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Distributing intelligence and organizing diversity in new-media projects[†]

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Abstract. In this paper we examine how web-design firms in the new-media industry probe and experiment with possible forms and sources of value that give shape to the new economy. Focusing on the collaborative engineering of cross-disciplinary web-design project teams, we examine how websites emerge as provisional settlements among heterogeneous disciplines as they negotiate working compromises across competing performance criteria.

Construction sites

Through the 1990s, construction sites in Manhattan grew in number; this growth accelerated to a peak in the spring of 2000. But although these new construction sites had subcontractors, they had no cement; they had architects, but no steel; they had engineers and designers and builders who built for retail firms, financial services, museums, government, and cultural institutions, but no one ever set foot in their constructions. These architects were information architects, the engineers were software and systems engineers, the designers were interactive designers, and the builders were site builders—all working in the Internet consulting firms that were the construction companies for the digital real estate boom that marked the turn of the millennium.

From the spring of 1999 through the spring of 2001 we were fortunate to be able to observe one of these start-up firms and watch its website construction projects, not through a plexiglass peephole, but close-up as ethnographic researchers. What we found, in almost every aspect, was a project perpetually 'under construction'. At the same time that the software engineers and interactive designers were constructing websites, they were also constructing the firm and the project form. And this relentless redesign of the organization was occurring simultaneously with the construction, emergence, consolidation, dissipation, and reconfiguration of the industry itself. 'What is new media?' This was the question we encountered numerous times scribbled on whiteboards in brainstorming sessions during or just prior to our meetings in various interactive companies. Or, as one of our informants posed the question, "People are always trying to come up with a metaphor for a website. Is it a magazine, a newspaper, a TV commercial, a community? Is it a store? You know, it's none of these ... and it's all of these and others, in many variations and combinations. So, there's endless debate." Of one thing you could be certain: if you were sure you knew the answer, then the pace of organizational innovation to make new business models, the pace of technological innovation to make new functionalities, and the pace of genre innovation to

make new conceptualizations had likely combined to make your answer already obsolete.

What is a new-media firm? In answering the question, the start-ups did not start from scratch. The form of the firm and the shape of projects were borrowed from previously existing models. Many were shaped around the consulting-firm model; others adopted the model of an architectural firm, an advertising agency, a film or television studio, a software engineering company or systems integration company, a design studio, a venture-capital firm, or the editorial model of a magazine. Forming the basic template, these models were repurposed for new functionalities as well as recombined for new purposes (for example, consulting model plus systems integrator, media production studio plus venture-capital model, etc).

But, whatever the choice of model (and note that, with few exceptions, most firms studiously avoided the 'construction company' moniker), every new-media firm that was in the business of constructing websites had to cope not only with the problem that the field was in flux but also with the fact that every successful innovation, in carving a niche, creating a new product, defining a new business model, or introducing a new technology, could be replicated by competitors. Unlike other high-tech firms in fields such as biotechnology, where patents could protect intellectual property, in the new-media field innovations were not likely to yield a stream of rents. Under circumstances of low barriers to entry (because innovations—in genre, technology, and organization—could be easily assimilated), firms were forced to be relentlessly innovative.

Thus, firms could not prosper simply by learning from their construction projects. It was not enough to master the project form, to codify, routinize, or even perfect what they had been doing. If you locked in to what you had done previously, regardless of how much you improved performance by your existing criterion, you would be locked out of markets that were changing rapidly. On the other side, if you spent all your organizational resources searching for new products and processes, always and everywhere exploring for new opportunities, you would never be able to exploit your existing knowledge. For the new-media companies, March's (1991) problem of 'exploration versus exploitation' could be rephrased as the problem of staying ahead of the curve without getting behind on your deadlines.

When firms are coping with complex foresight horizons (Lane and Maxfield, 1996), where dislocations can be anticipated in general but are unpredictable in their specific contours, we find them perpetually poised to pursue innovation. They build organizations that are not only capable of learning but also capable of suspending accepted knowledge and established procedures to redraw cognitive categories and reconfigure relational boundaries—both at the level of the products and services produced by the firm and at the level of the working practices and production processes within the firm. Our attention is drawn to organizations that innovate in ways that allow them to recognize, redefine, recombine, and redeploy resources for further innovation. In other words, these organizations 'invest in forms' (Thevenot, 1984) that allow for easy reconfiguration and hence minimize the costs of 'divestment' or reorganization. Such capacities for organizational innovation go beyond the discovery of new means to carry out existing functions more effectively and efficiently. Under conditions of radical uncertainty, organizations that simply improve their *adaptive* fit to the current environment, risk sacrificing *adaptability* in subsequent dislocations (Grabher, 1997; Grabher and Stark, 1997).

Organizational ecologists have long held that adaptability is promoted by the diversity of organizations within a population. The perspective adopted here, by contrast, is that adaptability is promoted by the *organization of diversity* within an enterprise.

The adaptive potential of organizational diversity may be most fully realized when different organizational principles coexist in an active rivalry *within the firm*. By rivalry, we do not refer to competing camps and factions, but to coexisting logics and frames of action. The organization of diversity is an active and sustained engagement in which there is more than one way to organize, label, interpret, and evaluate the same or similar activity. Rivalry fosters cross-fertilization. It increases the possibilities of long-term adaptability by improving search—improved because the complexity that it promotes and the lack of simple coherence that it tolerates increase the diversity of options.

We explore these themes by examining the collaborative interactions among the multidisciplinary project teams working in a Silicon Alley new-media firm. We begin by establishing the highly uncertain environment within which new-media firms operate, with the paramount uncertainty being the shifting content, parameters, and value of the new-media industry itself. What is the meaning and where is the value of new media? We then sketch the organizational features required of new-media firms to deftly reassess the shifting terrain and adjust their positioning and strategy. Most salient among these features is the organization of diversity through lateral accountability, properties constitutive of a new mode of organizing that we characterize as *heterarchy*. We then explore the dynamics of heterarchical organization by examining the process of collaborative engineering involved in the construction of websites. Prominence given to the competing evaluative and performance criteria specific to the multiple disciplines is matched by a scaling back of administrative hierarchy. In place of directives, the multiple disciplines engage in a discursive pragmatics in which the disciplined judgment needed to do a good job is balanced with the compromise needed to get the job done. Sharing the responsibility for getting the work done, one fights to promote the values of one's discipline, but one yields out of allegiance to the project and the firm. By distributing authority, the firm yields control of disciplined argument but wins the competitive edge that results by cultivating a diversity of options in the face of uncertainty.

An ecology of value
Silicon Alley: new firms in an uncertain environment
Silicon Alley is a (post)industrial district that can be thought of first as a place, running south of 41st Street along Broadway through the Flatiron District and SoHo into Chelsea and down to Wall Street. But it is also, and just as importantly, a social space between Wall Street and Midtown, linking the financial district to the traditional big advertising firms and the traditional big media companies in broadcasting and publishing. In this case, the physical place and the social space are, not coincidentally, isomorphic. By 1999, new media was one of New York's fastest growing sectors, with almost 100 000 full-time equivalent employees in Manhattan alone (that is, more than the city's traditional publishing and traditional advertising industries combined) and with an estimated 8500 new-media companies in the larger New York City area. In that same year, the New York new-media industry produced revenues of $16.8 billion and generated $1.5 billion in venture-capital funding and $3.5 billion in IPO (Initial Public Offering) funding (New York New Media Association, 2000).

Bolstered by industry associations, promoted by government officials, and exuberantly championed by its trade publications, the public face of these new-media companies showed a brash self-confidence. But the new-media companies were acutely aware that they were operating in a highly uncertain environment. Their statements to the Securities and Exchange Commission (SEC) upon filing for an IPO provide a chorus of this uncertainty. (All indented statements are quotations from SEC filings by Silicon Alley new-media firms.)

Among the risk factors reported by these new-media firms are some standard items commonly found in almost all SEC filings. More interesting are those factors common to early-stage companies in which the elapsed time from start-up to IPO is brief:

(1) We have an extremely limited operating history and may face difficulties encountered by early stage companies in new and rapidly evolving markets.

(2) Our recent growth has strained our managerial and operational resources.

For some new-media firms, the liabilities of newness were extreme, as in this case where almost all the senior personnel were newcomers to the company:

(3) Several members of senior management have only recently joined the company. Several members of our senior management joined us in 1998 and 1999 [this is from a March 1999 filing], including our Chief Financial Officer, Chief Operating Officer, Senior Vice President for Sponsorship, General Counsel, Vice President for Finance, Controller and Chief Accounting Officer, Senior Vice President for Human Resources, and the Chief Technology Officer. These individuals have not previously worked together and are becoming integrated as a management team.

In a tight labor market, loss of 'old hands' is a real threat and, in this knowledge-based industry, would spell a loss of the company's primary assets, especially where contacts with clients are through personnel:

(4) The loss of our professionals would make it difficult to complete existing projects and bid for new projects, which could adversely affect our business and results of operations.

Moreover, assets are not contained within the boundaries of the firm but are distributed across a network of interdependent firms. In choosing partners, alliances, and technologies, winners cannot be known in advance:

(5) We may not be able to deliver various services if third parties fail to provide reliable software, systems, and related services to us. We are dependent on various third parties for software, systems, and related services. For example, we rely on [another Internet company's] software for the placement of advertisements and [another Internet company] for personal home pages and e-mail. Several of the third parties that provide software and services to us have a limited operating history, have relatively immature technology and are themselves dependent on reliable delivery of services from others.

(6) Our market is characterized by rapidly changing technologies, frequent new product and service introductions, evolving industry standards, and changing customer demands. The recent growth of the Internet and intense competition in our industry exacerbate these market characteristics.

In a newly emerging field, measuring assets is also complicated by the absence of industry standards and by uncertain government regulations:

(7) The market for Internet advertising is uncertain. There are currently no standards for the measurement of the effectiveness of Internet advertising, and the industry may need to develop standard measurements to support and promote Internet advertising as a significant advertising medium.

(8) Government regulation and legal uncertainties could add additional costs to doing business on the Internet.

Being a front-runner in an emerging field is only a temporary advantage where there are few barriers to entry, no patentable rents, and larger and more established firms ready to exploit the profitable activities revealed by the trials and errors of the pioneering start-ups:

(9) We compete in a new and highly competitive market that has low barriers to entry.

(10) We do not own any patented technology that precludes or inhibits competitors from entering the information technology services market.

(11) We expect competition to intensify as the market evolves. We compete with: Internet service firms; technology consulting firms; technology integrators; strategic consulting firms; and in-house information technology, marketing and design departments of our potential clients.

(12) Many of our competitors have longer operating histories, larger client bases, longer relationships with clients, greater brand or name recognition and significantly greater financial, technical, marketing and public relations resources than we have.

Above all, will e-commerce prove viable? Will the Internet as we know it be sustainable? Will it continue to grow? And might it mutate into unpredictable forms?

(13) Our business may be indirectly impacted if the number of users on the Internet does not increase or if commerce over the Internet does not become more accepted and widespread.

(14) If the Internet is rendered obsolete or less important by faster, more efficient technologies, we must be prepared to offer non-Internet-based solutions or risk losing current and potential clients. In addition, to the extent that mobile phones, pagers, personal digital assistants or other devices become important aspects of digital communications solutions, we need to have the technological expertise to incorporate them into our solutions.

Hence, at the height of exuberance of the Internet bubble, there was the following sober assessment:

(15) We anticipate continued losses and we may never be profitable.

Searching for value in an evolving ecology

Our litany of risk factors in the Silicon Alley IPO filing statements points to the difficulties of evaluating Internet stocks. But over and above the problem of the market figuring out what these firms are worth is an even more interesting uncertainty: how do the firms themselves figure out what is *the basis of their worth*? To be clear, the problem is not in establishing the level of their market capitalization, which in any case is set by the market, but is of surveying their actual and potential activities to discover what they are doing (or could be doing) that is of value.

Many of the Silicon Alley new-media firms that were formed during the initial expansion of the web around 1995 began their operations designing websites. Suddenly, every corporation, it seemed, needed a website. This surge in demand for the skills of designers and programmers created a sizeable niche, with relatively few players, and a yawning knowledge gap between producers and clients. The folk history of the industry is strewn with stories by the start-up entrepreneurs who tell of their early experiences with mid-level corporate managers who had never surfed the web but who had been instructed by senior executives of major corporations to 'get us a website!'

Many of the twenty-something new-media pioneers were rebounding from a string of marginal jobs, having graduated from college after the 1987 stock market crash and the following recession that devastated the New York City economy. With the sudden expansion of the web, their generational position, which had seemed such a liability, now became an asset: having grown up in the computer age, they were quick to grasp the implications of the web. Equipped with a couple of PCs, an Internet connection, and the rudiments of HTML they could make some kind of living, doing something they enjoyed, while making up the rules as they went along (Kait and Weiss, 2001). Here was an opportunity to prove their worth—in circumstances where their marginality to the corporate world could be recast into a source of authority as legitimate interpreters of an alternative medium. With nothing to lose

and with little or no experience in the corporate world, they met corporate executives who had little or no experience in the emerging field of new media. They were frequently negotiating in their apartments-qua-offices, and the six-figure contracts they landed for building websites were instant proof (sometimes surprising in magnitude) of their value.

If the corporate world was not only paying attention but also willing to pay, what was it paying for? In these early days, corporations were anxious to establish a presence on the web, imagining websites as little more than billboards alongside the information superhighway. But, as the new-media entrepreneurs were introduced to the business operations of the firms, their interactions with various units yielded new insights about the capabilities of interactive websites as innovative corporate tools. Looking inside marketing departments, they realized that the web could provide new kinds of information about customers; in interactions with production departments, they learned that the web could establish new kinds of relationships to suppliers; and probing technology departments they recognized how the web could exponentially extend the network of information transfer well beyond the task of integrating proprietary data.

Although they were being paid for design work, the new entrepreneurs concluded that it was as consultants that they brought real value to the deal and to the client. And so they adjusted their positioning. As 'web shops' they were like construction companies, building in a digital medium to be sure, but nonetheless basically working to the specifications of the client. Reconfigured as 'web developers', they were in the business of advising clients about how to develop an overall strategy on and for the web. The new mottos and redesigned logos on their own websites told the story: for example, 'Interactive Strategy', and 'digital.change.management'.

The new management-consulting/web-design hybrid took the web developers more deeply and more intensively inside the organizations of their corporate clients (as the price of a well-designed corporate website rose to seven figures). And this increased interaction brought them into new fields with yet different identities. Their increased interaction with marketing departments, for example, resulted in 'interactive advertising' and brought them onto the domain of the Midtown advertising agencies. As they began to design intranets and virtual offices for flexible communication within the corporation, the web developers learned that their programming skills in graphic design had to be augmented with programming skills for the 'information architecture' of knowledge management. And, with the development of e-commerce, the 'front end' of the website (the interface with the customer) quickly became more integrated with the entire organization and with its 'legacy systems' working on older operating platforms in production, purchasing, billing, and data archiving. To deliver a comprehensive product that linked the user interface to the 'back end', the graphic designers, thus, also found themselves moving onto the terrain of the system integrators.

And so from graphic designers the web developers had evolved into interactive designers/management consultants/advertising agencies/information architects/system integrators. Some of them were now being approached by a new kind of client—not simply major corporations who needed a website to augment their bricks-and-mortar facilities but also start-up entrepreneurs with no physical plant and equipment but with ideas to build click-and-order operations. Whereas the mid-level executives of the earlier period had come with a corporate charge to 'build me a website', the exclusively e-commerce entrepreneurs now came with venture-capital backing to 'build me a company'. The entrepreneurs for galoshes.com, soapsudsonline, and YouNameIt.com brought financing, contacts to suppliers, and usually some modicum of marketing experience in a specific line of goods; but everything else from server farms to user

interfaces, from e-carts to returns policies, from supplier interfaces to knowledge of online consumer buying practices rested in the knowledge base of the web developer.

After creating one or two such virtual companies for fees, the web developers were confronted yet again with the problem of value: why simply charge a fee for a professional service when so much of the value of the virtual company resulted from their efforts? The answer was, in addition to fee for service, to acquire partial equity in the new online companies. But things were usually not so additive, and the resulting deals often involved trading off some part of fees for equity. So, to protect their 'investments' in deferred fees, some web developers began incubating their client companies, working closely with the managers of the start-up ventures to guide them to the market. In doing so, the web developers entered yet another new field of skills. In taking on a new project it was no longer enough to assess whether a new client could pay its bill. As equity holders, their value as a firm now rested in part on their ability to evaluate the potential of new ventures, their profitability, and/or their marketability. The more they began to think of their product as building a company, the more they had to consider the built company as a product, that is, they had to consider the likelihood that it could be sold whether through an IPO or to another round of investors. As such, in addition to all their other new identities, these web developers were taking on some of the roles of venture capitalists. Whereas the Silicon Alley new-media firms were once digital construction companies, now they joined the venerable New York City tradition of real-estate developers—developing properties on the digital landscape.

But as the web developers evolved in a zigzag course of learning where the value is, other actors, of course, were doing the same. The major Midtown advertising agencies, for example, established interactive units or spun off their own dedicated interactive agencies; the big consulting firms did not leave the field of interactive management to the new-media start-ups but moved aggressively into the field; and the big systems integrators developed their own e-commerce units and launched new initiatives in the lucrative business-to-business web-development field. From a scarcely populated niche, the field of new-media services was now filled with more established competitors, coming to it from multiple starting points.

Meanwhile, the nascent industry was faced with new waves of technological innovation disrupting its emerging digital ecologies. On the one side, players in the field were anticipating major breakthroughs in the development of broadband technologies which promised the convergence in one device of the various functionalities now parceled across your television, computer monitor, stereo, video recorder, and telephone. But, just when one might think that this hails a new 'single appliance' era, we saw, on the other side, the proliferation of myriad electronic devices (for example, wireless palm pilots, and the like) through which you can receive and transmit digital information in a mobile environment.

These simultaneous processes of convergence and divergence would have two consequences. First, the joint appearance of broadband technologies, on the one side, and multiappliance mobile interactivity, on the other, would have important consequences for the website interface design. That is, just at the point that the website genre seemed to be stabilizing, that moment of stabilization was revealed as a brief moment in the history of the medium. Second, as bandwidth was expanding to broadband proportions, another set of actors entered the field—cable companies, network broadcasters, recording companies, and telecommunications firms. Sony, NBC, AT&T, and Telefonica (the Spanish telecommunications firm), for example, were among the major corporations who moved most aggressively. They were joined, with the arrival of mobile interactivity (from *Wired* to the 'wireless revolution'), by new hardware

manufacturers such as Nokia, Ericsson, and Palm, Inc. (as well as by rapidly growing companies such as Symbol Technologies, makers of handheld, bar-code devices).

This crowding of the field happened at the same time as its economic contraction. As the IPO market for dot.coms slowed and then stopped altogether; firms that had put too many resources into developing companies instead of developing competencies found themselves with worthless holdings. Those who had scored early successes by tapping into the Internet gold rush with a timely IPO, and who had pegged their worth according to their soaring stock values (from $12 to $120 in months or even weeks), now found (with their shares trading in pennies) that allowing the market to be the measure of their worth could just as easily undervalue as overvalue the actual performance of a company. Those who had turned away clients in 1998 and 1999 because 'our cultures just do not fit', now found themselves making pitches in the most improbable places. And those who hoped that their reputations—as capable professionals who delivered value on the deadline—would help them weather the storm now found themselves competing for clients that were not only fewer in number but also much more cautious about allocating resources for Internet services.

Heterarchy

Companies striving to make headway amidst such dizzying impermanence were in constant search of that 'sweet spot' which consisted of finding the right temporary permanence to commit to—the winning clients, technology, marketing strategy—that would position them favorably for the next imminent shift of course. The challenge for these companies was not just to have the operational flexibility needed to change direction quickly; they also needed to maximize their capacity to recognize opportunities and realize their promise, not only by exploiting their immediate benefits but also by exploring them as openings to new opportunities. To enhance their innovative capacity, new-media firms experimented with new organizational forms that we characterize as heterarchy.

Heterarchy represents a mode of organizing that is neither market nor hierarchy: whereas hierarchies involve relations of *dependence* and markets involve relations of *independence*, heterarchies involve relations of *interdependence*. As the term suggests, heterarchies are characterized by minimal hierarchy and by organizational heterogeneity.

The twinned features of heterarchy are a response to the increasing complexity of the foresight horizons of the firm (Lane and Maxfield, 1996) or of its 'fitness landscape' (Kauffman, 1989). In relentlessly changing organizations where, at the extreme, there is uncertainty even about what product the firm will be producing in the near future, the strategy horizon of the firm is unpredictable and their fitness landscape is rugged. To cope with these uncertainties, instead of concentrating their resources for strategic planning among a narrow set of senior executives or delegating that function to a specialized department, firms may undergo a radical decentralization in which virtually every unit becomes engaged in innovation. That is, in place of specialized search routines in which some departments are dedicated to exploration while others are confined to exploiting existing knowledge, the functions of exploration are generalized throughout the organization. The search for new markets, for example, is no longer the sole province of the marketing department if units responsible for purchase and supply are also scouting the possibilities for qualitatively new inputs that can open up new product lines.

These developments increase interdependencies between divisions, departments, and work teams within the firm. But, because of the greater complexity of these feedback loops, coordination cannot be engineered, controlled, or managed hierarchically. The results of interdependence are to increase the autonomy of work units from

central management. Yet, at the same time, more complex interdependence heightens the need for fine-grained coordination across the increasingly autonomous units.

These pressures are magnified by dramatic changes in the sequencing of activities within production relations. As product cycles shorten from years to months, the race to new markets calls into question the strict sequencing of design and execution. Because of strong first-mover advantages, in which the first actor to introduce a new product (especially one that establishes a new industry standard) captures an inordinate market share by reaping increasing returns, firms that wait to begin production until design is completed will be penalized in competition. Like the production of 'B movies', in which filming begins before the script is completed, successful strategies integrate conception and execution, with significant aspects of the production process beginning even before design is finalized.

Production relations are even more radically altered in processes analyzed by Sabel and Dorf (1998) as *simultaneous engineering*. Conventional design is sequential, with subsystems that are presumed to be central designed in detail first, setting the boundary conditions for the design of lower ranking components. In simultaneous engineering, by contrast, separate project teams develop all the subsystems concurrently. In such concurrent design, the various project teams engage in an ongoing mutual monitoring, as innovations produce multiple, sometimes competing, proposals for improving the overall design.

Thus, increasingly rugged fitness landscapes yield increasingly complex interdependencies that in turn yield increasingly complex coordination challenges. Where search is no longer departmentalized but is instead generalized and distributed throughout the organization, and where design is no longer compartmentalized but is deliberated and distributed throughout the production process, the solution is *distributed authority* (Powell, 1996).

Under circumstances of simultaneous engineering where the very parameters of a project are subject to deliberation and change across units, authority is no longer delegated vertically but rather emerges laterally. As one symptom of these changes, managers socialized in an earlier regime frequently express their puzzlement to researchers: "There's one thing I cannot figure out. Who's my boss?" Under conditions of distributed authority, managers might still 'report to' their superiors; but increasingly, they are accountable to other work teams. Success at simultaneous engineering thus depends on learning by mutual monitoring within relations of lateral accountability.

As it shifts from search routines to a situation in which search is generalized, the heterarchical firm is redrawing internal boundaries, regrouping assets, and perpetually reinventing itself. Under circumstances of rapid technological change and volatility of products and markets, it seems there is no one best solution. If one solution could be rationally chosen and resources devoted to it alone, the benefits of its fleeting superiority would not compensate for the costs of subsequent missed opportunities. Because managers hedge against these uncertainties, the outcomes are hybrid forms (Sabel, 1990). Good managers do not simply commit themselves to the array that keeps the most options open; instead, they create an organizational space open to the perpetual redefinition of what might constitute an option. Rather than a rational choice among a set of known options, we find practical action fluidly redefining what the options might be. Management becomes the art of facilitating organizations that can reorganize themselves.

This capacity for self-redefinition is grounded in the organizational heterogeneity that characterizes heterarchies. Heterarchies are *complex* adaptive systems because they interweave a multiplicity of organizing principles. The new organizational forms are heterarchical not only because they have flattened hierarchy, but also because they

are the sites of competing and coexisting value systems. The greater interdependence of increasingly autonomous work teams results in a proliferation of performance criteria. Distributed authority implies not only that units will be accountable to each other, but also that each will be held to accountings in multiple registers. The challenge of a new-media firm, for example, is to create a sufficiently common culture to facilitate communication among the designers, business strategists, and technologists that make up interdisciplinary teams—without suppressing the distinctive identities of each.[1] A robust, lateral collaboration flattens hierarchy without flattening diversity. Heterarchies create wealth by inviting more than one way of evaluating worth.

This aspect of heterarchy builds on Knight's (1921) distinction between *risk*, where the distribution of outcomes can be expressed in probabilistic terms, and *uncertainty*, where outcomes are incalculable. Whereas in neoclassical economics all cases are reduced to risk, Knight argued that a world of generalized probabilistic knowledge of the future leaves no place for profit (as a particular residual revenue that is not contractualizable because it is not susceptible to measure ex ante) and hence no place for the entrepreneur. Properly speaking, the entrepreneur is not rewarded for risk-taking but, instead, is rewarded for an ability to exploit uncertainty. The French school of the 'economics of conventions' (Boltanski, 1999; Boltanski and Thevenot, 1991) demonstrates that institutions are social technologies for transforming uncertainty into calculable problems; but they leave unexamined the incidence of uncertainty about which institution ('ordering of worth') is operative in a given situation (Stark, 2000). Knight's conception of entrepreneurship as the exploitation of uncertainty posed within the heterarchy framework is thus rendered: entrepreneurship is the ability to keep multiple regimes of worth in play and to exploit the resulting ambiguity.

The firm and the project form
NetKnowHow
Over a two-year period, we observed the organizational features of heterarchy in practice at NetKnowHow, a pseudonymous new-media start-up firm in Silicon Alley navigating uncharted Internet territory. NetKnowHow is a full service Internet consulting firm. It was founded in 1995 by two young entrepreneurs, each with experience in the large corporate sector (traditional consulting and traditional media). In its formative years it was a software development company, but it quickly moved into the new-media field, producing intranets and websites for corporate and university clients. NetKnowHow acquired a reputation for excellence in retail e-commerce after its website for a famous department store won a prize for an outstanding e-commerce site. In 1999, while continuing to build retail e-commerce sites for nationally recognized corporate clients, it also built sites for start-up dot.coms (striking partnerships with several of these) and merged with another, smaller, start-up firm in the field of digital kiosks. In 2000 it stopped taking on dot.com clients, focusing instead on consulting for 'click and mortar' operations that combined physical and digital retailing while experimenting on the side in developing applications for the wireless interface. Like the overwhelming majority of new-media start-ups in Silicon Alley, it had no venture-capital funding; and, also like the majority of new-media firms during the period prior to the downward spiral of the industry beginning in April 2000, it was a profitable company. Also, like almost all firms in this sector, it is struggling in the

[1] A young business strategist in a leading new-media consulting firm in Silicon Alley grasped the problem intuitively. When asked whether he could speak the language of the designers and technologists on his project teams, he responded that he frequently did. But then he paused for a moment and added, "But I don't always do so. If I always talked to the technologist on his own terms, then he would never understand *me*."

wake of the dot.com meltdown. When we began our ethnographic research in the spring of 1999, NetKnowHow had about fifteen employees. Within eighteen months it had grown to over a hundred employees but has subsequently declined, in three rounds of layoffs, to about forty. Although very painful, this survival is itself an accomplishment in circumstances where much larger and much better financed companies have bit the dust.

The physical setting of our research was in the Flatiron District, at the core of Silicon Alley. At the point of its maximum growth, NetKnowHow occupied four workplaces, each several blocks apart—lofts converted from displaced printing operations, with as many as thirty computer workstations in an open room where no walls, dividers, or cubicles separated the programmers, designers, information architects, and business strategists. It was not just open, but so closely packed that almost anyone could reach out and literally touch someone. And, like a construction site, it was a place in movement. Although there were periods, typically mid-morning and mid-afternoon, where it seemed that everyone was still, each concentrating on his or her own monitor, for much of the time the rooms seemed in motion, with dozens of micromeetings in twos or threes, some sitting, others standing, leaning over shoulders to point at lines of code or graphics on their monitors, some meetings lasting thirty minutes, many only thirty seconds. Some formal project meetings took place around large tables in the conference rooms; but just as often a project team would claim a part of the open room by wheeling chairs and sitting on tables around several workstations. For the most intense discussions you could go to one of the 'private conference rooms' in the stairways and on the fire escape where smokers congregated.

The social setting of our ethnography, like the de rigueur hardwood floors, was Silicon Alley standard: the workforce of NetKnowHow was tightly grouped around its median age of twenty seven. But its demographics departed from the typical new-media start-up, with a higher proportion of women and a broader ethnic and racial mix. The following job listing indicates the qualities that NetKnowHow was seeking in its employees. For this programmer position, beyond the obvious technical qualifications, it seeks "team players" who "take pride in their work" and who can thrive in its "flat organizational structure".

"NetKnowHow, Inc. seeks Cold Fusion/ASP/MS SiteBuilder (or CGI/Perl) programmers with proven experience developing a wide range of leading-edge Internet systems. The ideal candidate will have experience in database design and development (Oracle/SQLServer) and strong HTML and JavaScript skills. *Team players must be able to juggle multiple projects, prioritize to meet client needs and established deadlines*. Requirements include one year solid experience programming in Cold Fusion or equivalent language, as well as familiarity with database systems (MS Access, MS SQL Server, Informix and Oracle). *We are looking for quality people who take pride in their work and enjoy working in an eclectic, hard-working and creative environment*. If you're interested in beginning a career with a cutting edge new media company, drop us a line. NetKnowHow's *flat organizational structure permits self-upers to thrive*. Benefits include medical, dental, 401-k and gym membership. If you have something special to contribute, submit your résumé and a cover letter describing your work experience and *what you think you could bring to NetKnowHow's table*, to recruiting@NetKnowHow.com" (emphasis added).

Reflecting the casual work environment, NetKnowHow's refrigerators were well stocked with soda, juice, and beer. And, like a construction site, the place was frequently noisy—not from crane engines and jackhammers but from the music that provided a nonstop umbrella of sound over the low hum of many conversations. In this setting, the counterpart of a hard hat was a headset wired to one's own music

as some protection against the din and as a signal 'not to be interrupted'. If the work atmosphere was casual, the actual work was intense and the hours long. Both hours and intensity increased with the approach of a project deadline and reached manic levels each autumn when the hardwood floors were littered with futons and mattresses as the employees at NetKnowHow worked literally day and night to build e-commerce sites that could be launched for the holiday buying season. Like preindustrial work rhythms, with bouts of work followed by relative idleness (Thompson, 1982), the rush work to meet deadlines could be followed by less intense periods 'between projects', but these were typically short. Opportunities for 'learning by watching' (Grabher, 2001) were limited where the general rule was 'learning by doing'—for there was nothing pre-industrial about the overall experience of temporality. In the new-media field, there was no sense of a 'passage of time'. Instead, time was compressed; like a time warp it was something that you were being shot through.

The web of a web project

The process of designing and building a website at NetKnowHow, as in new-media firms generally, takes the organizational form of a project. A project is not a permanent construct but a temporary ensemble whose players had been working on other projects before and will move to other projects after its conclusion. Together with every new-media firm we encountered in Silicon Alley, NetKnowHow devotes considerable energy not simply to monitoring projects ('building accountability of the project and in the project') but also to monitoring the project process ('codifying our practice', 'institutionalizing our process', etc)—in part as marketing strategy ('The Razorfish 5 Step Process'), in part because the project form is a critical component of the core competence of these firms.

Some projects last no more than a month. Some, whether because of their innate complexity or because of indecision or insolvency on the client side, can last five or six months. The typically sophisticated project runs for sixty to ninety days, and this extraordinarily compressed time-to-market is an important factor in project dynamics. Projects can bring earnings to the firm ranging from several hundred thousand to nearly a million dollars. Project fee structures can vary: NetKnowHow has sometimes contracted fixed fees, sometimes adopted a retainer model, and sometimes taken equity in lieu of partially defrayed or deferred fees. More typically, it negotiates overall price estimates based on material expenses plus billable hours.

Within the firm, the participants in a project include business strategists, interactive designers, programmers and other technologists, information architects, and merchandizing specialists. Each project has a project manager; most projects will include a designated design lead and technology lead, and larger projects will designate a lead information architect as well as a lead business strategist. While they are temporarily the 'members' of a project, personnel remain part of ongoing functional units (for example, design, programming, information architecture, strategy, etc), variously referred to as 'communities', 'disciplines', or 'guilds', but most frequently called 'teams' or 'groups' (for example, 'the design team', 'the technology group', etc).

Although everyone at NetKnowHow would prefer that people be assigned to only one project at any given time, the exigencies of this poorly capitalized firm (and its billable-hours revenue structure) frequently require that personnel work on multiple projects simultaneously. This fact creates time-allocation problems (and the need for cross-project coordination) among project managers. Moreover, it repeatedly short-circuits the ongoing discussion about the principles guiding the physical layout of the firm, specifically, whether personnel should be spatially grouped by project or by team.

A project, of course, is a project *for* a particular client. To an important extent it is also a project *with* a client. In some cases, representatives of the client are a *part of* the project. Project managers and members at NetKnowHow are aware that 'the client' is itself a complex entity in which different parties have different, and even conflicting, interests. When working with a large retail chain, for example, the proximate 'client' might be a new online unit that is itself involved in turf wars and budget battles inside its own organization. Similarly, the marketing department, financial services, warehousing, and production units that are a part of 'the client' can have different stakes in the (definitions of) success or failure of the venture. Thus, when NetKnowHow's project members (and not simply project managers) telephone, email, or instant message their counterparts in the client organization for technical information (for example, a programmer gets in touch with a database manager of the client's 'legacy' system or a merchandizing specialist calls a marketing manager) such contacts can also be opportunities for intelligence gathering.[2]

Motivated in part by the recognition of these complexities, some clients are hiring independent contractors who specialize in the role of interface between the corporation and the web-development project. Thus, just at the time that NetKnowHow and its competitors are acquiring the skills of 'managing the client', their corporate clients are hiring a new type of professional whose skills are to manage the representations of the client (on the one side) and to manage the project managers (on the other). From the vantage point of Internet companies such as NetKnowHow, such developments are a mixed blessing. The injunction that only one person speaks definitively for the client (and a corporate 'outsider' at that) can be potentially positive because nothing can be more disastrous for a project than to operate with erroneous or conflicting ideas of the intentions of the client firm. But, at the same time, as 'the client' is likely to have multiple (and even competing) objectives, the reduction to a single channel can result in messages which are difficult to decipher in the absence of multiple sources of information that make real interpretation possible. That is, mixed messages are likely, whether from one source or many. The challenge for the project is to construct from these mixed messages a relatively robust picture of the client, with enough depth of focus to commit resources and yet fuzzy enough to anticipate potential changes in direction or to facilitate quick adaptation to the unanticipated.

These interactions, whether tactically technical or strategically organizational, are part of the web of a web project. A more complete elaboration of the network of a web project would include: technology 'partners' (licensing and other arrangements through which the web developer can offer access and support for new technologies); hardware and network affiliations through which the web developer offers server space, maintenance, and network security; venture capitalists, whether brought from the side of the client or brought to the client by the web developer; other web-development firms (when different parts of a project are distributed among different firms or when the firm elects to subcontract parts of the project to other firms); vendors to the client (whose information systems must be reconciled with the categories and the functionalities of the site); order fulfillment firms, credit services, and so on. Intelligence is distributed across this web. We turn to lateral accountability among knowledge networks within the firm.

[2] Even when the client is not located in NYC, programmers (or other specializations for that matter) are in networks—school ties, special interest groups, immigrant communities, listserves, instant message buddy lists, bulletin boards, chat rooms—that make it relatively easy to open direct lines of communication to counterparts in the client's organization.

Distributing intelligence: collaborative engineering as emergent design

The life cycle of a web project typically has a preformative, 'preproject', stage of matching firm and client, followed by stages of identifying the project personnel, a formal 'kickoff', planning and site design, production, testing, soft launch, and a celebration at hard launch. Figure 1 presents a diagram of a typical project life cycle at NetKnowHow.

From the idealized representation in figure 1 it might seem that building a website is a matter of sequential engineering: in principle, all design and engineering should be completed before production begins. Within an overall sequentiality the diagram shows distinct moments of parallel engineering, for example, during weeks three to five, when the information architects, technical architects, and graphic designers work in parallel to draw up their plans for the site, which are then 'handed off' to the site builders. In the actual process, however, engineering is more simultaneous than sequential. At NetKnowHow, website construction is a process of collaborative engineering.

An industry in which there can be extraordinary first-mover advantages creates strong pressures to be quick-to-market. The results are excruciatingly tight project deadlines that force production to begin before design is completed. Typically, the database managers and other programmers begin construction just as soon as they hear initial ideas about the project. Of course, they are not literally writing each of the many thousands of lines of code from scratch, but are looking to previous work to find promising templates for the various functionalities that are likely to be adopted for the project. At the same time that they are searching through their existing stock of code, they are also searching for solutions to the new functionalities that were discussed in the kickoff meeting (as well as those that were not even mentioned there but which they are literally overhearing in the close quarters of the open workplace). If they started programming only after the information architect presented them with the finished 'wire frame'[3] (a kind of blueprint specifying the parts of the website and their inter-relations) the project could never be completed on deadline. Similarly, the information architect is consulting with the programmers about the code that they are already preparing, hearing their proposals about new solutions to old problems, and picking up new ideas that could be adopted in the site. Without such iteration, she or he might draw up an exquisite wire frame—but one that could not be completed on time and on budget. In short, production workers participate in design as a process that involves bricolage (Garud and Karnoe, 2001; Stark, 1999).

If production begins before design is completed it is also the case that design is ongoing, continuing almost to the point that production is completed. First, even with the best efforts to manage the client's expectations, and even within a project cycle as short as ninety days, it is nearly impossible to prevent 'project creep'—the racheting up of project specifications. Because clients learn during the process of building the site, they will demand new functionalities. Some can be resisted ('that's not in the project specifications'). But they cannot all be deflected, especially when the firm has promised a 'cutting edge' website and the client now sees the site of a competitor with new features that 'have to be adopted'. From a narrow business logic, new functionalities can be incorporated with a corresponding increase in price ('yes, but it will increase the programming costs dramatically'). But, from a design perspective, introducing new features can have enormous implications that ramify throughout the site. Seemingly simple changes in the order of steps within 'check-out', for example, might require major restructuring of the database.

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[3] The wire frame is an example of a 'boundary object' (Star and Griesemer, 1989)—stable enough to circulate, ambiguous enough to be an object of multiple meanings.

Week 1 2 3 4 5 6 7 8 9 10 11 12

Information architecture

Site objectives and goals

Graphic design

Technical architecture

Site building

Quality assurance planning

Testing

Soft launch | Hard launch

Migrate to operational support

Hosting (planning and set-up) | Client support/ operations

Marketing planning | Marketing preparation and execution | Ongoing marketing program

Strategy | Site performance analysis

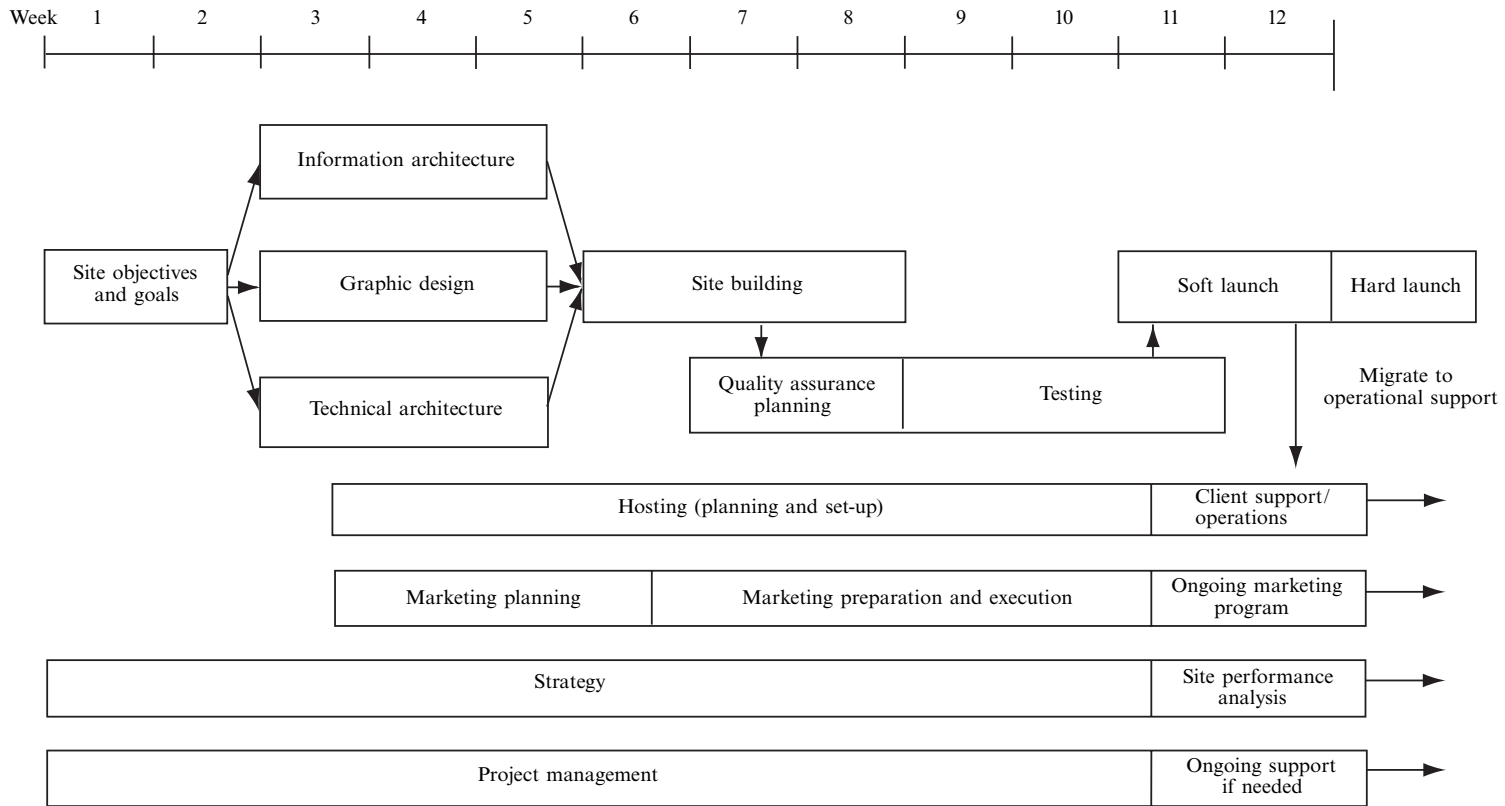Project management | Ongoing support if needed

Figure 1. NetKnowHow project-management guide.

But there is a second, more important, reason why design—as the work of figuring out the whole—can continue well through the production process, even when no additional functionalities are introduced after the initial stages. Because of the rapid pace of organizational, technological, and genre innovations, website construction at NetKnowHow was almost always a process of engineering something that had not been built before. Even when the project could benefit from utilizing existing templates, the particular combinations were likely to be novel, and likely to incorporate novel elements as well. Moreover, at NetKnowHow, learning was by doing. That is, instead of understanding a technology and then adopting it, one came to understand a technology by using it. As a result, the process of figuring out how all the pieces fit together did not take place in the initial 'design' phase but, instead, occurred during and through the process of constructing the site. "It's like a puzzle", explained Aaron, age twenty seven, one of the firm's two most senior project leads, "but it's peculiar because the picture on the cover keeps changing as you put it together." The passage from our conversation deserves quoting verbatim:

"Early on in the project you have a kickoff meeting and you do have an understanding of the project up front. You have a sense of what the project is, the size of it, the scope of it, and everything else. But as soon as that kickoff meeting is over, that whole concept just ... [throws up his hands]. It's like a puzzle—you see the cover of the box, you know what the puzzle is supposed to look like, you have a really good idea of what you need to do, but then you open the box, you just see all those pieces, and then you have to start putting all those pieces together."

"In trying to figure out how the puzzle pieces might fit together, the wireframes are not much help because the projects are always so fluid and there are always so many changes you have to go through, regardless. Every client wants changes; every project leader encounters some complexity that requires a change; so the deeper you go into changes, the farther you get from the realization. You'll have the puzzle pieces, and then someone will dump a whole other fifty or a hundred pieces into your lap. And when they dump the additional pieces in your lap, you also don't know how those fifty pieces relate to the cover on the box, you don't know if it's the bottom, on the side, on the top, or the left. But you do know that what you're going to end up with is not like the initial picture you upped with at the kick-off meeting, because you change so much."

"No matter how many new changes come across, for every new change you can tie up and get your arms around, get a resolution to, and get it implemented, then that actually serves to be a greater step towards the realization than just figuring out how the two pieces you had in the beginning fit together the way that you thought they would, because it's now more like you're getting these undefined pieces and you're able to define them and that sort of leapfrogs you toward that realization. At some point when you get all of those changes done and a good portion of the rest of it done and at that point, that's usually when I have that realization that YES! I see what it is that we're doing now. I have a good understanding of the whole thing and what it's going to end up looking like. For me it usually happens towards the end."

In these observations, Aaron is expressing a view that design is an emergent process, distributed across many actors in a highly interactive way. And, like design, innovation is not a moment that occurs at a particular stage in the web-development process. At NetKnowHow, innovation is not an activity confined to an R&D department. Every unit, indeed everyone, is involved in the process of innovation as an immensely pragmatic activity of collaborating to 'figure out how it fits together'. In short, instead of the conventional view of innovation by design, in these website construction projects we

find design by innovation. As a self-organized, emergent process, it is not engineered from above.

To understand the complexities of 'figuring out how it fits together' we need to go beyond the simple front-end/back-end dichotomy that figures so prominently in discussions of websites. The distinction exists in the folk categories of the web: the front end is what you, the end user, experience when you go to a website, but it is like the tip of the iceberg; the back end is everything you do not see below the waterline, but which makes it work. The distinction is meaningful, but misleading—especially if it connotes website construction as comprising of parallel processes that have to be made to converge or if it leads to metaphors in which the front-end people (designers and such) are building a bridge from one side, the back-end people (programmers) are building from another side, and they have to meet in the middle. Their interdependencies are, of course, much greater.

In the simple version of the front-end/back-end model, there are two computers and one interface: the server where the code of the website is resident, your PC, and the graphical user interface (GUI) through which you experience the site. But sophisticated e-commerce sites involve many computers and multiple interfaces—yours, the servers leased by the client of the web developer, the mainframes on which the client's multiple databases are operating, as well as the computers of the client's suppliers and vendors, the computers of the order-fulfillment service, credit-card companies, and so on. Your click as end user can initiate a purchase, create a delivery form, enter a credit-card payment, provide feedback to marketing, and route an order directly to a supplier. Some sophisticated e-commerce sites reach deeply into the production and inventory systems of multiple suppliers and use algorithms (with weights for the suppliers' price, location, level of inventory, opening or closing phases of production runs, and even the quality of the suppliers' data) to determine which supplier will fill a particular customer's online purchase.

The challenge for the website developers is to build a site in which the activities of the end user are seamlessly linked to the various other computers to which the site is interfaced. The performance of the website critically depends on the performance of an actor—the user—whose actions might be anticipated but cannot be controlled. It is this interdependence that most dramatically increases the interdependencies among the website construction crew. A programmer can design a beautiful interface between the website and the suppliers, but she or he needs to make sure that it does not interfere with how the information architect is thinking about navigational issues for the interface with the user. The more the site is truly interactive, the more the various parts of the team must interact. A change in the categories of the database, for example, can change parameters for the graphic designers and vice versa. The more the intelligence of the site is distributed—including, most critically, the user's intelligence—the more the construction site must use a distributed intelligence among the team in collective problem solving. When graphic designers and database programmers speak, the phrase 'being on the same page' can refer to an injunction to focus on the same problem, a request to consider how an action will have consequences in another sphere, an opportunity to bring each other up-to-date on new methods, applications, functions, and reporting systems as well as quite literally being on the same page of code. The more they must take into account how their actions will shape the parameters of others, the more they must increase the lines of lateral accountability. As a young programmer explained to us in an apt epigram for collaborative engineering: "In this company, I'm accountable to everybody who counts on me."

Organizing diversity

Multiple performance criteria

The directionality of accountabilities in heterarchical organizations such as NetKnowHow is lateral. But these accountabilities are not of a singular logic. These are sites where evaluative principles operate in multiple registers.

Questions of value—the value of work and the value of the product of work—are central to a web project. At NetKnowHow some criteria of worth are shared across all communities. Formal credentials are unimportant; actual skills are critical. Not surprisingly, in this project-based organization, an ability to work well with others is highly valued. This trait has several components. First, there is the ability to get along with others in an extraordinarily stressful and fast-pace environment.[4] Knowing the subtle cues for when and how you can interrupt is one of the skills relevant in this area. Second, there is the ability to convey knowledge (whether explicit or tacit) to others. Third, and most ubiquitous, there is the ability to figure things out quickly. As important as (and for some even more important than) one's absolute or relative knowledge is the rate of acquiring new skills and knowledge, as well as being talented in being able to rethink a problem so that it can be solved. 'Picking things up quickly' is highly valued whether within a community of practice or across them.[5]

However, not all criteria of worth are shared. The different communities of practice at NetKnowHow differ in their conceptions of value and in their measures of performance:

For **programmers**, a good programmer is above all *logical*, and a good site must be judged by the same criterion. When she or he performs well, she or he does so with *speed*, *efficiency*, and *accuracy*; and a good website must do the same. A good programmer can *translate*—express a functionality in the language of a computer code that is *categorical* and *hierarchical*. A good programmer understands the deep structure as well as the quirks and idiosyncracies of the program. When she or he speaks it is not simply on behalf of other programmers but on behalf of the program. The legitimate tests and proofs of worth are the quality assurance tests and other instruments that measure the speed, efficiency, security, and reliability of the site.

For **designers**, a valuable designer must be knowledgeable about processes of *perception*, and a good website must use graphic cues that conform to these processes. When he or she performs well, he or she does so with *creativity*, and the results will be *exciting* and *stimulating*. A good designer is also a *translator*—into a language that is *visual*, *intuitive*, and *interactive*. At work he or she engages in a visual dialogue with other designers, the client, and users. When this work of translation is successful it makes links to the *imagination* because both the client and the user live not only in a real world and in a virtual world but also in *imaginary* worlds. The designer's translation creates multiple links among all these—in the process, making connections between the self-image of the client and that of the user. Exploiting interactive as well as visual features, he or she creates the overall 'look and feel' through which the site achieves the desired *effects* and *affects* and conveys a branding *experience*. If necessary, he or she has authority to argue with the client, provided that he or she speaks as an advocate of the brand. Winning clients, winning audiences, and winning competitions are legitimate proofs of worth.

[4] As academics we might think about this in a collegial respect, but that would miss the physical dimension of working in such close proximity. Imagine five people all working together in a space the size of your office; if you have a big office, imagine ten and then you will get the idea.
[5] In 2000 NetKnowHow initiated a formal evaluation process for all employees. Each employee was able to choose five coworkers to write evaluations. 'Picking things up quickly' was one of the most frequently mentioned positive traits. The summary statements that follow are drawn from these evaluations as well as from our field interviews and observations.

For **information architects**, a good information architect must be knowledgeable about principles of *cognition*. A site that successfully applies these principles will be characterized by *clarity*, *ease*, and above all by *usability*. A good website conveys information by creating navigable pathways that conform to cognitive pathways. An information architect's activities are valuable because they are based on *studies* that use *statistics* to understand user *behavior*. In discussions with other members of the project, including the client, the information architect is an advocate of the *user*. The user lives in a world of *information* that is accessed through *tools* some of which are more and some of which are less *appropriate* for the *tasks* that the user attempts to perform. 'Conversion rates' and other statistical metrics of user activities are legitimate tests of the performance of a website.

For **merchandizing specialists**, a good website is one that moves products. To do so a good online merchandizer exploits powers of *suggestion*. Because the *shopper* lives in a world of *desire*, she or he is open to suggestion. *Playful*ness takes precedence over information, surprise takes precedence over search; product *placement* takes precedence over navigation; and *pleasurability* takes precedence over usability. Proofs of value are metrics that measure how product is moving in relation to inventory.

Okay, it works, but how does it perform?

In the section on collaborative engineering we focused on the pragmatic activity of figuring out how everything fits together. But collaborative engineering also involves the discursive activity of evaluating how a website performs.

You build a website that works. But, as more websites get built, you cannot make a distinction between yours and that of others simply on the grounds that yours works. You say that yours performs better. But then immediately you must begin to articulate your performance criteria.[6] You cannot silence the talk about evaluative principles and point to a purely pragmatic frame as your claim that you are making a valuable product raises the question not only of what is its value but of why this is so.

The various communities of practice at NetKnowHow were articulate and adamant about their respective performance criteria. 'We yell and scream' was a repeated refrain in conversations when we talked about this friendly rivalry. Discussions could be heated, especially when proofs of worth (Boltanski and Thevenot, 1991) were not immediately recognized outside of the frames that made them seem so obvious to their proponents. The statistical studies on user behavior produced by the leading information architect, for example, were characterized by a leading designer as 'arbitrary', provoking the countercharge that this was yet another instance in which he, the designer, was being 'irrational'.

Despite occasional flare-ups the temperature stayed cool as the dominant mode was persuasion rather than denunciation. Because every community of practice was a minority view, each attempted to enlist or enroll others in recognizing the legitimacy of their performance criteria. In this process of ongoing realignment (Latour, 1986; 1991), people spoke openly about seeking allies. We saw this process at work, for example, in a dispute over competing claims about who could speak on behalf of 'the user' that went on for many months at NetKnowHow and was still ongoing when we concluded our fieldwork. This development was triggered by the information architects, who thought that they had a special claim on knowledge about the user. Their hope was that every group would up focusing on the performance of the user and that, by maintaining their special definition, they could raise their own performance criteria to a special status to which all groups gave credence. The strategy of the information

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[6] See Hennion (1997) for a fascinating analysis of performance criteria in the field of popular music.

architects was initially successful: as references to 'the user' indeed circulated through the company, we could hear this theme more and more frequently in discussions, formal and informal.

But the strategy also had consequences unintended by the information architects: instead of deferring to the information architects, each of the disciplines began to articulate their own definitions of the user that were consistent with their value systems and metrics of performance. That is, each community developed its own distinctive claims to represent the user. The merchandizing specialists, who had previously seemed to be speaking on behalf of the merchandizer, offered seminars in which they presented their view of the user as 'shopper' and mobilized an alternative set of findings. Similarly, the firm's leading designer, who was genuinely most attentive to the studies of the information architects, came to the defense of the designer who had derided them as 'arbitrary', pointing out that these statistical studies were conducted at a particular stage of the development of the web. In a variety of settings, he suggested new directions in the evolution of the web that could make these findings obsolete. And, more quietly but quite forcefully in their individual interactions with the other communities, even the programmers began to articulate their own representation of the user.

Disputes such as these were vital for firms like NetKnowHow. If the firm locked-in to a single performance criteria, it could not be positioned to move with flexibility as the industry changed and the web evolved. Thus, even the principle we have not yet mentioned—profitability—was not itself an evaluative principle that trumped all others as continuing profitability was itself based on the ability to anticipate new developments and to re-cognize new performance criteria for evaluating well-designed and well-functioning websites. The toleration, even encouragement, of such friendly rivalry was a source of innovation to navigate the search for value within the young industry.

To build a site, make settlements

Collaborative engineering is a discursive pragmatics. It is, at once, an ongoing conversation and an intensely practical activity. I present to you accounts of my work so that you can take my problems and goals into account in yours. We do what works to make it work. We need to talk to get the job done; but to get the job done we need to stop talking and get to work. We give reasons, we explain the rationale, but we use different rationalities. We do not end disputation so much as suspend it. To build sites, we make settlements.

Settlement of the web and settlement in web projects share some common features, not least because the two dynamics are recursive. As a frontier, the web is going through a process of settlement. [On settlement, see the extraordinarily rich and insightful analysis of online newspapers by Boczkowski (2001)]. It is not simply that sites are built, but that they are built in settlements. Landscapes are reshaped and structures are recognizable by their contours. We can distinguish an e-commerce site from a portal site from an informational site. Things get settled.

For the members of web projects, the process of building websites has the result that things also get settled. From a very low division of labor, some professional boundaries develop. It is possible to recognize a graphic designer from a business strategist from an information architect. Things settle down, people settle in. They work out ways of dividing tasks and managing the relationships across their professional boundaries. On many issues they reach agreement.

But you cannot settle back in your ergonomic chair too long, because, unlike settlements on physical landscapes, things do not stay settled on the web. The built

structures on the digital landscape lack the permanence of physical structures. An abandoned warehouse is a boarded-up blight on the landscape until it is destroyed or gentrified into luxury apartments. An abandoned website is a Code 404, "File Not Found". Websites can be destroyed with ease and new ones created. Repurposing takes more work,[7] but in general the process of recombining forms takes place with marked rapidity when working in the digital medium.[8] Thus, just when we thought we could easily recognize the difference between e-commerce sites, portal sites, and information sites, fusions began that confused the distinctions. AOL's mall of affiliated storefronts began to double as a portal, the Yahoo portal adopted e-commerce features, and we could go to the dominant e-commerce site, Amazon, for information and for its affiliated shops. Things might be settling down, but they are not settled.

Life in web projects is much the same. Sometimes the parties actually come to agree. But frequently, instead of *reaching an agreement*, they *reach a settlement*. Like the term 'settlement', with its connotations of law and locality, our informants at NetKnowHow reach settlements: (1) by judicious appeals to other actors who are outside the dispute, and (2) through their highly localized practices. When the incommensurable systems of value come into conflict in a project they are sometimes settled by contingent compromises (often through appeals to the project lead) and by 'relativization' (through appeals to the client). In relativization (Boltanski and Thevenot, 1991) the parties to the disagreement can maintain their principled position; they merely agree to accede to whatever outcome is chosen by the 'outsider'. 'So, it's settled, right?' The highly localized practices of the project, so confined in space and time, further contribute to temporary settlements. Working in such tight quarters creates a forced intimacy and a heightened tolerance. Where everything is overheard and everyone is monitoring not only what is said but also the tone of voice, project team members are on the alert for a pitch of voice that signals an unproductive impasse. 'Okay, let's settle this and get back to work'. Deadlines have a way of settling disagreements.

Not surprisingly, like those on the landscape of the web, these settlements are more provisional than permanent. Limited in time, localized in space, a project is a provisional settlement.

Bountiful friction

The provisional character of project settlements is an expression of discursive pragmatism. They are pragmatic because provisional settlements make it possible to get the job done. They are discursive because provisional settlements are open to reinterpretation when the project is concluded and the next begun.

Our understanding of collaboration in heterarchical organizations is thus more complex than coordination within a project. A frictionless coordination, in which everyone shared the same performance criteria, might make life smooth for project managers, but it would lose the creative abrasions (Brown and Duguid, 1998) that are the source of ongoing vitality. Settlements facilitate coordination within projects; the unsettling activity of ongoing disputation makes it possible to adapt to the changing topography of the web across projects in time. Friction promotes reflection, exposing variation from multiple perspectives.

[7] The analogy to physical buildings and landscapes has merit when we move from destruction (almost without cost in the digital case) to repurposing. Sites like Amazon, Yahoo, and AOL can be rebuilt only with considerable investment. Like news magazines, they can be cosmetically redesigned with some frequency; but changing their *form* and functionality is a major operation that is fraught with difficulties. Witness the calamity at Deja.com.

[8] Even in the digital environment, relative stabilizations occur because of investment in forms (Thevenot, 1984). Genre forms are malleable, but not infinitely so.

The type of complex coordination of a discursive pragmatics thus differs from the silent coordination of circulating boundary objects (Star and Griesemer, 1989). It is not enough to note that coordination occurs among heterogeneous actors. We should be attentive to their work of persuasion as they offer competing performance criteria justified by heterogeneous evaluative principles. In doing so, we see multivocality not as the property of a position that is structurally privileged by its location as a unique intersection of multiple networks (Padgett and Ansell, 1993) but as a property of an organization. Entrepreneurship is not brokering difference between otherwise disconnected identities but instead occurs at sites where identities and their competing orders of worth are densely interacting. Complex coordination is a function not only of the values we share or of the language we have in common (Galison, 1997) but also of our creative misunderstandings.

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