	1	0	0	3	9
Vigor - Resource Cntrl/Accum	3	3	1	2	2	2	4	2	3	22
Vigor - Productivity	3	3	6	2	4	3	2	4	3	30
Resilience	0	0	0	0	1	1	0	1	1	4

Table 36: BComp Episodes by Capital Effects

	Founding	Website/White Paper	Hiring of Todd Mayweather	VC Funding	Acquisition of JSoft	Ongoing Growth
<i>Economic</i>	+ (investment by founders)		+ (investment by Mayweather)	+ (investment by VC Firms)	- (investment by BComp, payable to Marvin; wages)	revenue generation; operating expenses (-)
<i>Social</i>	+ (Early Community Relationships)	+ (Shared Mental Model, acculturation)	+ (shared business, industry contacts from Mayweather)	+ (shared business, industry contacts from VC firm)	+ (Trust building, Communications, shared technical contacts)	community growth
<i>Symbolic</i>	+ (From Reputation of Founders)	+ (legitimacy and credibility)	+ (Mayweather's reputation in open source adds credibility, legitimacy)	+ (reputation of VC firm adds credibility, legitimacy)	+ (BComp, JSoft share reputation, credibility)	credibility increases over time
<i>Organizational</i>	+ (planning/development)	+ (site/papers good for reference)			+ (Synergy by combining org capital bases)	productivity
<i>Human</i>	+ (founders' industry knowledge; developers' tech knowledge)		+ (Knowledge sharing of OSS, managerial experience)	+ (Knowledge sharing of industry, managerial experience)	+ (Knowledge sharing of JSoft community, project leader)	learning, hiring new developers, community skill sharing
<i>Trigger</i>	entrepreneurial desires	need for shared vision	need for expertise, social connections	need for funding	need for income by proj lead; need for social, org capital integration	

Table 37: MComp Episodes by Capital Effects

	Founding	TCorp Failure	Rebirth	Hiring of Bill Coleman	Rival development team Fork	Acquisition of GSoft
<i>Economic</i>	+ (investment by founders; wages for key contributors)	- (wages, working capital no longer available)	+ (training, consulting revenues; consultant wages)		- (few lost contracts)	- (investment by MComp, payable to Royal; wages)
<i>Social</i>	+ (Early Community Relationships)	- (some community members left)	+ (Community Relationships)	+ (shared business, industry contacts from Coleman)	- (lost communications with developers / consultants)	+ (Trust building, Communications, shared technical contacts)
<i>Symbolic</i>		- (reduced legitimacy due to funding failure)	+ (increased legitimacy as revenues begin to flow)	+ (increased legitimacy due to business model, Coleman reputation)	- (lost perceived legitimacy, credibility)	+ (MComp, GSoft share reputation, credibility)
<i>Organizational</i>	+ (planning & development, software)	- (business plan failed)	+ (new business model; software, documentation developed)	+ (improved business model)		+ (Synergy by combining org capital bases)
<i>Human</i>	+ (Knowledge Acquisition from Community, Devs)	- (reduced developer skill available)		+ (Knowledge sharing of industry, managerial experience)	- (lost expertise of 6 developers / consultants)	+ (Knowledge sharing of GSoft community, project leader)
<i>Trigger</i>	entrepreneurial desires	reduced economic capital in external markets	need for services by users; entrepreneurial desires	need for expertise	dissatisfaction with inducements	need for income by proj lead; need for social, org capital integration

Table 37: MComp Episodes by Capital Effects (cont'd)

	VC Funding	Cigar / CWare Acquisition	Acquisition by OpenSoft	Ongoing Growth
<i>Economic</i>	+ (investment by VC Firms)		+ (payouts from OpenSoft to investors, shareholders)	revenue generation; operating expenses (-)
<i>Social</i>	+ (shared business, industry contacts from VC firm)		- (lost contacts via departed officers, developers)	community growth; hiring from community
<i>Symbolic</i>	+ (reputation of VC firm adds credibility, legitimacy)	+/- (increase in initial credibility, potential long-term decline)	+ (shared legitimacy, credibility of larger OpenSoft)	credibility increases over time
<i>Organizational</i>			+ (integration of capital bases); 0 (new business, sales models)	productivity
<i>Human</i>	+ (Knowledge sharing of industry, managerial experience)		+ (increased development staff; knowledge share by RHat developers)	learning, hiring new developers, community skill sharing
<i>Trigger</i>	need for credibility	BigWare: need to protect its market	need for legitimacy; desire for financial returns	

7.0 DISCUSSION

In this chapter, we review the significant findings of this study and the implications they have for research and practice. We also attempt to show how these results are linked to the two research questions that we originally sought to address.

7.1 Summarized Study Findings

We have uncovered several significant findings during the analysis of the two ecosystems. We summarize these findings and their relation to the research questions that guided our efforts. These findings are grounded in the analysis from the previous three chapters as well as existing theoretical support.

7.1.1 Theory of Ecosystems in Organizational Research

In analyzing the units involved in our study and the interactions between them, we have derived a theoretical conceptualization of ecosystems applicable to research in organizational fields from the corresponding original application to biological ecosystems. In this section, we define the core concepts upon which our ecosystem theory is based.

Recall that our original definition from ecology states that an ecosystem “involves the circulation, transformation, and accumulation of energy and matter through the medium of living things and their activities”. There are three key components in this definition: the living things, the energy and matter they conduct, and the activities they perform. The primary energy in biological ecosystems is sunlight, some of which is converted into organic material by primary producers (plants). All other organisms in the ecosystem are consumers that feed on the primary producers or on other lower-level consumers. We add to this metaphor the environment in which

they exist, consisting of abiotic materials such as water, soil, and air, from which many of the nutrients and other resources are imported.

Metaphorically applying this definition to organizational ecosystems, we can see that a similar set of three components arise: actors, capital resources, and interactions among them. The actors in an organizational ecosystem are typically individuals and organizations. In turn, these organizations are composed of individuals.⁵⁴ Owing to the nature of ecosystems as open systems with highly flexible boundaries, this set of actors is typically fluid and dynamic. For instance, most open source ecosystems allow participation by nearly anyone who wishes to contribute. This does not indicate that membership in every aspect and every interaction of the ecosystem is equally fluid, as powerful actors may move to limit the potential actions by other members of the ecosystem. This was demonstrated in the analysis of the RDT group's attempted fork of the MComp code.

For the purposes of our framework, these actors possess a portfolio of several types of capital that circulates through the ecosystem via the interactions between the actors. The capital is a proxy for the energy that is circulated and stored throughout biological ecosystem. For instance, a hypothetical developer in our study possesses human capital (development expertise), social capital (relationships within the development community), and symbolic capital (the person's legitimacy and reputation as a developer). Similarly, our hypothetical developer may be employed by a firm that possesses organizational capital (e.g. a business model and source code) from which it hopes to generate revenues (economic capital) through its relationships with end users and partners (social capital) and its reputation (symbolic capital) with these other actors.

⁵⁴ In complex systems, there may be several layers, or groups, between the topmost organization and the individuals themselves. For the purposes of the current study, these groups are omitted from our analysis.

These actors contribute capital from their capital portfolios to the ecosystem, where it is transferred to the point where it can be utilized, subject to transaction costs. At that point, it is stored for future use, combined with other actors' capital contributions to generate outputs, or appropriated by other actors for their benefit. In the case of the capital combined to generate outputs, such as source code or services in the present study, the resultant products are circulated to the point where they also are stored, combined, or appropriated. Often, these interactions are combined to form exchange relationships. For instance, our hypothetical developer contributes human capital to create source code for use and distribution by the greater ecosystem, for which the contributor receives economic capital in the form of a salary from the employing organization in exchange for contributions. As with most employees, the two interactions are dependent upon each other, i.e., without the financial compensation, our developer is likely to contribute far less code (if at all).

We thus propose that *an organizational ecosystem consists of a system of actors that interact with each other in order to achieve their needs and goals. Through these interactions, capital of various forms is contributed, combined, stored, circulated, and appropriated by these actors.* It is the aggregate set of these actors, capital portfolios, and interactions form the system that defines our specific ecosystems. This differs from our conception of a firm, in which we are typically concerned with the 'nexus of contracts' that exist in market relationships. Instead, we note that there is a much larger mesh of relationships among the actors in an ecosystem as opposed to the confined market space of a single firm.

The existence of this mesh of relationships outside the firm boundaries is not inconsistent with Coase (1937), who theorizes that the rationale for firms is based largely on the effect of transaction costs in obtaining the necessary goods and services. If we argue that the transaction

costs are much lower for distributed knowledge-based coproduction efforts such as open source, especially those efforts that can take advantage of technological improvements such as the Internet, then we can conclude that many of the inefficiencies associated with distributed production of goods and services are reduced, making structural arrangements, such as ecosystems, more feasible than possible for physical goods production.

7.1.2 Equilibrium and Stress in Organizational Ecosystems

Recall that our initial framework of open source ecosystems was based on the Barnard-Simon Theory of Organizational Equilibrium, reproduced below. Individuals participate to the degree that they are able to appropriate benefits in return as inducements. If the benefits accumulated by the contributing participants do not exceed the perceived value of their contributions, based on either experience (in the case of continued contributions) or expectations (in the case of initial contributions), there will be less incentive to participate going forward.

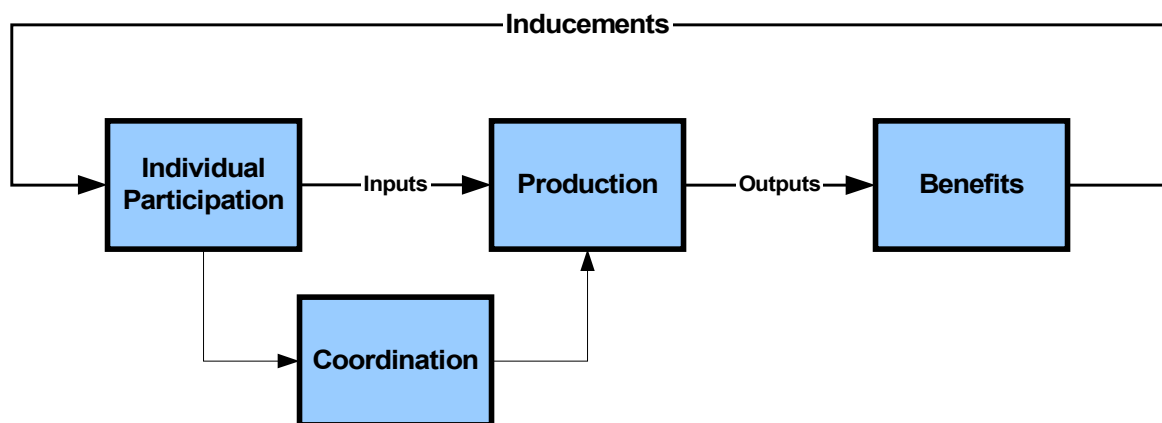


Figure 26: Barnard Simon Theory of Organizational Equilibrium

From an ecosystem perspective, there needs to be ample capital benefits produced by the ecosystem at equilibrium to induce the continued participation by the existing set of actors, perpetuating the ecosystem's existence. In reality, this is rarely the case as actors' needs and goals change, leading to changes in their participation or the amount of contribution they make available to the ecosystem. Changes in the composition of actors or capital composing an

ecosystem via contribution, sharing, or exchange or changes in the specific interactions between the actors can trigger changes in other actors' participation or interaction. Reducing the effect of actors to the capital they represent, we deduce that changes in the capital available and contributed to the ecosystem can trigger *stresses* in the ecosystem. These stresses can be positive (e.g. venture capital funding) or negative (e.g., RDT fork), as well as planned (e.g. acquisition of component projects) or emergent (failure of TCorp).

Regardless of the characteristics of the stress induced in an ecosystem, an actor may choose to enact a given capacity or tendency (or mechanism) in an attempt to respond to the given stress. For the purposes of our study, these mechanisms are changes in the contribution, circulation, appropriation, storage, or distribution of capital within the ecosystem. The mechanisms that each actor is capable of enacting depend largely on the portfolio of capital under that person's control as well as the aggregate portfolio of capital across the ecosystem. In other words, mechanisms are rooted in the capital structure available and the skills of the actors to apply these mechanisms.

The stages through which actors go through were hypothesized to include a planning stage (particularly by the actor that initiates the stress), the enactment of the stress itself, and an adaptation stage, followed by a local equilibrium point. We have found that the stresses studied in this research have generally followed this model. For those parties who were not aware of the impending stress, the planning stage was limited or non-existent. Instead, the earliest portions of the adaptation phase included elements similar to the planning stage. This is exemplified by MComp' response to the RDT defection or the CWare acquisition.

7.1.3 Health in Organizational Ecosystems

To this basic framework, we proposed a more detailed model of ecosystem health in open source ecosystems to include the specific capital contributions and benefits, external inputs and outputs, and the impact of stresses upon the ecosystem. We now examine this model in more depth based on the insights from the two cases.

7.1.3.1 Organization

The organization of an ecosystem is concerned with the ability of the ecosystem to act in ways that satisfy the needs of the system as a whole and the specific participants themselves. We have identified three mechanisms that we posit were used to control and coordinate the actions of the members in such a way as to benefit the ecosystem as a whole (coordination, integration, and implementation) and two mechanisms that were enacted when individual members found that their needs were not being met (forking and defection).

7.1.3.2 Vigor

Our definition for vigor is the aggregate throughput of the ecosystem consisting of the full range of outputs produced by the members of the ecosystem and the capital resources contributed to produce them. We have identified two categories of mechanisms associated with these efforts. There were six mechanisms identified that are associated with the control and accumulation of capital and resources (investment, control, shared utilization, and knowledge acquisition, gap awareness, and attraction), with the latter two characterized as motivations to enact other mechanisms. Eight other mechanisms (productivity, knowledge sharing, codification, monetization, adoption, compensation, legitimization, and synergy) are associated with the conversion, exchange, transformation, and use of capital by the members of the ecosystem.

7.1.3.3 Resilience

An ecosystem can be resilient to the extent that it is able to maintain its vigor and organization (or productivity and structure) in order to continue to exist and operate following perturbations or changes in the system. We have posited that a majority of the mechanisms enacted in response to a given stress can be classified as vigor or organization as identified in the preceding two sections. However there are four other mechanisms that we have identified within the two cases as being enacted to adjust to changes in the cultural or behavioral patterns of the ecosystem or those that attempt to maintain the existing patterns by eliminating these changes. The four mechanisms identified in our study include acculturation, communications (including marketing and feedback), trust building, and uncertainty reduction mechanisms.

7.1.4 Other findings

The POS firms (MComp, Inc and BComp, Inc. in our two sites) are keystones which control much of the capital flows in the entire ecosystem and thus over the attraction and retention of participants. Iansiti and Levien (2004) characterize keystones as the firms that are the hub of business ecosystems. These hubs act to improve the overall health of the ecosystem and thus ensure its sustained performance. These firms are the key conduits through which the user and innovation communities share and transfer capital and materials to each other. In so doing, they are able to appropriate portions of the value created by the two communities for their own prosperity.

POS firms are business-centric and thus, the accumulation and ultimate conversion to economic capital is the primary goal within the ecosystem. Future research should validate that other forms of OSS ecosystems (such as sponsored- and community-OSS ecosystems) have different primary capital goals based on the principle of *cui bono*. As mentioned previously in this research, ecosystems that are less interested in the accumulation of economic or financial

resources have less incentive for enacting monetization or compensation mechanisms, which may be reflected in a different capital structure and different responses to both positive and negative stresses.

In addition to the reactionary enactment of mechanisms to respond to unanticipated negative stresses, ecosystems and the actors that comprise them often enact mechanisms in an attempt to proactively defend against anticipated future stresses. For example, MComp' hiring of developers, such as Royal, was at least partially an attempt to formalize the relationships between the firm and its service providers, in an attempt to defend against another attempted forking like the RDT partners attempted. Additionally, the communications mechanisms that the BComp team enacted in an attempt to mitigate the buildup of distrust or uncertainty following the acquisition of JSoft was an attempt to reduce the possibility of a mass defection and forking on the part of the pre-existing JSoft community.

7.2 Relevance for research questions

In this section, we outline how the preceding information relates to the two research questions addressed. For reference, the questions are repeated.

1. What mechanisms does an OSS ecosystem employ to respond to stresses in an attempt to remain healthy (and thus survive)?

In the preceding chapters we have identified the various mechanisms that were enacted by the actors in the two ecosystems in response to a series of stresses that occurred in their history. We have further shown how these mechanisms are enacted.

- The mechanisms derive from the capital available to the actors.
- The actors enact these mechanisms in response to changes in the capital flow and stores, and hence the inducement-contribution balance, in the ecosystem. These changes may be initiated purposefully or encountered due to emergent changes in the ecosystem or the environment in which they exist.

- The mechanisms enacted by the actors lead to periods of adaptation during which a *new* equilibrium is achieved as the individual actors endeavor to balance their level of contribution with an acceptable level of inducements that result.
- Thus, the health of an ecosystem is the result of the amount of capital available within the ecosystem, the efficiency of the interactions that underlie the ecosystem, and the ability of actors to respond and adapt to the changing capital flows and stores.

2. How are these mechanisms, and thus the health of OSS ecosystems, developed over time?

We have above discussed the relationship between the capital present in an ecosystem and the mechanisms that result, and vice versa. This recursive relationship defines the mechanisms available across an ecosystem as follows:

- The mechanisms that each actor is capable of enacting depend largely on the portfolio of capital under the actor's control as well as the aggregate portfolio of capital across the ecosystem. In other words, mechanisms are rooted in the capital structure available.
- The capital available in an ecosystem may be altered by changes in the composition of an ecosystem. For example, as a new sponsor (i.e. BigWare) joins the ecosystem.
- Alternatively, the enactment of mechanisms alters the existing capital portfolio in the ecosystem and its actors (by definition of a mechanism as a capital-altering tendency). This change in capital alters the mechanisms that are available for subsequent enactment by the actors based on their revised portfolios.
- Thus, we see that as the capital structures of an ecosystem evolve due to evolutionary or revolutionary forces, there is a corresponding change in the mechanisms that are available to be enacted in response to a subsequent stress.

7.3 Implications

7.3.1 Contributions for Research

The current study extends our knowledge of the ecosystem concept, particularly those ecosystems revolving around professional open source software. By fully exploring this metaphor in the study of capital flows among business and technological ecosystems (including multiple capital types), we have proposed a new theoretical framework for exploring the interactions among the complex network of participants that offers deeper insights into the resulting contributions, production, and functional outputs. In so doing, this research develops a

more complete means of assessing not only the health, but also the potential value of participating in these ecosystems.

The current study has also further developed the notion of the individual, firm, and ecosystem as portfolios of capital and mechanisms to affect them. Similar efforts have been pursued by other researchers , but to my knowledge this research consists of one of the first efforts to combine each capital and the interactions between them in a qualitative manner. Certainly, this is one of the first research efforts discussing the interactions of various capital types in the creation of software.

We have also developed a nomenclature and structure for graphically representing the impact of the capital changes and mechanisms discussed in this chapter. Although we believe these diagrams hold much potential for this area, they are still in an embryonic state and will need to be refined and extended prior to publication.

Finally, we have conducted a qualitative realist study in information systems. Future efforts will be spent (along with a colleague who has also conducted a qualitative-based study under a realist philosophy) in trying to create a set of guidelines and methodological checkpoints for future researchers willing to pursue such studies.

7.3.2 Implications for Practice

As open source software, especially professional open source, becomes more prominent in the enterprise accepted IS environment, it will become even more important to understand the means by which the surrounding ecosystem (which each stakeholder depends upon for the attainment of its goals) is able to sustain itself and provide value over the long term. By investigating the circulation, transformation, and accumulation of capital, researchers and practitioners alike will be able to identify key mechanisms, antecedent factors, and structural

means by which an ecosystem's health evolves. This understanding will subsequently enable the development of tools for the purposes of diagnosing the performance and sustainability of open source and other ecosystems.

When selecting technological components to add to their enterprise information systems platforms, IS leaders must be able to choose components for which they will be able to integrate into the current environment and obtain support in the event of systems failures. Professional open source software provides these capabilities similarly to those provided by proprietary firms. However, not all technology ecosystems have equivalent levels of service or health. The findings from this study give these managers criteria that they can employ to assess the health of these ecosystems as a component of the selection process. Future research may be able to use these findings to create a simpler means for practitioners to evaluate the quality and health of a technological ecosystem.

Entrepreneurs wishing to create ecosystems around their technology-based firms (and professional open source software development firms in particular) need to pay particular attention to more than simply the basic transaction of selling products or services to users. Instead, entrepreneurs and senior management for these firms should include each of the five forms of capital in their operational and strategic planning. In so doing, the firms can effectively keep track of the ecosystem's vitality and viability. This is not a suggestion to disregard the monetization of human and organizational capital, since the long-term success and survival of the firm itself will depend upon its ability to create and appropriate financial capital. However, the accumulation of other forms of capital makes the difference between ecosystems that are able to continue to thrive despite the stresses that come their way and those that are unable to do so.

This accumulation also enables the members of the ecosystem to intentionally enact positive stresses in order to defend against future threats or to reach new levels of success.

Although this research is centered on OSS, its application is by no means restricted to this context. Other contexts such as web services, RFID, and ERP systems require participation by an arrangement of other stakeholders that may be investigated using the framework developed in this study. Even technologies such as medical, bioscience, consumer, or other technologies may benefit from an understanding of the impact of capital and mechanisms in organizational settings. Thus, it is anticipated that the viewpoint developed in this research study will be deployed further in subsequent investigations into ecosystems surrounding other technological platforms.

7.4 Opportunities for further research

The current research focuses on the health of the ecosystems surrounding two similar professional open source ecosystems. Similar research into other forms of open source software ecosystems (i.e. sponsored or community) could yield different results. Also, the study of different technologies, including those outside the scope of information systems, could yield different results as well. It is important to realize that we are not interested in developing an exhaustive list of mechanisms and reactions, since the limitless combinations of capital and the similarly boundless imagination of humans will always create new mechanisms and actions to counteract stresses as they arise. Rather, we are interested in the overarching thesis that the health of technological ecosystems is maintained by mechanisms that affect the vigor, organization, and resilience of the ecosystem.

We have also focused primarily on the revolutionary effects of stresses and mechanisms in the current study. Although we briefly mentioned the ongoing capital effects, there is a gap in

studying the constant evolutionary and status-quo mechanisms of the ecosystem with respect to their impact on the capital portfolios within the ecosystem. A portion of the interview data gathered in this research effort was focused on the day-to-day inducements and contributions experienced by the various participants interviewed. Subsequent analysis will be performed to explore the creation, distribution, and accumulation of capital during non-revolutionary periods as well as during the periods of change studied here.

In the current research, we employed five forms of capital that we believe to be most significant for the current contexts of our study. However, there are other forms of capital that may prove beneficial in studying the contributions and inducements in other ecosystems. The emotional components of human capital (e.g. happiness, self-esteem, and health) have been investigated in other studies of open source development . Inclusion of these components may yield additional insights, particularly with respect to the continuous effects of mechanisms in the ecosystem.

7.5 Limitations

The current research has been conducted in accordance with generally accepted guidelines for qualitative case study methodology. However, there are several limitations that are associated with this study that are related to the researcher, sites, and the methodology itself.

As the primary researcher, I approached this study with a bias toward the existence of multiple types of capital as a key concept in organizational and ecosystem theory. Thus, much of the interpretation was conducted with this viewpoint in mind. Given that I conducted much of the data collection and analysis on my own with very little assistance or few viewpoints other than my own (except for the validity checks provided by the interrater reliability tests), the researcher's inherent biases may have affected the outcome of this study. I met weekly with my

dissertation advisors to discuss the data and findings of this research in order to mitigate much of these biases. The complexity of the interactions between the various actors within the ecosystem and the many different capital stores and flows complicates the analysis significantly.

The sites chosen for study were very similar in terms of their motivations and strategic goals. This was not coincidental since the top management for BComp consulted the top management of MComp for advice prior to its founding. Additionally, several members of the MComp management team and board of directors were members of the BComp management team and board of directors. Thus, the business model for both firms is similar in several respects. It is possible that a professional open source software ecosystem revolving around a firm with a different business model and fewer common actors would have resulted in different results. However, it is reasonable to believe that the findings developed in this study would be similar and applicable to other professional open source ecosystems as well as other types of technological ecosystems.

The study of the BComp ecosystem is in some respects premature because of the relatively short existence of the firm. As such, the ecosystem has not experienced any known negative or unanticipated stresses to date. Future research should be conducted to continue to observe the effect of ongoing stresses in this ecosystem.

The interviews conducted with the various members of the ecosystem were retrospective in nature. However, these were combined when possible with contemporary accounts of the episodes from media reports, blogs, archived mailing lists, and other electronic media. Because of the sheer numbers of messages and emails available for both ecosystems, it is impossible to ensure that all meaningful data were included. However, the amount of data included is sufficient to meet the intended objective of supplementing the interview data.

In addition, not all of the interviews proved to be beneficial toward the research questions underlying this report. Some interviewees simply did not have enough time to participate fully within the proposed interview guidelines. Other potentially valuable interviewees never responded to interview requests. However, the interviews conducted and the time spent within each interview, combined with the archival and observational data, yielded sufficient data for the purposes of this study.

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APPENDICES

Appendix A: Ecosystem Definitions

Definition	Citation
Ecology & Human Ecology	
"The whole system (in the sense of physics) including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome-the habitat factors in the widest sense." (299)	Tansley 1935
"The system composed of physical-chemical-biological processes active within a space-time unit of any magnitude, i.e., the biotic community <i>plus</i> its abiotic environment" (400)	Lindeman 1942
"An ecosystem is an arrangement of mutual dependencies in a population by which the whole operates as a unit and thereby maintains a viable enviromental relationship" (26)	Hawley 1986
Business Ecosystems	
In a business ecosystem, companies co-evolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations.	Moore 1993
"An economic community supported by a foundation of interacting organizations and individuals—the organisms of the business world." (26)	Moore 1997
"The relationships among a community's populations, between the community and its environment, and, by extension, among their resource supplies and among their resource suppliers form the community's ecosystem." (87)	Bidwell, Kasarda 1998
Like business networks, biological ecosystems are characterized by a large number of loosely interconnected participants who depend on each other for their mutual effectiveness and survival. And like business network participants, biological species in ecosystems share their fate with each other. If the ecosystem is healthy, individual species thrive. If the ecosystem is unhealthy, individual species suffer deeply. And as with business ecosystems, reversals in overall ecosystem health can happen very quickly. (8-9)	Iansiti, Levien 2004
"a set of companies, cooperating and competing at once, that together deliver a product or service by providing different components that share some critical capabilities."	Sviokla 2005
"...the interrelated set of technologies and forces (especially social and technical forces) that may impact innovation, development, and adoption." (4)	Adomavicius, et al 2006

Table A-1: Ecosystem Definitions

Appendix B: Evergreen Pilot Study

B.1 Case Background

Evergreen is an open source project sponsored by the Georgia Public Library Service (GPLS). Currently, the library operates the PINES (Public Information Network for Electronic Services) system, which is a proprietary integrated library system (ILS) that automates the circulation and cataloging functions for 252 libraries in 123 counties throughout the state. Under the current system, patrons can request materials from any of the consortium libraries without additional cost. However, the proprietary software is incapable of providing several of the functions needed by the library consortium, specifically those functions directly related to the local acquisition and system-wide circulation of new materials. The goal of the Evergreen is to replace the current ILS with one developed in-house (Open-ILS) under an open source license. In so doing, Open-ILS will not only address the shortcomings of the proprietary system, but also it will enable the state to save several hundred thousand dollars each year in licensing fees to the proprietary vendor and in support contracts required for the hardware requirements of the current software.

Not every library in the state is part of the PINES consortium. Several of the larger libraries, such as the Atlanta-Fulton County library system, are not members because of a concern that patron requests from the smaller libraries would consume many of the materials, reducing access by local patrons. These larger systems have the resources to select and operate separate software vendor contracts. Upon completion of the Evergreen project, several of these larger libraries may join the PINES consortium in order to share in the significantly reduced costs.

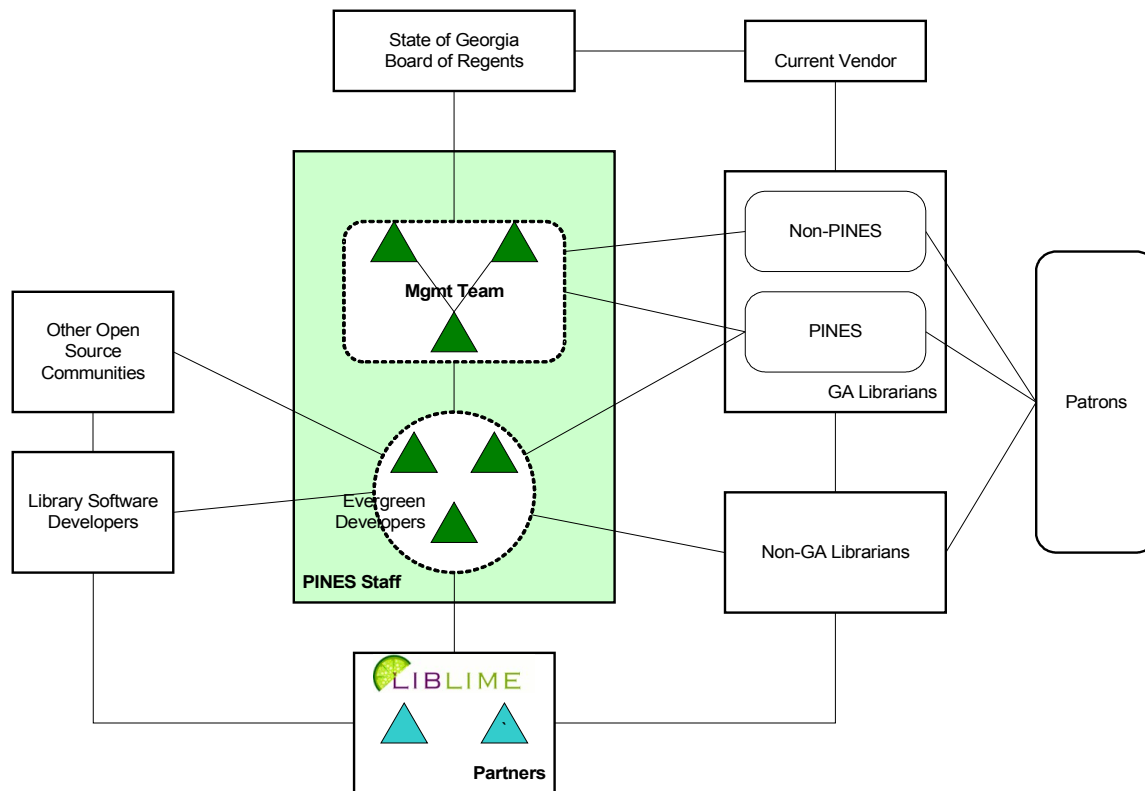


Figure 2: Evergreen Ecosystem

B.2 Organization

The core of the project includes the developers and the management team, all of whom are hired by the GPLS. Shortly after getting approval to launch, one developer was reassigned from another role on the PINES staff and two new ones were hired. Additionally, there are 4 staff persons and two interns working primarily on the project, including not only development but training, support, and project management. A contract was struck with developers at Liblime, an open source library software consulting firm, to provide software testing and quality assurance services.

The three GPLS developers are responsible currently for nearly all of the development of Open-ILS. Some development is provided by the contract firm hired to perform QA tasks for the project, but there is no other major development work being performed by the users themselves

(as is typical in open source projects). However, the current PINES librarians play an important part in ensuring that the developers are aware of all of the tasks that are necessary in their daily routines. To provide this knowledge to the developers, the librarians have participated in several face-to-face meetings in their home locations and in the developers' offices. The local visits and focus groups were instrumental both for providing insight into the procedures and daily routines that the librarians follow and the new features and modifications that the librarians wanted. The periodic committee meetings are primarily used to update the librarians on the developers' progress and to ensure that the work done to date is satisfying their needs and requirements.

The most common means of communication between the librarians, PINES staff, and the development team is via email. There are a number of restricted mailing lists that have been setup to enable communications to occur within specific subsets of the community, including the core team (PINES staff and development team), specific subcommittees (including circulation and cataloging), and all PINES members (core team plus subcommittees). In addition, two public mailing lists exist to facilitate technical and non-technical discussions, respectively. The public lists are frequented by the development team, partners, and interested observers including librarians from outside the state of Georgia. Many of these external members of the ecosystem also communicate via a blog containing items such as status reports, corrections, and other announcements.

The development team members are all located in the local area, which enables them to meet once per week to discuss things such as code progress, staff matters, and plans for upcoming releases. Otherwise, they communicate primarily via an IRC channel that they inhabit for much of the day. They also monitor and contribute to an additional IRC channel used by the larger community of library software programmers.

Because of the perceived lower cost of open source compared to the vendor offerings, there is some degree of interest in open source library packages such as Evergreen and Koha. Users outside the state have been instrumental in providing technical assistance, bug reports and suggestions based on their own needs and experiences, documenting many installation/support tips on the project website, and promoting awareness of the project among the library developers around the world.

B.3 Vigor

The contributions made to the ecosystem as well as the benefits received from the ecosystem can be expressed in terms of different forms of capital, which are convertible into other forms on the basis of various exchange relationships . As state above, the total production and circulation of capital within an ecosystem can be identified as the *vigor* of the ecosystem. In this section, we examine the vigor of the Evergreen system. The typology of capital employed here includes economic, social, human, symbolic, and organizational capital.

In many respects, the Evergreen project is designed to recapture economic capital that would otherwise be expended annually. Currently, the PINES system costs approximately \$15M per year in licensing and maintenance fees. When complete, the Evergreen project will save the State over \$10M per year. The project is funded directly through the GPLS, a unit of the University System of Georgia. These funds are used for hiring, facilities, equipment, and other expenses necessary for the operation. Because this financial support is responsible for the vast majority of the contributions made to the project, there is little incentive to tailor the code to any group outside of the PINES system. There are no plans to actively market the application to any other library system. Instead, the hope is that other library systems that wish to deploy the software will hire their own development and support teams to custom the software for their own

needs (and contribute the changes back to the original project) while the current team of developers continues to support the PINES community.

Human Capital is defined as the skills, knowledge, and abilities of an individual that can be used to generate income or other useful outputs . As stated above, the vast majority of the application development is provided by the three GPLS-employed developers. However, other members of the ecosystem contribute human capital (knowledge, experiences, and values) in different ways. The staff and librarians share their experiences and knowledge of the current practices and workflows to the developers, which they incorporate into the new software. These librarians also provide information to each other in an effort to share useful hints and tips with respect to the use of the system. Outside users have taken the lead to write much of the documentation, which resides on a wiki site.

There are three dimensions of social capital: structural, cognitive, and relational dimensions . Within the Evergreen ecosystem, structural contributions include access to external knowledge and resources via the multiple communications paths and the underlying hierarchical structures of the GPLS and PINES networks.

Evidence of contributions from the cognitive dimension include the existence of shared language and codes. The developers had to obtain this shared knowledge by spending time with the librarians and staff members. However, they have contributed to this shared knowledge through new constructions in the new ILS as “meat grinders”, which reflects a batch processing for “buckets” of books such as book bags or staff recommendation lists. Over time, the developers and users have forged a common language based on each other’s individual terminologies.

The relational dimension includes factors such as trust, norms, and obligations. It is apparent that these factors have developed along with the application. Trust is the belief that the other party will act in an appropriate manner and is based on belief in the good intentions, competence, and reliability of the other party . The project manager explained the perceived trust PINES librarians have in the development team as follows:

It's almost like PINES has faith in us. They know we're gonna do the right thing. They know that we understand their needs. They know that [the PINES Project Director] has been in Georgia libraries for 20 years. They know that we know. We feel their pain. So, they feel like they already have a dog in the fight. They know that we're gonna do the right thing.

The norms of cooperation are evident in the amount of shared production that exists between the different roles, particularly between developers on the IRC channels. Code is shared, testing is provided, and information is passed between the channel inhabitants with very little contractual obligation to comply. Instead, it is the expectation of future benefits from the other participants that appears to drive this sharing.

The accumulation of goodwill and prestige within a social system can be defined as a form of symbolic capital . Along with the trust and obligations, the various members of the team have developed levels of legitimacy and social status as the project takes shape. As the software has taken shape, the heightened interest by outsiders has led to invitations for the staff and developers to make presentations about the project at library conferences and professional meetings throughout North America. This capital can be exchanged for other forms of capital at a later point . For instance, the status an external individual attains because of his/her recognition as a member of the ecosystem may in fact be convertible into economic capital if GPLS needs to hire a new staff member.

Organizational Capital is the accumulation of routines and processes by an organization or group. This capital is generated through the codified documents and procedures that arise over

time as particular ways of working are routinized. The current processes reflect the ideal operation of the librarians as well as the capabilities of the underlying ILS software. Because the ILS is an integral part of many of the functions of the libraries' operations from online catalogs to patron fines to circulation reserves, the system heavily influences the actions of the librarians. It is these actions and procedures that the new system must account for and incorporate. These procedures are not always incorporated verbatim, especially workarounds that were created because of the limitations of the current system. The staff has been trying to convince the librarians to "try to think outside of the way we do things now." As such, many new policies may need to be changed as the new system is incorporated. Many of these policy changes must be approved by the PINES executive committee before being incorporated into the software. Thus, the organizational capital must be generated from the capabilities of the system but must be regenerated in many cases once the system is complete.

B.4 Functional Outputs

There are two primary functional outputs within the ecosystem: the Evergreen software and the services required by the other members of the ecosystem in support of the software. These services include training, implementation, troubleshooting, and more. We discuss these further in this section.

The Evergreen software is currently released in pre-beta, with the full rollout implementation to each of the libraries (as well as several others that are awaiting completion of the software) scheduled for later this year. The software is built on top of a number of other open source components. According to the developers, "part of the original rationale for going open source [as opposed to a proprietary solution] was the availability of OSS components such as Spidermonkey, XUL, and more." By utilizing the efforts of others, the developers were able to

produce working code quicker and more efficiently. In return, the developers contribute code out to the greater community. One of the developers rewrote portions of the Jabber server while another wrote an interface using OpenSearch for the library OPAC. As such, the staff has established themselves as trusted members of the overarching library technical community.

The training will be provided originally by the PINES staff to the library directors. These directors (or their staff) will in turn provide the training to the rest of their staff. Because the system is designed to be intuitive and the various staffs are already used to a similar system, it is believed that the training will be much easier than the original training by the vendor of the current system. Similarly, the implementation processes will be provided by the librarians or their staff. The current system is supported by a help desk that will transition over to the new system. However, much of the help will be provided by other users via the mailing lists or via personal contacts.

B.5 Resilience

The final component of ecosystem health is resilience, which is the capacity to resist stresses that could prove to affect the vigor and organization of the system and the ability to respond to changes that exceed this resistance . This resilience can be manifest as the sustainability or stability of the system, predictability in terms of the expected future outcomes, or growth in the capital circulated and accumulated within the system. For organizations, resilience depends upon several characteristics, including surplus resources, flexibility, commitment, coordination, and leadership . Processes that promote resilience are typically emergent and adaptive .

In the Evergreen project, resilience is enacted through the availability of resources to meet the challenges that arise. In many respects, the existence of the project is the end result of

an emergent process that enabled GPLS to code the software in response to the perceived inability of the current vendor to meet its operational needs. Rather than continuing to operate in a manner that required constant workarounds and adjustments, the decision was made to create a system which could be tailored to fit the specific needs of a large library consortium such as PINES.

One of the possible stresses that may arise in this ecosystem is the loss of a developer.⁵⁵ There is a significant investment in training each of the developers to enable them to understand the processes embodied in the PINES system. If a developer leaves, there would presumably be a reduced contribution of human capital toward development, support, and training. There may also be a reduced level of symbolic capital as the loss increases concerns that the project may not be completed as promised.

Unlike many OSS projects, the ability of the GPLS as the sponsoring organization to hire a new developer from the library developer community reduces the risk of this stress. The external community has a reasonable degree of awareness in the progress and features of the software because of the open nature of open source projects. As stated by the Deputy State Librarian in a memo shortly after the project was first announced, deploying the software under an open source license eliminates being locked into the specific developers.

“[O]ur open system will be owned by GPLS and we will be free to hire other developers and system administrators to further develop or maintain the system if required. ... By fostering a worldwide community around our software, we’re actually creating outside expertise in the system, and safeguarding our future.”

⁵⁵ This is strictly a hypothetical exercise. I certainly know of no immediate reason that any of the developers would be considering leaving at this time.

In other words, the system enables resilience by retaining ownership of the code, having sufficient and surplus resources, and maintaining the social contacts (structural social capital) to be able to access the skills necessary to replace the lost capital contributions.

It is also beneficial that there are no reasonable alternatives for the librarians in case of any problems with the development process. Each individual librarian could conceivably decide not to utilize the new system, but a replacement would be significantly more expensive (especially compared to the ‘free’ deployment of PINES or Evergreen). Were there another inexpensive, fully supported alternative, the individual library systems might have more incentive to consider abandoning the project altogether. Instead, the lack of such an alternative would induce a commitment by both parties to achieve a working solution together. In the worst case, major portions of the software itself would need to be rewritten, but there is little chance of it being dropped altogether based on the current successes.

Appendix C: Interviewee List

(Interviewee List omitted for confidentiality)

Appendix D: Sample Interview Guide and Consent Script (BComp)

Interview Guide

1. What is your overall impression of the quality of the BComp ecosystem so far?
2. What contribution do you make to the operation of the ecosystem?
3. What is the biggest advantage or benefit that you receive as a member of this ecosystem?
4. How do you communicate with the developers?
5. How do you communicate with other users?
6. How do you communicate with the core team?
7. I have identified the following list of events that have occurred within the BComp ecosystem in the past. Can you recall any others which are not on this list?

Initial founding of the company

Acquisition of JSoft, KSoft, (other companies)

VC funding

Todd Mayweather, other executives joining company

First certified release

Sourceforge Project of the Month

8. In your opinion, which of these have been the most significant events in terms of the effect they have had on the functionality and health of the ecosystem? Why?

(For each of the most significant events)

9. What was the original stress that led to the occurrence of this event?
10. What caused that stress to occur?
11. How did you and your organization react to this stress?
12. How did other members' reactions affect your reactions?
13. How did this stress affect the flow of human capital from your perspective? (or economic, social, symbolic, or organizational capital – must define each during the interview)
14. What was the eventual outcome? How did this stress affect your level of contribution and participation?

Interview Consent Script

Thanks for taking the time to talk with me today.

This interview is a part of my dissertation research into the health of open source ecosystems. As a member of the BComp ecosystem, your experiences and opinions are valuable with respect to the health. I am looking to understand more about your experiences with respect to your participation in the ecosystem and your observations regarding the operation of the ecosystem as a whole.

In the context of the present study, OSS ecosystems can be defined as *an arrangement of individual and organizational units, involved in or affecting the circulation, transformation, and accumulation of capital (in various forms) in order to provide cooperative development, testing, marketing, distribution, implementation, and support of OSS*. By capital, we not only include economic capital, but other capital types such as knowledge, routines, reputation, social contacts, and more. I am interested in how you and your organization acquire this capital from the ecosystem and what contributions you provide to the ecosystem. I am especially interested in how this has changed over time in response to various stresses that you may have encountered. Thus, I would like you to prepare for our interview by considering any changes in the ecosystem that led to changes in how you (and your organization) chose to participate and extract value from this participation.

I anticipate our interview taking approximately an hour of your time. During that time, I would like to tape record our interview in order to ensure that your responses are accurately noted. The recording will be transcribed upon completion of the interview, at which time you will be sent a copy of the transcript to review for any errors that may have been made. Any changes you make will be incorporated. The information attained in this research project may be published or used in further studies, but that information will not be attributed to you (upon your request).

If you have any further questions about this study at any point during the course of the research project, please contact either myself (dewynn@uga.edu), Dr. Richard Watson (rwatson@terry.uga.edu, 706-542-3706), or Dr. Marie-Claude Boudreau, (mcboudre@terry.uga.edu, 706-583-0887).

Again, thanks for agreeing to participate in this research study!

Donald Wynn, Jr.
Primary Researcher
MIS Dept,
312 Brooks Hall
Athens, GA 30602

Appendix E: Current Theoretical Framework and Coding Guidelines

The premise of my dissertation is that we can assess the health of a technological ecosystem in a similar way to that of biological ecosystems. An ecosystem can be defined in a number of ways. However, at its core, an ecosystem “involves the circulation, transformation, and accumulation of energy and matter through the medium of living things and their activities” . This definition includes the flow of materials and energy among the various living including non-living components such as water, air, soil . As a metaphor, business and technological ecosystems provide a rich, informal term which allows stakeholders to easily view their roles in a holistic view of a given network of relationships. Thus, OSS ecosystems can be defined in the context of the present study as *an arrangement of individual and organizational units, involved in or affecting the circulation, transformation, and accumulation of capital (in various forms) in order to provide cooperative development, testing, marketing, distribution, implementation, and support of OSS.*

In this study, we propose to identify the mechanisms through which open source ecosystems are able to establish and maintain a state of health (as dimensionalized by vigor, organization, and resilience). An assessment of these items can best be accomplished through studies which seek to isolate the effects of specific events (or *stresses*) on the health of the ecosystem. We will develop and refine a theoretical model of OSS ecosystems and ecosystem health based on an analysis of various stresses and their effects which have taken place in two different OSS ecosystems. We will now examine several aspects of our preliminary theoretical model and the identify codes which are suggested.

Ecosystem Health

Healthy ecosystems enable both the production of functional outcomes and benefits and the accumulation of these benefits by contributing members. In ecology, the concept of ecosystem health is a multidimensional one, encompassing aspects such as the vigor, organization, and resilience . Specifically, ecosystem health implies that the ecosystem can maintain its structure (organization) and aggregate function (vigor) in the face of external stress (resilience). We now examine these dimensions in more detail.

Organization

The organization of an ecosystem includes the structure and diversity of units and the interactions between them. A highly organized ecosystem evolves into an increasingly diverse set of specialists with an equally diverse set of exchange pathways . Less organized ecosystems will have fewer unit types or fewer interactions between them. The key lies in the capacity of an ecosystem to efficiently communicate and transport resources as the members diversify into specialized roles including core contributors, suppliers, partners, complementary vendors, distributors, customers, and even competitors. The interaction between these members is determined by the existence and strength of formal and informal arrangements, norms, intraorganizational structures, coordination efforts, etc. Additionally, our model theorizes that the ecosystem consists of a developer-oriented community and a user-oriented community. These communities are interdependent upon each other and upon the POS firm itself for their survival (see figure 1).

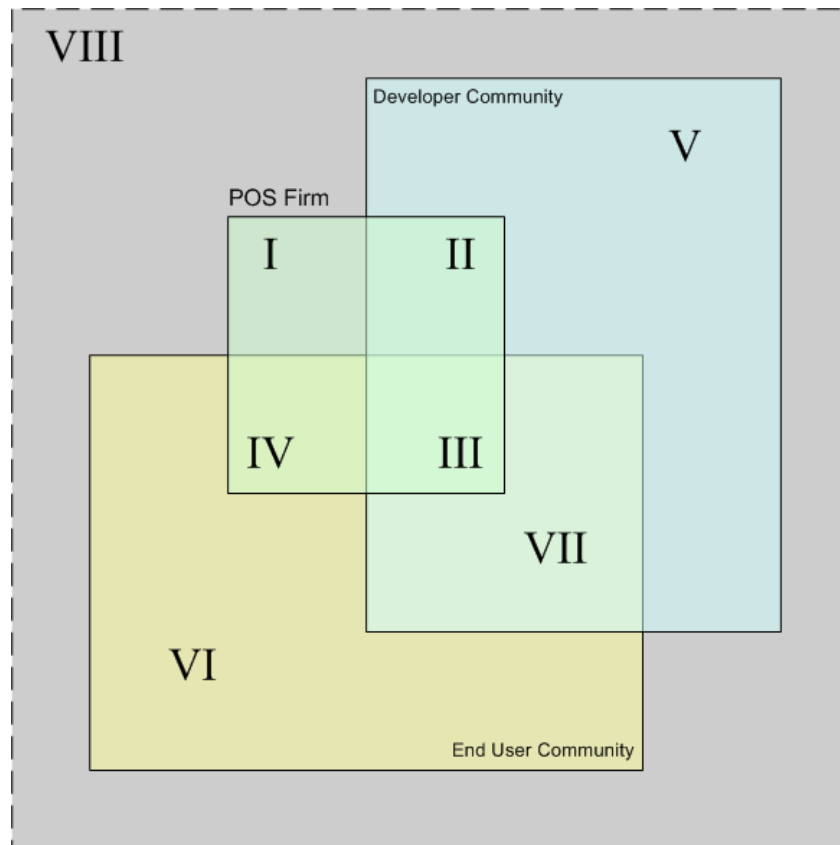


Figure 1: Ecosystem and Community Grid

Codes this suggests:

- Specific Units
 - Developer [UnitDev]
 - User [UnitEndUser]
 - Sponsor/Investor [UnitSponsor]
 - Mgmt Team [UnitMgmt]
 - POS Firm itself [UnitPOSFirm]
 - Developer community [UnitDevComm]
 - User community [UnitUserComm]
 - Competitor [UnitCompetitor]
 - Partner – if the specific arrangement is unspecified [UnitPartner]
 - ISV – independent software vendor [UnitISV]
 - OEM [UnitOEM]
 - Supplier [UnitSupplier] – including components included in the finished product
 - ...other units as encountered
- Frequency of Interaction [InteractionFreq]

Vigor

The purpose of an organization is to combine and coordinate the resource contributions of a number of individuals and groups of individuals toward *specific functional outputs*. These contributions as well as the resulting inducements can be classified as different forms of *capital*, including social, symbolic, human, organizational, and economic capital (see table in appendix). This capital is acquired, converted, combined, and distributed throughout the ecosystem by the units themselves. The functional outputs produced in software ecosystems include the software and source code as designed and coded by the developers. It also includes services required by the other members of the ecosystem such as training, installation, testing, maintenance, and support. As such, vigor is the throughput or productivity of the ecosystem, consisting of both the functional outputs produced by the members of the ecosystem and the capital resources contributed to produce them. Within our conceptualization of an ecosystem, units contribute to the ecosystem by either contributing capital or resources or converting between the various forms of capital and resources. These units acquire and accumulate this capital and resources for their current or future usage. Units may also exchange resources and capital as one side of a given transaction contributes them and the other acquires them.

Codes this suggests:

- Capital Types (see table in appendix)
 - Economic [EconCap]
 - Human [HumCap]
 - Social [SocCap]
 - Symbolic [SymCap]
 - Organizational [OrgCap]
- Functional Outputs
 - Software code (computer language and modules written by the developers) [FOutSW]
 - Software application (the actual product being developed) [FOutAppl]
 - Perks (clothing, mugs, travel, etc. – goods used as incentive) [FOutPerks]
 - Documentation [FOutDocum]
 - Services

- User support [SvcSupport]
- Testing [SvcTest]
- Training [SvcTrain]
- Maintenance [SvcMtce]
- Suggestions / requests [SvcSugg]
- ...other services as required [SvcOther]
- Functions
 - Innovation and Software Development [FuncInnov]
 - Marketing [FuncMktg]
 - Distribution [FuncMktgDist]
 - Sales [FuncMktgSales]
 - ...other functions as required [FuncOther]
- ...Other functional outputs as required [FOutOther]

Resilience

The resilience of an ecosystem is its “ability to maintain vigor and organization in the presence of stress” . In other words, a resilient system maintains its structure and exchange relationships (organization) in order to continue combining resources and producing outputs (vigor) following perturbations to the entire system or individual units. The ecosystem may not return to its exact structure or level of output after the stress, but may have to establish a new pattern to adapt to the changing environment. For business and technological ecosystems, resilience refers to the ability of the members to successfully adapt to extenuating circumstances , including both the ability to resist the effects of stress as well as the ability to recover from any ill effects that may result. As such, resilience can be measured in terms of the nature of both the initial stresses and the resulting actions by members of the ecosystem. The model of ecosystem resilience that we propose is based on a stage model of change as presented below.

There are five general phases associated with changes in the health of an ecosystem, as typified by the diagram in Figure 2. These phases are bracketed by near-equilibrium states on either end in which the needs of the participants are balanced with the production and availability of capital required to meet these needs. These states are considered antecedent to change and typically

arise over time as a result of self-organization and negotiation on the part of the units in the ecosystem. The end result of these change phases is an additional antecedent phase which may only be a transitory state preceding the next change. We also note that these states are not truly at equilibrium as we expect the degree of change to be continuous, complex, and interrelated.⁵⁶

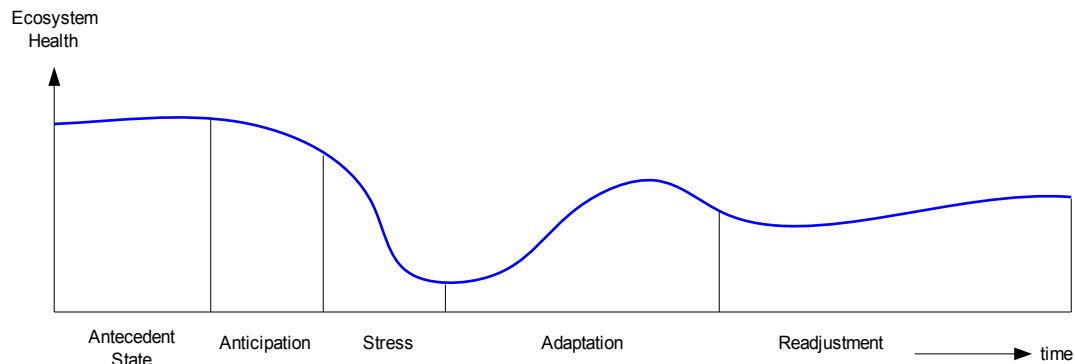


Figure 2: Phases of Change in Ecosystem Health (negative change)

In anticipation of any stresses or changes that may occur, an anticipation phase may exist in which the units of the ecosystem detect and prepare for future stresses that may be perceived as a result of efforts to monitor the health of the ecosystem (Meyer, 1982). The plans developed at this point are often the result of ‘what-if’ analyses and are designed to be executed in response to potential stresses. In other words, the mechanisms which are enacted upon the occurrence of a stress are often planned and designed in advance by anticipating the resources and routines that will be needed should a given situation arise.⁵⁷ Of course, many of the stresses for which the

⁵⁶ Complexity researchers argue that there is no such thing as equilibrium in organizations and other complex systems for these various reasons.

⁵⁷ Note the similarity to dynamic capabilities here (see Teece, D. J., G. Pisano, and A. Shuen (1997) "Dynamic capabilities and strategic management," *Strategic Management Journal* (18) 7, pp. 509-533).

units of the ecosystem strategically prepare may never actually occur. However, this foresight is a key function of an organizational unit. In the case of endogenous change, this preparation and planning is the responsibility of the agent responsible for initiating this change about, which often is the central units responsible for the regulation, control, and growth of the ecosystem.⁵⁸

The stress itself triggers changes in the health of the ecosystem. This stress is defined for us as *any event which positively or negatively alters the health of an ecosystem as dimensionalized by its vigor, organization, and resilience*. This includes changes in the amount of capital produced or otherwise available, the pathways through which this capital flows, the material goods or services provided, the overall structure of the ecosystem, the efficiency by which it operates, or the ability to devise and execute plans to respond to future stresses.

Following the occurrence of endogenous or exogenous stresses, there follows a period of adaptation⁵⁹ in which the various units must renegotiate their position within the ecosystem to match the resultant changes. This may require simple execution of contingency plans or a wholesale reorganization of the ecosystem depending on the degree of change initiated by the stress. For instance, the attainment of venture capital by BComp initiated very little change within the ecosystem since it had already been anticipated, whereas the RDT fork initiated several structural and operational changes within the MComp ecosystem.

⁵⁸ Thompson (1967) argued that this was typically done within an administrative layer which buffers the internal layers of the organization against the fluctuations that exist in the environment. Similarly, we propose that the management team of the commercial open source firm at the center of the ecosystem is the ‘outer layer’ that interfaces the most with the environment and shields the technical core, here the internal and external developers, from many external influences.

⁵⁹ Or ‘transition’ according to Lewin(1947)’s model.

For many sudden external events, adequate contingency plans may not exist. The precursors that foreshadow these jolts may either be non-existent or simply overlooked by the members of the ecosystem. In these cases, the stress itself triggers the planning activities conducted within the ecosystem (and thus, the duration of the anticipation phase as shown in Figure 2 would be significantly shorter or perhaps even nonexistent with respect to the particular stress encountered). As such, an ad hoc response must be developed to address the demands of the new system parameters. In still other cases, the stress may not be detected even after it has already occurred.⁶⁰

Lewin (1947) argued for a change model that consisted of three states: unfreeze, change, and refreeze. The stress has the effect of ‘unfreezing’, or altering the near-equilibrium and introducing a degree of uncertainty and discomfort among the members of the ecosystem. With proper execution of endogenous change, much of the uncertainty can be avoided by making the previously developed plans known throughout the ecosystem in order to enable them to devise their own plans for adapting to the changing environment. For instance, BComp made their plans to obtain VC funding known as early as their first white papers on the subject. This cushioned the reactions by the various users and developers when the first rounds of funding were obtained. By comparison, the surprise fork of the developers in the MComp ecosystem was so sudden that

⁶⁰ Diamond (2004) theorizes that complex societies collapse as a result of either failure to anticipate a stress, failure to perceive a stress that has already occurred, failure to attempt to solve a perceived problem due to individual interests acting with no regard for the collective (i.e. the tragedy of the commons), and failure to solve a problem due to lack of resources or a late response. It is easy to map these possibilities to commercial organizations as well.

no prior plans existed and as a result, there were several days of uncertainty among the various members within the ecosystem as the response planning was carried out.

Following this adaptation phase, the various units have renegotiated their relationships within the ecosystem. The next phase, readjustment (or refreezing), enables the system to restore a new near-equilibrium point. Note that this is not likely to be same degree of health as before. This may be true for very simple, low-impact stresses (such as single units joining the ecosystem), but for most stresses there is a high likelihood that the vigor, organization, and resilience of the organization will be different from the antecedent stages. Using our preceding example, the venture capital funding had a very significant impact on the ecosystem in terms of both reputation (symbolic capital) and financial capital. Thus, after the planned stress was initiated, the ecosystem adjusted to the new capital availability and organizational structure and the health of the ecosystem was significantly altered. Conversely for MComp, the fork of the RDT developers eventually fell apart and new people were brought in to replace the work previously assigned to them. Several members of the ecosystem did not see the fork as a significant event since it had little effect on their operations and plans. As a result, the fork had less impact on the health of the organization than originally anticipated.

Change Types

We expect that the stresses will affect the health of an ecosystem through their impact on its organization, vigor, and resilience. A non-mutually exclusive typology of these stresses will therefore include at least those that affect the structure and relationships (particularly exchange relationships) throughout the ecosystem, number and diversity of members within the ecosystem, and the specific levels of capital resources available in the ecosystem. In this section, we treat

each of these individually although it is apparent that a specific event may subsequently or simultaneously affect more than one of these.

There are several types of stress that may act upon the structure and relationships between members of an ecosystem. For example, a fork is an attempt to change the relationships between a group of developers and the rest of the ecosystem, effectively creating new pathways through which resources would be exchanged. Similarly, the acquisition of an open source component that was already being deployed within an application is a change in the relationship between the hired developers of the component and the acquiring firm. As with many other types of stresses, the actual stress may result in a change in membership or resource availability as the ecosystem attempts to adapt to these changes.

Membership changes are often gradual and emergent in nature. For instance, as a firm grows it requires the services of a larger workforce to meet the growing demands within its production workflows. However, other changes are more sudden in nature such as the departure of a key contributor or acquisition of a customer. When BigWare announced its support and sponsorship of the Utopian web server project, there was a significant positive impact on the health of that entire ecosystem. Conversely, when Great Bridge, LLC closed down 16 months after receiving \$25M in venture capital to “market commercial products, services and support for PostgreSQL”⁶¹, there was a significant negative impact on the health of Postgres ecosystem (although it certainly survived). Other anecdotal examples include Oracle’s decision to offer contracts to OpenSoft Linux customers, hiring executives into commercial open source firms (e.g. the hiring of Bill Coleman at MComp), and taking on venture capital finding (which also increases the available resources as discussed in the next paragraph). Changes in membership are

⁶¹ See <http://news.com.com/2100-1001-272715.html>.

significant not only for the resources they add or delete from the ecosystem, but also for the impact they have on subsequent evolutionary or revolutionary changes in the ecosystem.

BigWare is thus significant in the Utopian ecosystem not only because of the human capital (developers) and financial capital (sponsorship) that it provides but also because of the impact it may have on changes in the strategic direction and goals of the project going forward.

Aside from membership or relationship changes, the amount of resources available to the members of an ecosystem may also be a source of stress within the ecosystem. As mentioned previously, changes in resource level include adding venture capital funding (increases not only the financial resources, but also the social and symbolic capital) and acquisitions (which increase the available organizational and human capital).

Codes this suggests:

- Stress (initial triggers that cause a given reaction to occur)
 - Endogenous / Exogenous source [EndoStress] [ExoStress]
 - Eustress (positive stress) or Distress (negative stress) [Eustress] [Distress]
 - Planned / Unplanned [PlannedStress] [SuddenStress]
- Stage (phase in the resilience model that a given action occurred)
 - Antecedent (prior to any change occurring) [Anticipation]
 - Anticipation (becoming aware of and/or planning for possible stress) [Anticipation]
 - Stress (the triggering event itself) [Trigger]
 - Negotiation (the repositioning of members in response) [Negotiation]
 - Readjustment (attempting to return to an equilibrium state) [Readjustment]
- Actions (steps taken by members of the ecosystem)
 - Prevention (actions taken to prevent future stresses) [ActPrevent]
 - Initiation (actions taken to create stresses) [ActInitiate]
 - Detection (actions taken to identify and be aware of stresses) [ActDetect]
 - Planning (actions taken in preparation for a stress) [ActPlanning]
 - Evaluation (actions taken to assess the impact of stresses) [ActEval]
 - Correction (response actions taken to mitigate negative effects of stresses) [ActCorrect]
 - Catalyst (response actions taken to encourage positive effects of stresses) [ActCatalyst]
- Result (outcome of the particular stress and reaction)

- Overall Evaluation
 - Positive [OutcomePositive]
 - Negative [OutcomeNegative]
- Change (Type of change that happened)
 - Membership (change in the membership of the ecosystem) [ChgMember]
 - Resources (change in the resources available within the ecosystem [ChgResources])
 - Relationships (change in the structure and relationships of the ecosystem)
 - Exchange pathways (chgs in the direction of resource flows) [ChgExchange]
 - Appropriations (changes in the levels of resource flows) [ChgFlows]
 - Stability (changes in the stability of relations, e.g. contracts) [ChgStability]
 - Other changes as encountered

Appendix F: Distribution to MComp Shareholders following OpenSoft Acquisition
(Names omitted for confidentiality purposes)

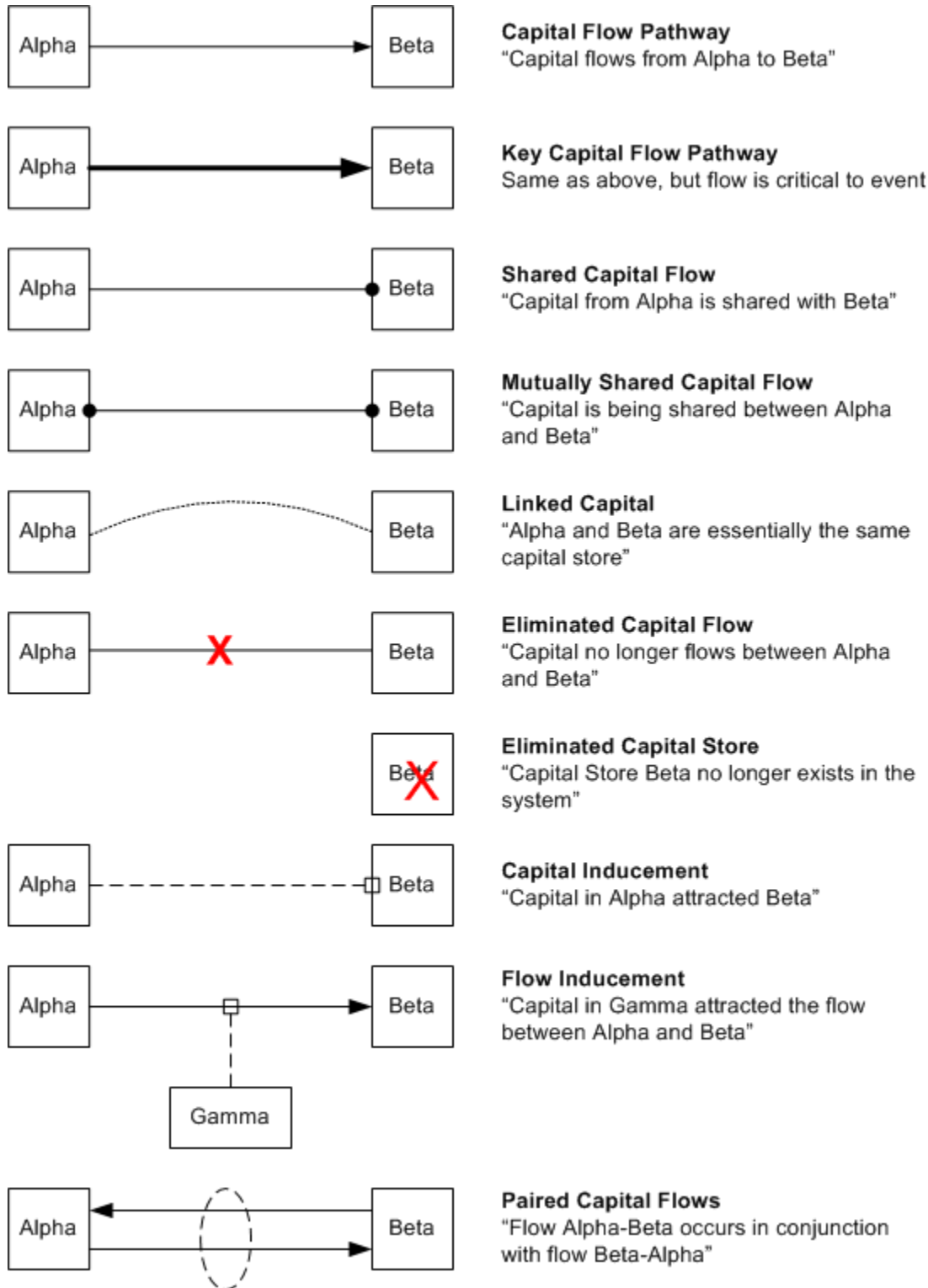
	Number of MComp Shares	% of Shares	Value of RHT Shares	Value of Cash	Value of Total Distribution	Recipient Name	Position
Founders	712,439	10.65%	\$ 20,489,746	\$ 13,885,671	\$ 34,375,417		
	1,570,702	23.48%	\$ 45,173,390	\$ 30,613,500	\$ 75,786,889		CEO
	466,561	6.97%	\$ 13,418,294	\$ 9,093,428	\$ 22,511,722		Dir of Communications
	485,242	7.25%	\$ 13,955,560	\$ 9,457,526	\$ 23,413,086		ex-CTO, VP Technology
	3,234,944	48.36%	\$ 93,036,989	\$ 63,050,124	\$ 156,087,114		
Investors	77,181	1.15%	\$ 2,219,726	\$ 1,504,283	\$ 3,724,009		
	43,268	0.65%	\$ 1,244,388	\$ 843,308	\$ 2,087,695		
	347,314	5.19%	\$ 9,988,751	\$ 6,769,264	\$ 16,758,015		
	45,368	0.68%	\$ 1,304,784	\$ 884,237	\$ 2,189,021		
	65,450	0.98%	\$ 1,882,342	\$ 1,275,642	\$ 3,157,984		
	47,151	0.70%	\$ 1,356,063	\$ 918,989	\$ 2,275,051		
	1,635,174	24.44%	\$ 47,027,604	\$ 31,870,080	\$ 78,897,684		
	29,791	0.45%	\$ 856,789	\$ 580,636	\$ 1,437,426		
	607	0.01%	\$ 17,457	\$ 11,831	\$ 29,288		
	6,814	0.10%	\$ 195,971	\$ 132,807	\$ 328,778		
	2,298,118	34.35%	\$ 66,093,874	\$ 44,791,077	\$ 110,884,951		

	Number of MComp Shares	% of Shares	Value of RHT Shares	Value of Cash	Value of Total Distribution	Recipient Name	Position
Mgmt Team	6,721	0.10%	\$ 193,296	\$ 130,995	\$ 324,290		Board of Directors
	126,021	1.88%	\$ 3,624,364	\$ 2,456,191	\$ 6,080,555		COO
	160,654	2.40%	\$ 4,620,409	\$ 3,131,199	\$ 7,751,608		EVP
	44,488	0.67%	\$ 1,279,475	\$ 867,086	\$ 2,146,561		Director of Support
	7,174	0.11%	\$ 206,324	\$ 139,824	\$ 346,148		VP of Product Management
	41,309	0.62%	\$ 1,188,047	\$ 805,126	\$ 1,993,173		VP of Worldwide Channels
	35,877	0.54%	\$ 1,031,823	\$ 699,255	\$ 1,731,077		Dir of Channels
	8,768	0.13%	\$ 252,168	\$ 170,891	\$ 423,059		Dir of Marketing
	27,112	0.41%	\$ 779,741	\$ 528,422	\$ 1,308,163		VP of Services
	109,314	1.63%	\$ 3,143,871	\$ 2,130,566	\$ 5,274,437		VP End User Sales, Americas
	43,053	0.64%	\$ 1,238,204	\$ 839,117	\$ 2,077,321		CFO
	610,491	9.13%	\$ 17,557,721	\$ 11,898,671	\$ 29,456,392		
Development Core	51,262	0.77%	\$ 1,474,295	\$ 999,113	\$ 2,473,408		Chief Architect
	195,126	2.92%	\$ 5,611,824	\$ 3,803,070	\$ 9,414,894		GM, MComp Europe
	39,478	0.59%	\$ 1,135,387	\$ 769,439	\$ 1,904,827		Training Director
	285,866	4.27%	\$ 8,221,506	\$ 5,571,623	\$ 13,793,129		

	Number of MComp Shares	% of Shares	Value of RHT Shares	Value of Cash	<i>Value of Total Distribution</i>	Recipient Name	Position
Hired Proj Leads	6,845	0.10%	\$ 196,862	\$ 133,411	\$ 330,274		
	25,859	0.39%	\$ 743,705	\$ 504,000	\$ 1,247,705		
	3,540	0.05%	\$ 101,810	\$ 68,996	\$ 170,806		
	37,173	0.56%	\$ 1,069,095	\$ 724,514	\$ 1,793,609		
	12,733	0.19%	\$ 366,201	\$ 248,170	\$ 614,371		
	86,150	1.29%	\$ 2,477,674	\$ 1,679,092	\$ 4,156,766		
RDT Partners	168	0.00%	\$ 4,832	\$ 3,274	\$ 8,106		
	2,352	0.04%	\$ 67,644	\$ 45,841	\$ 113,485		
	268	0.00%	\$ 7,708	\$ 5,223	\$ 12,931		
	2,788	0.04%	\$ 80,183	\$ 54,339	\$ 134,522		
Sub Totals (N=36)	6,518,357	97.44%	\$ 187,467,947	\$ 127,044,926	\$ 314,512,873		
108 other recipients	171,063	2.56%	\$ 4,919,772	\$ 3,334,074	\$ 8,253,846		
Totals	6,689,420	100.00%	\$ 192,387,719	\$ 130,379,000	\$ 322,766,719		

- Notes:**
1. Information from RHT Prospectus Supplement (Form 424B7) filed with SEC on 9/11/2006
 2. MComp shares include outstanding common, preferred, and restricted shares and vested options
 3. Figures do not include potential "earn-outs", which would be approximately 20% more
 4. Final values not validated with any recipients due to privacy concerns, thus must be considered reasonable estimates
 5. Additional information obtained from RHT Forms 8-K (filed 4/7/2006), 8-K/A (filed June 2, 2006), and 8-K (filed 6/8/2006)

Appendix G: Legend for Capital Flow Diagrams



The diagrams also show the effect of each flow on the capital types at the endpoints. A '0' indicates that there is no change to the level of capital, a '+' indicates that the level of capital is increased, and '-' indicates that the level decreased. Combining the effects for both ends of a two-way interaction between capital types, we can define the type of relationship that exists between them based on similar definitions of species interaction in an ecosystem.



Neutral

The flow has no effect on Alpha or Beta .



Commensalistic

Capital in Beta is increased , but there is no effect on the Capital in Alpha .



Parasitic

Capital decreases in Alpha as it increases in Beta.



Mutualistic or Synergistic

Capital in both Alpha and Beta increase as a result of the flow.



Amensalistic

Capital in Beta is decreased , but there is no effect on the Capital in Alpha .