TECHNOLOGIES OF COOPERATION

Institute for the Future

www.iftf.org

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About the …

Institute for the Future

The Institute for the Future is an independent, non-profit strategic research group with over 35 years of forecasting experience. The core of our work is identifying emerging trends and discontinuities that will transform global society and the global marketplace. We provide our members with insights into business strategy, design process, innovation, and social dilemmas. Our research generates the **foresight** needed to create **insights** that lead to **action**. Our research spans a broad territory of deeply transformative trends, from health and health care to technology, the workplace, and human identity. The Institute for the Future is based in Palo Alto, CA.

Acknowledgments

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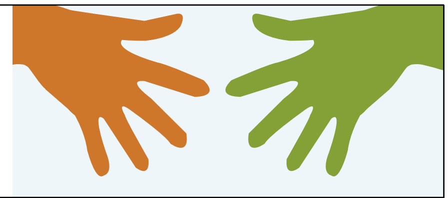
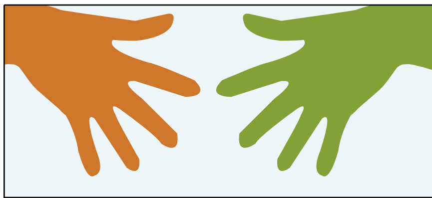


Emerging digital technologies present new opportunities for developing complex cooperative strategies that change the way people work together to solve problems and generate wealth. Central to this class of cooperation-amplifying technologies are eight key clusters, each with distinctive contributions to cooperative strategy:

- **Self-organizing mesh networks** define architectural principles for building both tools and processes that grow from the edges without obvious limits, that distribute the burden of the infrastructure throughout the population of participants, and that establish the foundation for the emergence of swarm intelligence in systems of people and devices.
- **Community computing grids** provide models for recovering currently squandered resources from distributed sources and for providing mutual security within a network of people and/or devices, supported by explicit choices about when and how to foster cooperation versus competition.
- **Peer production networks** create a framework for volunteer communities to accomplish productive work. These potentially unbounded communities create new value by rapidly solving problems that would tax or stymie smaller workgroups.
- **Social mobile computing** includes a cluster of technologies and principles that allow large or small groups of people—even if they are strangers—to act in a coherent and coordinated fashion in place and space, supported by information accessed in real time and real space.
- **Group-forming networks** represent ways to support the emergence of self-organized subgroups within a large-scale network, creating exponential growth of the network and shortening the social distance among members of the network.
- **Social software** makes explicit, amplifies, and extends many of the informal cooperative structures and processes that have evolved as part of human culture, providing the tools and awareness to guide people in intelligently constructing and managing these processes to specific ends.
- **Social accounting tools** suggest methods and structures to measure social connectedness and establish trust among large communities of strangers, building reputation along dimensions that are appropriate to a specific context and creating a visible history of individual behavior within a community.
- **Knowledge collectives** model the structures, rules, and practices for managing a constantly changing resource as a commons, for securing it against deliberate or accidental destruction and degradation, multiplying its productivity, and for making it easily accessible for wide-ranging uses.

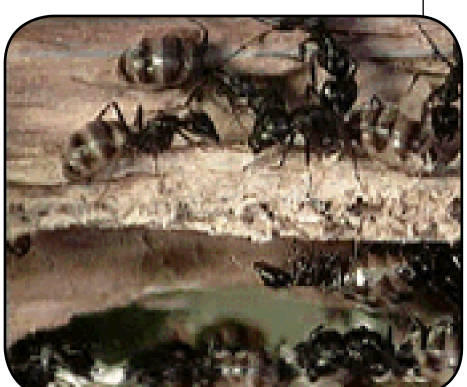
Each of these technology clusters can be viewed not only as a template for design of cooperative systems, but also as tools people can use to tune organizations, projects, processes, and markets for increased cooperation. Specifically, each can be used in distinctive ways to alter the key dimensions of cooperative systems—structure, rules, resources, thresholds, feedback, memory, and identity.



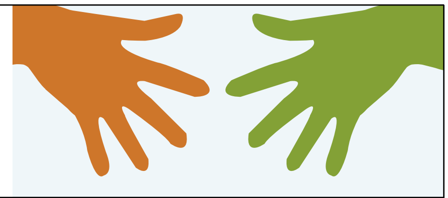
Executive Summary

This report, *Technologies of Cooperation* (SR-897), maps the key concepts and choices associated with these eight technology clusters and concludes with a set of seven strategic guidelines:

- Shift focus from designing systems to providing platforms
- Engage the community in designing rules to match their culture, objectives, and tools; encourage peer contracts in place of coercive sanctions by distant authority when possible
- Learn how to recognize untapped or invisible resources
- Identify key thresholds for achieving "phase shifts" in behavior or performance
- Track and foster diverse and emergent feedback loops
- Look for ways to convert present knowledge into deep memory
- Support participatory identity



Introduction



When social communication media grow in capability, pace, scope, or scale, people use these media to construct more complex social arrangements—that is, they use communication tools and techniques to increase their capacity to *cooperate* at larger and larger scales. Human history is a story of the co-evolution of tools and social practices to support ever more complex forms of cooperative society.

First Experiments: The Hunter–Gatherers

Humans lived as hunter–gatherers in small, extended family units long before they lived in agricultural settlements. For most of that time, small game and gathered foods constituted the most significant form of wealth—enough food to stay alive. At some point, larger groups figured out how to band together to hunt bigger game. We don't know exactly how they figured this out, but it's a good guess that some form of communication was involved, and however they did it, their banding-together process must have solved collective-action problems in some way: our mastodon-hunting ancestors must have found ways to suspend mistrust and strict self-interest long enough to cooperate for the benefit of all. It is unlikely that unrelated groups would be able to accomplish huge-game hunting while also fighting with each other.

We do know that humans were successful at hunting down, burning down, or driving herds of large game over cliffs. One immediate effect of this new, more socially complex and more dangerous way of hunting must have been the social dilemma presented by sudden wealth. Suddenly, more protein was available than the hunters' families could eat before it rotted. Did those who ate the rewards of the hunt but did not themselves hunt owe something to the hunters? Did they pay them something in exchange? In any case, social relations must have become more complex. And new modes of cooperation must have emerged. Undoubtedly, new ways of using symbols were enlisted to keep track of these increasingly complex social arrangements.

Extended Reach: The Emergence of Empire

About 10,000 years ago, larger numbers of humans began to settle in rich river valleys and cultivate crops instead of continuing their perpetual nomadic hunting and gathering activities. In these settled flood plains, large-scale irrigation projects must have required—and enabled—an increase in the scale and complexity of social organization. The "big man" form of social organization changed in some places into kingdoms, and in a very few places, the first mega-kingdoms, or empires, began to construct cities out of mud and stone.

The first forms of writing appeared as a means of accounting for the exchange of commodities such as wine, wheat, or sheep—and the taxation of this wealth by the empire. The master practitioners of the new medium of marks on clay or stone were the accountants for the emperors and their priest-administrators. When writing became alphabetic (claims McLuhan), an altogether new kind of empire, the Roman Empire, became possible.

Each time the form of communication media became more powerful, social complexity was amplified and new forms of collective action emerged, from pyramid building to organized warfare. Lewis Mumford called this "the birth of the megamachine"—the alliance of armed authority with religious hierarchies, who organized people as units in social machines.

Extended Thought: The Power of Literacy

Alphabetic writing was the exclusive tool of the administrators of empires for thousands of years. An elite group of priests and civil administrators were taught the secret of encoding and decoding knowledge and transmitting it across time and space. Then the printing press enabled populations of millions to amplify their thinking by becoming literate.

Again, new forms of collective action emerged from newly literate populations. The Protestant reformation, constitutional revolutions, and the scientific method as a means of collective knowledge creation all stemmed from the ability of complex societies to share their knowledge and their thought processes. A worldwide economy also began to emerge: markets are as old as the crossroads, but capitalism is only about 500 years old, enabled by stock companies that share risk and profit, government-backed currency, shared liability insurance companies, and double-entry bookkeeping, all of which rely on printing.

Extended Tools: Societies of Technologies

What we are witnessing today is thus the acceleration of a trend that has been building for thousands of years. When technologies like alphabets and Internets amplify the right cognitive or social capabilities, old trends take new twists and people build things that never could be built before.

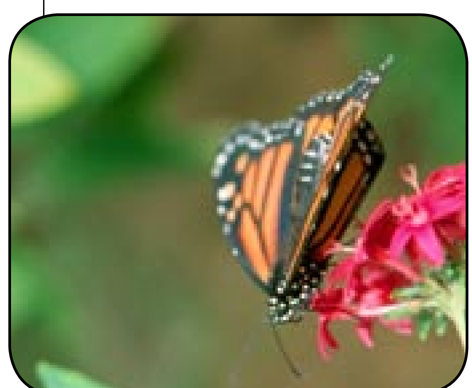
Over time, the number of people engaged in producing new things has grown from an elite group to a significant portion of the population; at the same time, the tools available to these growing populations have grown more powerful. With Moore's Law dictating technological capacity and the need for constant economic growth driving new technological applications, larger and larger populations are adopting ever more powerful devices.

As these devices become technically networked—as they themselves are organized into increasingly complex societies of cooperating devices—the value of the technical network multiplies by N^2 (Metcalfe's Law). Reed's Law says that the value of the network multiples far more rapidly, at the exponential rate of 2^N, when human social networks use the technical networks to form social groups. As a consequence, social capital, knowledge capital, and the politically potent ability to organize collective action are growing faster and faster, while social disruption, new forms of power and power shifts, and new kinds of growth and wealth begin to erupt.

Strategy at the Leading Edge: New Cooperative Technologies

Strategy is itself a function of the technologically expanded human capacity to think and act together. It makes sense, then, that the leading edge of strategy found at the leading edge of cooperative tools and techniques—that deliberate use of these technologies can enhance our deliberate plans for working and living together more effectively.

But today's technologies of cooperation (and perhaps all tools throughout history) exist on the border between deliberate design and unpredictable emergence. Sometimes, the complex human–machine constructions are intentional. Often they are the emergent result of aggregating a large number of individual interactions. And occasionally they are both.



For example, the Internet protocols and WWW protocols were technical specifications that were deliberately designed to decentralize innovation, but eBay and virtual communities were emergent social phenomena that grew out of the technological network enabled by those protocols. The architectural freedom was built into the Internet because the protocol designers suspected people would think of uses that they couldn't imagine for an interconnected web of computers. A physicist in Switzerland created the Web by giving it away to a few friends; a few years later, that enabled students who started Yahoo! and Google on their college computers; these platforms, in turn, enabled the creation of complex online marketplaces for goods and services.

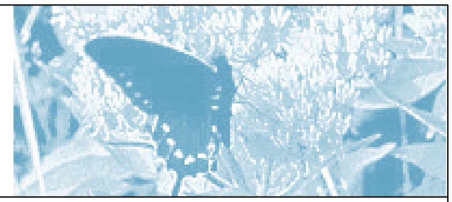
Cooperative strategy thus has two faces:

- One seeks to apply the new tools to situations in which we believe increased cooperation will produce better outcomes—for example, to resolve a social dilemma or simply to increase the effectiveness of teams.

- The other seeks to understand the tools as templates for new kinds of social organization and to anticipate the strategic environment these new societal forms will create—and the choices they will impose.

This report, *Technologies of Cooperation* (SR-897), will try to take both perspectives as it explores eight clusters of cooperative technologies that are emerging at this still very early stage of the digital revolution.

A Strategic Map of Cooperative Technologies



In *Toward a New Literacy of Cooperation in Business* (IFTF SR-851 A, 2004), we identified seven dimensions of cooperative strategy, along which we can slide a metaphorical lever to increase or decrease cooperative behavior in all kinds of systems, from teams to entire societies. These are:

- **Structure:** from static to dynamic
- **Rules:** from external to internal
- **Resources:** from private to public
- **Thresholds:** from high to low
- **Feedback:** from local to systemic
- **Memory:** from ephemeral to persistent
- **Identity:** from individual to group

In this report, we want to look at how these tuning levers work in eight clusters of cooperative technology:

- **Self-organizing mesh networks** that create societies of cognitively cooperating devices
- **Community computing grids** that support emergent swarms of supercomputing power
- **Peer production networks** that build a constantly expanding commons for innovation
- **Social mobile networks** that foster the collective action of "smart mobs"
- **Group-forming networks** that integrate social and technical networks
- **Social software** that enables the management of personal social webs
- **Social accounting tools** that serve as trust-building mechanisms
- **Knowledge collectives** that extend the nature and reach of knowledge economies

By applying each of the levers to each of the eight technology clusters, we can begin to build a map of the options for cooperative strategy that are emerging as part of the digital revolution (see page 9). This map includes several features:

- A list of early technologies that are part of each cluster (some of which belong to more than one cluster)
- A characteristic shift that each technology cluster produces for a particular strategic lever (for example, in self-organizing mesh networks, identity tends to shift from "user versus provider" to "user as provider"); these shifts can be used both to understand the tendency of the technology and the strategic intervention the technology can aid
- A range of key concepts and phenomena that define the intersection of strategic levers and technology clusters

Please note that this map represents an early interpretation of the literature of cooperation and the evolution of technology. Think of it as version 1.0 of the strategy map for technologies of cooperation.

TECHNOLOGIES OF COOPERATION

SELF-ORGANIZING MESH NETWORKS

DUST NETWORKS · MESH RADIO · The Free Network Project · XML · SELF-ORGANIZING SENSOR NETWORKS · SMART ROUTERS · PEER-TO-PEER NETWORKS · SOFTWARE RADIO · COMPUTER VIRUSES

COMMUNITY COMPUTING GRIDS

SWARM COMPUTING · Folding@home · UNITED DEVICES · APPLETS · COMPUTATION NATIONS · SMART CLIENT–SERVER SOFTWARE · UBIQUITOUS MIPS

PEER PRODUCTION NETWORKS

CREATIVE COMMONS · LINUX · The Apache Software Foundation http://www.apache.org/ · GNU: GENERAL PUBLIC LICENSE · OPEN STANDARDS · OPEN CODE

SOCIAL MOBILE COMPUTING

MOBILE PHONES · LOCATION-SENSING DEVICES · HANDHELD COMPUTING DEVICES · SMS · GEOCODED HYPERMEDIA · COMMUNICATING SENSORS · BROADBAND WIRELESS · WEARABLES · RFID

GROUP-FORMING NETWORKS

CHAT · BUDDY LISTS · DIGITAL COLLECTIBLES GAMES · LISTSERVS · MESSAGE BOARDS · ebay · MASSIVELY MULTIPLAYER ONLINE GAMES · AUCTION MARKETS

SOCIAL SOFTWARE

SOCIAL-NETWORK SOFTWARE · Meetup · INSTANT MESSAGING · PERSONAL MEDIA · FRIEND-OF-A-FRIEND (FOAF) NETWORK · BLOGS · BUDDY LISTS

SOCIAL ACCOUNTING

AUTOMATED REFERRAL SYSTEMS · Epinions.com · METAMEDIA · COLLABORATIVE-FILTERING SYSTEMS · RATING SYSTEMS · FEEDBACK-CONTINGENT FEE SYSTEMS

KNOWLEDGE COLLECTIVES

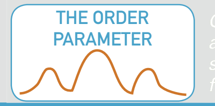
SOCIAL BOOKMARKING · WIKIS · del.icio.us · GROUP-VISUALIZATION TOOLS · RSS · LIST-CREATION TOOLS · flickr · ONLINE KNOWLEDGE MARKETS · BLOGS · SHARED ONLINE WORKSPACES

STRUCTURE

Technologies of cooperation emphasize distributed processes, emergent relationships, networks that build from the edges, and small components that can aggregate in flexible ways to form large-scale or scale-free systems.

SELF-ORGANIZING MESH NETWORKS	COMMUNITY COMPUTING GRIDS	PEER PRODUCTION NETWORKS	SOCIAL MOBILE COMPUTING	GROUP-FORMING NETWORKS	SOCIAL SOFTWARE	SOCIAL ACCOUNTING	KNOWLEDGE COLLECTIVES
From centrally planned relays to self-creating relays	From central, dedicated processor to distributed, ad hoc processing	From scheduled proprietary projects to continuously evolving small-scale components	From random crowds to self-organizing info-driven crowds	From one-to-one or one-to-many networks to facilitated subgroups within a network	From limited informal networks to facilitated scale-free networks	From branded transactions to rated interactions	From proprietary IP management to collective IP maintenance

FREQUENCY PULLING
- Rhythm + communication = synchronous behavior



Groups tend to synchronize at an average cycle rate, flanked by two smaller groups with slower and faster cycle rates

PEER-TO-PEER ARCHITECTURES
- Memory
- Processing
- Communications

MODULARITY
- Many distributed players
- Many small parts
- Short timeframes

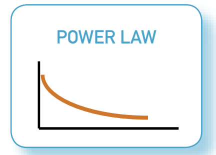
SCALES OF INFINITY
- Infinitely large pools of people (or devices)
- Infinitely small tasks
- "People do it because they can"—*Benkler*

SMART MOBS
- People +
- Devices +
- Information +
- Places and spaces

GEOSPATIAL FOCAL POINTS
- A merger of physical and digital space
- From boundaries to focal points

SMALL-WORLD NETWORKS
- Clustered groups connected by a few long links reduce the degrees of separation in a network

SCALE-FREE NETWORKS
- A few well-connected nodes + many poorly connected nodes



INFOMATED MARKETS
- Low cost to get information
- Low cost to provide information
- Multiple sources of information
- Multiple paths to sources

EMERGENT KNOWLEDGE STRUCTURES
- Enhance proximity
- Manage quality
- Encompass diversity
- Clearly define roles and relationships
- Fill roles and relationships flexibly

RULES

Technical rationality and economies of time and effort tend to take the place of moral precepts in the rules of cooperative technology systems—with visible mechanisms for monitoring.

SELF-ORGANIZING MESH NETWORKS	COMMUNITY COMPUTING GRIDS	PEER PRODUCTION NETWORKS	SOCIAL MOBILE COMPUTING	GROUP-FORMING NETWORKS	SOCIAL SOFTWARE	SOCIAL ACCOUNTING	KNOWLEDGE COLLECTIVES
From legitimate use of spectrum to distributed permissions to connect	From exclusionary rules to voluntary practices	From contractual obligations to technical rationality	From broad social norms to situation-specific instructions and guidelines	From rational neutrality to codes of "likeness"	From informal social conventions to technically managed procedures	From legal sanctions to social transparency	From gatekeeping to content update and repair

ARTIFICIAL LIFE
Programming rules based on social behaviors:
- Flocks of birds
- Beehives
- Anthills

MUTUAL SECURITY
- Mutual assistance improves individual security

CODE INTEGRITY
- Parts of code may be proprietary to prevent reverse engineering and contamination of results

ISSUE: Who has the right to volunteer the resource?

FAQs AS RULE SETS
- Ownership customs
- Cultural procedures
- Technical operations

"LET THE CODE DECIDE"

SUCCESSIVE APPROXIMATIONS
- To time
- To place
- To task

AD HOC CULTURES
- Task-specific instructions
- Simple ways to recognize members
- How-to behaviors
- Rapid sharing of adaptations

THE RULE OF DIVERSITY
- More extreme groups
- More extreme rules of engagement within groups
- Multiple personal codes of behavior

DOMAINS OF COOPERATION
- Cooperate locally, compete globally vs.
- Compete locally, cooperate globally

SOCIAL NETWORK DESIGN
- Sign-up procedures
- Mediated access
- Statistical referrals
- Emergent linking

PRIVACY VS. TRANSPARENCY
- Transparency shifts emphasis from punishment to prevention

MUTUAL MONITORING
- Doing one's own work requires checking another's work
- Ease of repairing and updating the commons

Ask Me Help Desk

RESOURCES

Technologies of cooperation create opportunities for new relationships with property that go beyond public versus private; these relationships create new ways to generate both public and private wealth and suggest principles for protecting and growing common-pool resources.

SELF-ORGANIZING MESH NETWORKS	COMMUNITY COMPUTING GRIDS	PEER PRODUCTION NETWORKS	SOCIAL MOBILE COMPUTING	GROUP-FORMING NETWORKS	SOCIAL SOFTWARE	SOCIAL ACCOUNTING	KNOWLEDGE COLLECTIVES
From limited bandwidth to self-generating bandwidth	From individually untapped processing cycles to economical aggregate cycles	From individually untapped time to aggregate productivity	From scattered political and economic power to collective power	From value of content or transactions to value of the joint resource construction	From untapped personal relationships to personal capital	From advertising dollars to trusted ratings	From scarce knowledge to knowledge as a common-pool resource

INCREASING RETURNS
- Users share the burden of the infrastructure
- Resource grows as users grow

BANDWIDTH

CORNUCOPIA OF THE COMMONS
- Lower costs
- New models of philanthropy
- New social solutions

MIPS

DISTRIBUTED QUALITY
- Work gets organized to get good results

TIME

SMART MARKETPLACE
Markets signal more than simple prices with:
- Transaction technologies
- Location technologies
- Reputation technologies

POWER

INDIVIDUAL ACTIONS ➡ LARGE PUBLIC RESOUCES

ALTERNATIVE PROPERTY REGIMES
Focus on:
- Public goods
- Common-pool resources

CONNECTIVITY

NETWORKS OF INFLUENCE
- Alternate models of advertising—for example, bloggers select ads, create ad memes

SOCIAL CAPITAL

TRUST MARKETS
Trust increases the value of a market: Higher ratings = higher prices paid

BUT CAUTION: Markets can always be gamed

TRUST

COMMON-POOL RESOURCES
- Clear boundaries
- Rules match needs and partcipants can change the rules
- Graduated sanctions
- Low-cost conflict resolution

KNOWLEDGE

THRESHOLDS

Thresholds signal a significant change of behavior—a kind of phase shift—and cooperative technologies have the potential to redefine key thresholds for group participation, value creation, problem solving, meaning making, and security in a group or community.

SELF-ORGANIZING MESH NETWORKS	COMMUNITY COMPUTING GRIDS	PEER PRODUCTION NETWORKS	SOCIAL MOBILE COMPUTING	GROUP-FORMING NETWORKS	SOCIAL SOFTWARE	SOCIAL ACCOUNTING	KNOWLEDGE COLLECTIVES
From low thresholds for costly disruptions to high thresholds for easy-to-repair disruptions	From high thresholds for dedicated capacity to low thresholds for ad hoc capacity	From high thresholds for structured problem solving to low thresholds for emergent problem solving	From affective thresholds to informational thresholds	From linear thresholds to exponential thresholds	From segmentation thresholds to degrees of separation	From regulated risk thresholds to context-specific risk thresholds	From high thresholds for contributing to low thresholds for repairing damage to known stores

COST TO REPAIR (high – low) / COST TO DISRUPT (low – high)

COST TO DISRUPT \ COST TO REPAIR	high	low
low		
high		

EMERGENT SYNC
Synchronization creates emergent phenomena:
- Communications traffic jams?
- Smart mobs?
- Other?

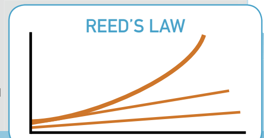
ENSEMBLE FORECASTING
- Multiple models
- Multiple data sets
- Multiple simultaneous runs

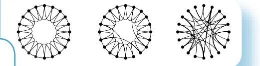
"Many eyeballs make all bugs shallow"

ThinkCycle

UNINTENDED COLLECTIVE ACTION
What are the information thresholds that separate blind mobs from smart mobs:
- In the street?
- In the marketplace?
- In the political arena?
- On the battlfield

MANY-TO-MANY COMMUNICATION
Network communities:
- 1-to-many grow at 1^N
- 1-to-1 grow at N^2
- Many-to-many grow at 2^N





DEGREES OF SEPARATION
- Gaming degrees of separation: Six Degrees of Kevin Bacon

CERTAINTY \ VALUE	low	high
high	market price	regulation
low	rating system	collaborative filtering

ADAPTIVE RISK MANAGEMENT

SIGNAL-TO-NOISE RATIO
- Aggregate statistical referral systems ease search, provide measure of quality

SOFT SECURITY
- Anyone can change anything
- Everyone is responsible for accuracy
- Everything is archived
- Updating and repairing are easy

FEEDBACK

New forms of feedback emerge from cooperative technologies; these forms can influence both cooperative behavior and resolve social dilemmas, providing both rewards and sanctions in ways that might have been inefficient or impossible in the past.

SELF-ORGANIZING MESH NETWORKS	COMMUNITY COMPUTING GRIDS	PEER PRODUCTION NETWORKS	SOCIAL MOBILE COMPUTING	GROUP-FORMING NETWORKS	SOCIAL SOFTWARE	SOCIAL ACCOUNTING	KNOWLEDGE COLLECTIVES
From centrally monitored traffic to locally responsive nodes	From peer-reviewed publishing to real-time iterative problem solving	From monetary feedback to community recognition and use as feedback	From time-delayed remote feedback to instant local feedback	From mass trends to fragmented affinities	From breadth of influence to depth of influence	From post hoc legal proceedings to a priori aggregate ratings	From centrally maintained indexes to distributed, real-time filters

SWARM INTELLIGENCE
- Signal strength
- Fading signals
- Alternate routes

MIRRORS & THERMOSTATS
- Local feedback produces stable large-scale systems

COMPETITIVE COOPERATION
- Teams of donors
- Deadlines
- Real-time donor statistics
- Real-time problem-solving statistics

RAPID ITERATION

USERS AS REVIEWERS
- Testing cycles
- Bug reports

RATIONAL RITUALS

QUORUM SENSING
Crowds acquire tools for sensing:
- Size thresholds
- Proximity thresholds
- Information thresholds
- Reputation thresholds

PRESENCE MANAGEMENT
- Media choice
- Buddy preferences
- Multiple avatars

GROUP PROFILING
Alternatives to traditional segmentation:
- Context
- Social networks
- Experience
- Swarms

SOCIAL METADATA
- Social network graphs
- Hit counting on personal Web sites
- Blog statistics
- Trackbacks

THE SHADOW OF THE FUTURE
Extending the "shadow of the future" enhances cooperation—aggregate rating and reputation systems make each interaction count

Imagination is a note space that has private, shared, and public spaces

AD HOC TAXONOMIES
Who else is thinking about what I'm thinking about?
- Collaborative keywords
- Shared note spaces

MEMORY

The combination of automated record keeping, linking, statistical analysis, and visual modeling embedded in many technologies of cooperation changes the ways that groups and communities can remember past actions of its members, changing their cooperative behavior in the present.

SELF-ORGANIZING MESH NETWORKS	COMMUNITY COMPUTING GRIDS	PEER PRODUCTION NETWORKS	SOCIAL MOBILE COMPUTING	GROUP-FORMING NETWORKS	SOCIAL SOFTWARE	SOCIAL ACCOUNTING	KNOWLEDGE COLLECTIVES
From proprietary system performance histories to publicly aggregated node histories	From proprietary process notes to public progress records	From official documentation to communities of advice	From cultural memory embedded in ritual to local memory embedded in place	From curated cultural repositories to jointly maintained environments	From static personal archives to self-generating social archives	From historical highlights to aggregate reputations	From archive as back-up to archive as self-healing system

NETWORK AS MEMORY
- The network is the representation of the history of its members

Folding@home

WORK CREDITS
Records of:
- Hours or cycles donated
- Code donated
- What others build on

DISTRIBUTED HELP DESK
List serves:
- Multiple advisors
- Multiple solutions

GEOCODED PLACES
Geocoded data enhances—
- Places as signals to act
- Places as symbols of behavior
- Places as records of group intelligence

COMMUNITY MEDIA
Media exchange standards
- Royalty-free media communities
- Media blogs
- New IP protection arrangements

Creative Commons offers alternative ways to protect, share, and re-use IP

creative commons

NETWORK AS SOCIAL RECORD
Social networks diagram:
- Personal capital
- Organizational capital
- Influence and obligations

STUDIED TRUST
- High trust ➡ cooperation
- Low trust ➡ monitoring

VISIBLE HISTORY
The public record is:
- Persistent
- Broad-based
- Scaled
- Continuously updated
- Collectively created

AUTOMATED ARCHIVING
Complete records
- Version restoration
- Change detection

Wikipedia offers one-click version restoration to correct abuse and errors

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IDENTITY

Cooperative behavior depends on how much individuals associate their identity with various groups and their participation in those groups. Technologies of cooperation change the opportunities for defining both individual and group identity.

SELF-ORGANIZING MESH NETWORKS	COMMUNITY COMPUTING GRIDS	PEER PRODUCTION NETWORKS	SOCIAL MOBILE COMPUTING	GROUP-FORMING NETWORKS	SOCIAL SOFTWARE	SOCIAL ACCOUNTING	KNOWLEDGE COLLECTIVES
From "user vs. provider" to "user as provider"	From dedicated professionals to "part-of-the-solution" nodes	From contracted employee to resource contributor	From "lost in the crowd" to "empowered by the crowd"	From a single coherent identity to multiple group-specific identities	From demographic profiles to personal brands	From a resume to a rating icon	From juried contributor to jury member

GROUP-ALIGNED SELF INTEREST
- Users are incented to protect the resource
- No distinction between using and depleting the resource

VALUED NODE STATUS
- Personal contribution
- Personal connectedness
- Personal reward and recognitions

SYMBIOTE
- Problems + passions + politics
- Opportunistic communities

GROUP STATUS
- Individual credit is a motivator for participation
- "Forking" diminishes reputation

AD HOC, SHORT-TERM GROUP IDENTITIES
- Mix-and-match values and beliefs
- Fragmentation of long-term affiliations

CHALLENGE: Sustainable group identities

CITIZENS OF AFFINITY
People define their citizenship rights and responsibilities in relation to affinity groups more than nation states

Citizenship rights:
- To belong
- To define membership
- To multiple affinities
- To doctrinal education
- To choice

NETWORKING IQ
- Group participation
- Referral behavior
- Online lifestyle
- Personal mobile connectivity
- Locative activity

PERSONAL PROFILES
- Blog reputations
- Technorati stats
- Personal media
- Full-life archives

IDENTITY MANAGEMENT
- Identity iterates with external ratings
- Identity is statistically computed
- Identity risks are locally high

INTERCHANGEABLE IDENTITIES
- User/producer
- Reader/author
- Player/designer
- Buyer/seller

The Technologies of Cooperation: From Examples to Principles

Today's technologies of cooperation are practical tools for organizing people and solving problems that we face right now. But they are also harbingers of new forms of social and economic organization—forms that may help resolve some of the complex social dilemmas that confront the world. So each example of a cooperative technology is also a model for thinking about future social forms as well as future tools; each example embodies principles that can help us think more strategically about cooperation.

In this chapter, we examine eight categories or clusters of cooperative technologies—calling out key examples, identifying the distinctive ways in which they are shaping innovative cooperative strategies, and then extracting key principles that seem to derive from these examples.

Like any taxonomy, our eight categories are necessarily a bit arbitrary, and the boundaries between categories are sometimes blurred. And as tools evolve, the categories may shift in the future. In fact, as the "cooperation commons" grows and we apply some of these very tools to our analysis, we expect a much more robust "folksonomy" of cooperative technologies to emerge. For now, however, this analysis provides a way to think systematically about the tools and their strategic implications.

WHAT THEY ARE

Self-organizing mesh networks are constellations of devices that can serve as both transceivers and relays or routers, with built-in intelligence to recognize compatible devices and configure themselves as a node in the network. They thus eliminate the need for any centrally controlled backbone network. Their self-organizing properties may be encoded in either hardware or software.

EXAMPLES

Software radio combines the ability of the computer to perform very fast operations with the capabilities of digital signal processing that makes it easier to extract signals from noise—using built-in software that is smart enough to configure the signal to overcome any obstacles and taking advantage of locally available spectrum by adjusting power, frequency, and modulation. They were developed initially for use in emergency and battlefield situations.

Self-organizing mesh networks define architectural principles for building both tools and processes that grow from the edges without obvious limits. They distribute the burden of maintaining the infrastructure among all participants in the network, and the capacity of the network as a resource grows—rather than shrinks—with each additional participant. In essence, they form societies of intelligently cooperating devices, as David Reed has pointed out. If better ways of using resources remain to be discovered, the architectural principles of mesh networks might furnish an important hint.

From Dumb Radios to Smart Receivers

Wireless receiving devices of the 1920s were unable to distinguish between nearby signals from central broadcasters in similar frequency ranges. As a result, the practice of dividing valuable wireless frequency bands into pieces of property that were controlled by their licensee “owners” was established.

However, in the 21st century, more intelligent receivers can treat spectrum in a less consumptive way. Using more sophisticated forms of signal analysis and signal processing, they can effectively create additional spectrum, eliminating the need to divvy up the spectrum among competing users. This is the basis for the Open Spectrum movement.

From Communications to Energy

Jock Gill, in a blog post, proposes that the notion of intelligent, self-organizing could be applied to energy as well as communication:[1]

> … let’s take Internet architecture further and apply it to our electrical power system. This yields an “InterGrid”—every building powering itself as its demands require rather than every “demand” depending on a centralized power station with a many-decades replacement cycle. Just as centralized communications stifles innovation so does centralized power generation.
>
> We need a local grid for mutual security. That is, I and my neighbors need redundancy and back up in case our individual power system conks out. We will therefore connect our “homes” to one another in a mutual assistance grid. Logically it would make sense to then interconnect these

edge grids for further security. Thus you organically build from the edges: the new InterGrid starts at the edges and builds in every direction, unlike the old central grid which starts at the center and builds towards the edge.

Social Correlates

The architectural principles of mesh networks can also be applied to all kinds of organizations and processes, including commerce and governance. As Gill states in his blog, “It is time to apply everything we have learned in the last 100 years, including the lessons provided by the Internet and its new architectural approaches, to the core of the operating system for our democratic and civil society.”

STRATEGIC PRINCIPLES

Structure | Intelligent nodes decide which connections to develop, allowing the network to grow from the edges.

Rules | Mutual assistance improves individual security, if you consume, you also provide.

Resources | Users share the burden of the infrastructure and resources grow as the number of users grows.

Thresholds | Redundancy increases the thresholds for disruption and lowers the cost to repair.

Feedback | Local feedback makes it possible to grow stable large-scale systems from the bottom–up.

Memory | Local nodes hold the relevant local knowledge.

Identity | Users are also providers, creating group-aligned self-interest.

EXAMPLES (CONT.)

Mesh radios act as their own communication routers, sending around packets of data for other radios in the network. The technology has been used to provide broadband wireless access to private LANs, the Internet, and video programming.

Mesh sensor networks are communicating sensors that likewise serve as routers for other sensors in the network, relaying the sensor readings throughout the network and eventually to some other type of network where the data can be put to use. (Dust’s SmartMesh motes)

P2P file exchanges apply this principle to a more socially defined practice—participants allow portions of their computers to be used as temporary repositories for files that anyone in the network can access. They may also be required as part of the social protocol to contribute some of their own files to the commons.

2 COMMUNITY COMPUTING GRIDS: SWARMS OF SUPERCOMPUTING POWER

WHAT THEY ARE

Community computing grids are networks of computation created by volunteers who share excess CPU cycles from their own personal devices in order to aggregate massive processing power to solve computation-intensive problems. Each personal computer processes a tiny fragment of a huge problem, creating collective super-computer capabilities that measure in teraflops.

EXAMPLES

Rational drug design uses the collective power of community computing grids to tackle large computational problems associated with designing and developing synthetic drugs. Projects such as Folderol (http://www.folderol.com) and Folding@home (http://www.folding@home.org) use human genome data and volunteers to conduct medically-crucial protein-folding computations.

Community computing grids is a strategy for amassing computing power from resources that would otherwise be wasted, and creating levels of computation and analysis not easily or quickly available. Such computing structures depend on their social networks of participation in creating a common resource and sacrificing immediate individual costs or resources for the provision of a public good.

From Sharing Memory to Sharing Processing

Community computation, also known as “distributed processing” or “peer-to-peer” computing, had already been underway for years before Napster awoke the wrath of the recording industry with this new way of using networked computers. But where Napster was a way for people to trade music by sharing their computer memory—their disk space—distributed processing communities share central processing unit (CPU) computation cycles, the fundamental unit of computing power. Sharing disk space does no more than enable people to pool and exchange data, whether it is in the form of music or signals from radiotelescopes. CPU cycles, unlike disk space, have the power to compute, to do things to data—which translates into the power to analyze, simulate, calculate, search, sift, recognize, render, predict, communicate, and control.

Today, millions of people and their PCs are not just trading music, but are tackling cancer research, finding prime numbers, rendering films, forecasting weather, designing synthetic drugs by running simulations on billions of possible molecules—taking on computing problems so massive that scientists have not heretofore considered them.

Aggregating Power into Computing Swarms

Distributed processing takes advantage of a huge and long-overlooked source of power.[2] It isn’t necessary to build more computers to multiply computation power if you know how to harvest a resource that until now had been squandered—the differential between human and electronic processing speeds.

Even if you type two characters per second on your keyboard, you’re using only a fraction of your machine’s power. During that second, most desktop computers can simultaneously perform hundreds of millions of additional operations. Time-sharing computers of the 1960s exploited this ability. Now millions of PCs around the world, each of them thousands of times more powerful than the timesharing mainframes of the sixties, connect via the Internet. As the individual computers participating in online swarms become more numerous and powerful and the speed of information transfer among them increases, a massive expansion of raw computing power looms, enabling qualitative changes in the way people use computers.

Third parties are beginning to serve as catalysts in aggregating community computing grids and supplying processing power for profit (such as United Devices) or philanthropically (such as Intel who sponsors a philanthropic peer-to-peer program).

When Social Swarms Meet Computing Swarms

Community computing ultimately amplifies the power of both people and machines. Peer-to-peer swarming, pervasive computing, social networks, and mobile communications multiply each other's effects. Not only can millions of people link their social networks through mobile communication devices, but the computing chips inside those mobile devices will soon be capable of communicating with radio-linked chips embedded in the environment. Expect startling social effects after mobile P2P achieves critical mass—when the 1,500 people who walk across Tokyo's Shibuya Crossing at every light change can become a temporary cloud of distributed computing power.

STRATEGIC PRINCIPLES

Structure | Peer-to-peer structures among participants enable social network effects among large numbers of small contributions and aggregate computing power.

Rules | Social arrangements among voluntary contributors (when your CPU is idle; work on shared problem) enable sharing of excess, distributed processing.

Resources | Community computing generates new computational resources from those that would have been squandered, creating increasing returns from what appeared to be finite resources.

Thresholds | Community computing lowers the threshold of computational complexity by amassing analytical power

Feedback | Swarm computing can efficiently provide quick feedback to complex situations and conditions.

Memory | Community memory may contribute to group identity and further participation in community computing grids.

Identity | Group identity is likely to encourage participation in community computing.

EXAMPLES (CONT.)

Peer-to-peer analysis collectives harness shared processing for solving complex analytical problems. Evolution@home (http://www.evolutionary-research.org) searches for genetic causes for extinction of species. Distributed.net (http://www.distributed.net) solves cryptographic challenges. SaferMarkets (http://www.safermarkets.org) seeks to understand the causes of stock market volatility.

Ensemble forecasting uses "fuzzy prediction" based on multiple models rather than a single "best guess" forecast. For example, climate change forecasts use hundreds of thousands of state-of-the-art climate models, each with slightly different physics to represent uncertainties. Distributed processing is a practical strategy for this kind of forecasting.

3 PEER PRODUCTION NETWORKS: BEYOND THE FIRM AND THE MARKET

WHAT THEY ARE

Peer-to-peer production networks are ad hoc, emergent networks of actors who participate cooperatively in the creation of a common good or resource without hierarchical control. They are structured around the interconnectedness of nodes rather than on a server-client model. Motivation to participate in peer networks includes diverse drivers and social signals rather than market price and command structures.

EXAMPLES

Open source software networks use commons-based, peer-to-peer production methods to create many kinds of software, including operating systems like Unix and Linux, and Web server software such as Apache (which enjoys over 60% market share). Open source software is owned by nobody but produced by various coder volunteers who contribute to larger software objectives by solving small coding tasks.

Peer production networks aggregate many small, distributed resources to create a larger resource pool, solve problems, and produce goods that no single individual could have done otherwise. They provide an alternative structure for production and value creation beyond the firm and the market. Peer network principles form the structural basis of many new experiments in bottom–up social and economic models of exchange.

Emergence of a Third Alternative

Linux and other open source software are produced by ad hoc networks of individual programmers, linked by the Internet, a form of organizing for production that Yochai Benkler proposes as a third alternative to the classic institutions of the firm and the market.[3] Benkler points to open source software production as "a broader social–economic phenomenon" and an emergence of a third mode of production in the digitally networked environment." In peer production networks like open source, the property and contract models seen in the firm and market are radically changed. Maintaining a vibrant resource commons and protecting the right to distribute over the right of ownership are key elements of the model.

Emergent Governance and Complexity at the Core

Eric Raymond saw deep distinctions between his experiences with Unix development and what he was witnessing with the development and spread of Linux and other open source software produced through peer production networks. He characterized the deep innovation of open source production methodology as the difference between "The Cathedral and the Bazaar:"[4] The former is a centralized model with strong individuals or groups guiding a strategy of rapid prototyping and evolutionary programming. The latter is a philosophy of "release early and often, delegate everything you can, be open to the point of promiscuity." Steven Weber, in *The Success of Open Source*, suggests four general principles for organizing distributed innovation:[5]

- Empower people to experiment
- Enable bits of information to find each other
- Structure information so it can recombine with other pieces of information
- Create a governance system that sustains this process

Licenses Support the Commons

A key to peer production networks is the creation of resource commons that are open to anyone for use. Mechanisms are needed in order to protect the commons from abuse, depletion, and from others interested in proprietary gain from enclosing them. The "General Public License," under which open source software is distributed, is itself a legal technology of cooperation that uses the restrictions of the law to ensure the freedom to use and improve the open source commons.[6] Creative Commons is another licensing tool that protects the distribution of artistic and cultural content. An important part of these licensing schemes is that they make restrictions that forbid anyone to deny or surrender users' rights to distribute, copy, or alter licensed resources.

STRATEGIC PRINCIPLES

Structure | Network participants form ad hoc and self-organized systems of exchange.

Rules | Internal codes of conduct, ownership customs, and decision-making norms, such as technical rationality as in, "let the code decide," shape interactions.

Resources | Licensing protects access and distribution by restricting privatization of public goods and thus enables a rich resource commons.

Thresholds | Open participation increases network size and decreases the threshold for repair.

Feedback | Open participation increases network size and increases local feedback.

Memory | The resource commons provides a systemic memory of value created.

Identity | Individual and group identity drive participation in peer production efforts.

EXAMPLES (CONT.)

Open source research and design networks share their knowledge, IP, and creative innovation to solve large, complex problems. P2P networks such as ThinkCycle (from the MIT Media Lab) leverage the collective design expertise, or "think cycles" of many to solve global design problems for developing countries. A recent project designed a compact medical kit to instruct medical teams (including many illiterate trainees) in the use of IV drip-set equipment.

Peer-to-peer media networks allow widespread sharing and creation of music, literature, and other digital art forms to perpetuate creative and cultural innovation rather than enclose it. A notable network is BitTorrent, in which downloaders swap portions of a file with one another instead of all downloading from a single server. This way, each new downloader not only uses up bandwidth but also contributes bandwidth back to the swarm.

4 SOCIAL MOBILE COMPUTING: SMART MOBS

WHAT THEY ARE

Social mobile computing represents the convergence of three trends: mobile communications and computing technologies, social-networking applications and processes, and aware physical environments that are embedded with communicating sensors, RFID tags and other devices. This convergence represents the emergence of aware, social environments that will serve as a new platform for human cooperative and collective activities.

EXAMPLES

Smart mobs have been one of the first pieces of evidence of social mobile computing in action, particularly those with political action as their purpose. Examples from around the world demonstrate how mobile communications and social networks with a shared interest can catalyze effective political action. The Internet's capability of connecting people who share an interest, combined with the mobile telephone's ability to access resources from anywhere, helped elect a President in Korea, rocket a U.S. Presidential candidate from

Social mobile computing combines the richness of social networks with the power of pervasive communications networking. By connecting the dots among people, places, and information, social mobile computing will enable people to act together in new ways and in situations where collective action was not possible before.

Early Indicator: Smart Mobs

Smart mobs will usher in a new form of mobile social computing. We're only seeing the first-order ripple effects of mobile-phone behavior now—the legions of the oblivious, blabbing into their hands or the air as they walk, drive, or sit in a concert, or the electronic tethers that turn everywhere into the workplace and all the time into working time. It is likely that these early instances of collective action are signs of a larger future social and organizational upheaval. Considering the powerful effects of group-forming networks, the second-order effects of mobile telecommunications of all kinds—cellular phones, SMS, location-sensing wireless organizers, electronic wallets, and wireless networks are likely to bring a social resolution. An unanticipated convergence of technologies is suggesting new responses to civilization's founding question—how can competing individuals learn to work cooperatively?

Cooperation Amplified

Social mobile computing is poised to become an important organizational strategy for communities, governments, and businesses alike. A new literacy of cooperation—a skill set for how to leverage the power of socio-technical group-forming networks and catalyze action—will become an important competency in the next decades. From daily activities as mundane as shopping and as important as obtaining health care and participating in civic life, smart-mob skills will play an important role in how people interact on a daily basis. Those who are not equipped to manage this sort of group action will be at a disadvantage—a new class of digital have-nots.

STRATEGIC PRINCIPLES

Structure | As people connect to each other, information and place, structure grows organically from the edges.

Rules | Rules are simple, few in number, and clearly articulated.

Resources | Social-network effects help grow public resources.

Thresholds | Thresholds in group size shape the type of collective action possible.

Feedback | Local feedback helps provide customized information and solves coordination problems.

Memory | Physical place can become an important trigger of group memory.

Identity | Physical place becomes an important extension of individual and group identity.

EXAMPLES (CONT.)

obscurity to front-runner status, and organize demonstrations at the 1999 WTO meetings in Seattle. Elections in Kenya, Manila, and Spain have been similarly influenced.

Mobile gaming In the summer of 2003, "flash mobs" broke out all over the world: groups of people used e-mail, Web sites, and mobile phones to self-organize urban performance art. Ad hoc groups of young gamers in Scandinavia and Singapore use cellular phones equipped with GPS functionality to play urban adventure and superhero games like Bot Fighter and Street Fighter.

Location-based services are on the horizon and will be a form of providing customized experiences, services, and environments for social networks. Mobile Internet services that are designed to suit in-place group and individual experiences will further make the physical environment a personal and social space.

5 GROUP-FORMING NETWORKS: INTEGRATING THE SOCIAL AND THE TECHNICAL

WHAT THEY ARE

Group-forming networks (GFNs) represent the combination of human social networks and technical networks. GFNs are essential for understanding technologies of cooperation because they multiply the social and economic value from human–computer networks far more effectively and rapidly than other kinds of networks like television, telephone, or cable networks.

EXAMPLES

Social transaction networks such as those affinity groups of collectors and hobbyists on eBay reflect the ability of GFNs to create locally meaningful value. Other such networks include FreeCycle (http://www.freecycle.org) that connects people who share an interest in recycling goods and materials and reducing waste; Interra (http://www.interraproject.org/), a community development project that uses connective technologies to collectively direct a small percentage of daily merchant transactions to local organizations and nonprofits;

Group-forming networks (GFNs) operate on the basis of Reed's Law, which states that networks grow exponentially by the number of nodes. This rapid growth explains how social networks, enabled by e-mail and other social communications, drove the growth of the Internet beyond communities of engineers to include every kind of interest group. Reed's Law is the link between computer networks and social networks.

Exponential Network Growth

In the economics of computer-mediated social networks, four key mathematical laws of growth have been derived by four astute inquirers: Sarnoff's Law, Moore's Law, Metcalfe's Law, and Reed's Law. Each law is describes how social and economic value is multiplied by technological leverage.

According to David Reed, GFNs grow much faster than the networks where Metcalfe's Law holds true. Reed's Law shows that the value of the network grows proportionately not to the square of the users, but exponentially. That means you raise two to the power of the number of nodes instead of squaring the number of nodes. The value of two nodes is four under Metcalfe's Law and Reed's Law. The value of ten nodes is one hundred (ten to the second power) under Metcalfe's Law and 1,024 (two to the tenth power) under Reed's Law—the differential rates of growth climb the hockey stick curve from there.

Reed's insight emerged as he pondered the success of eBay and realized that it doesn't sell merchandise—it provides a market for customers to buy and sell from each other.

"eBay won because it facilitated the formation of social groups around specific interests. Social groups form around people who want to buy or sell teapots, or antique radios … I realized that the millions of humans who used the millions of computers added another important property—the ability of the people in the network to form groups."

Sources of Network Value

GFNs change the kind of value generated by the network that emerges from the creation of social capital within and among groups. They enable new kinds of affiliations among people that provide the possibility of new kinds of collectively constructed user-value found in media such as online auction markets, multiplayer games, entertainment media sharing, and other social group media.

Reed describes three categories of value from networks: the linear value of services aimed at individual users, the "square" value from facilitating transactions, and exponential value from facilitating group affiliations.

"In a network dominated by linear connectivity value growth, "content is king." That is, in such networks, there is a small number of sources (publishers or makers) of content that every user selects from. The sources compete for users based on the value of their content (published stories, published images, standardized consumer goods). Where Metcalfe's Law dominates, transactions become central. The stuff that is traded in transactions (be it e-mail or voice mail, money, securities, contracted services, or whatnot) are king. And where the GFN law dominates, the central role is filled by jointly constructed value (such as specialized newsgroups, joint responses to RFPs, and gossip)."[13]

His key observation is that scale growth of a network tends to shift value to a new category, despite the driver of growth.

STRATEGIC PRINCIPLES

Structure | GFN structures grow dynamically from the edge as affiliations form social networks and links across group; social networks have the structure of scale-free "small world" networks.

Rules | Social capital builds and grows from ties that form GFNs.

Resources | The value of GFN emerges from the joint creation of value as compared to pushed content or linear transactions between pairs

Thresholds | Exponential growth shapes thresholds.

Feedback | GFNs provide diverse feedback from their various subgroups.

Memory | GFNs support local community memories.

Identity | GFNs are identity building networks, both individual and group identity.

EXAMPLES (CONT.)

and the Media Venture Collective (http://www.mediaventure.org/call.html), a collective philanthropic venture effort to fund citizens-based media.

Knowledge networks like the Wikipedia, group Web logs, and open source peer communities leverage GFNs to create trusted communities of practice and production. (See Knowledge Collectives for more detail.)

6 SOCIAL SOFTWARE: THE MEASURE OF SOCIAL CAPITAL

WHAT THEY ARE

Social software is a set of tools that enable group-forming networks to emerge quickly. It includes numerous media, utilities, and applications that empower individual efforts, link individuals together into larger aggregates, interconnect groups, provide metadata about network dynamics, flows, and traffic, allowing social networks to form, clump, become visible, and be measured, tracked, and interconnected.

EXAMPLES

Web logs—or blogs—are easy-to-update Web pages with the entries arranged in chronological order, with links and content that is either critical commentary about the links and/or opinion or diary confessions. Web logs can serve as peer-to-peer filters for the constant flow of information online: each blogger can be a maven who collects important links and passes along important news in a particular field.

Social software brings to life the group-forming networks that Reed discusses by helping to make them concrete social resources. It provides a rich connective online environment by providing various applications that allow affinity groups, hobbyists, professionals and communities of practice, and social cliques to find each other, meet, and connect. As social software converges with location-based technologies and embedded communications tools, social software will help integrate social networks across digital and physical spaces.

Catalyzing Social Groups

In the 1990s, virtual communities grew out of the use of synchronous many-to-many media such as chat, instant messaging, and MUDs, as well as asynchronous media such as listservs, message boards, and Usenet.

These media were only the beginning of the branching evolution of many media that enable small and large groups to organize social, political, and economic activity. In the first years of the 21st century, the use of online community media has continued to grow: in 2003, millions of people posted nearly a quarter billion messages to more than 100,000 Usenet newsgroups alone. At the same time, new kinds of social media began to emerge, notably Web logs, wikis, and social-network software. More than 4 million bloggers now run up-to-the-minute mini-guides to their special interest, critical filters for Web content, a peer-to-peer news medium, a hybrid of diary confession and gossip.

Meanwhile, friend-of-a-friend software has become part of the daily toolkit for people who want to build their own social capital by extending their networks through their friend's networks. These tools even link to real time and real space: some work has been done with software designed for wirelessly linked wearable computers that use zero-knowledge algorithms to anonymously check each other's address books when users are in proximity, notifying them if they have a certain threshold of friends in common.[14]

The Significance of Metadata

A key component of social software are the tools that help make networks visible and help network members view connections and traffic in and out of their social spaces.

Blogdex (http://blogdex.media.mit.edu/) and Technorati (http://www.technorati.com) provide ways to order the influence of bloggers—to see who is connecting to whom, from where, and which are the most popular blogs. Technorati now shows on an hourly basis which blog posts link to others, and Blogdex, displays the online items that have been linked to by the most people in recent hours.[15]

Syndication is another tool that enhances the connective flows of Web logging and other online publishing media. RSS and Atom create, in effect, an entirely new metamedium for publishing to each other, enabling instant syndication of blog content and other dynamic content to other blogs, Web pages, and mobile devices. At the same time, an increasingly sophisticated means of "trackbacks" that alert a blogger to other blogs that link to a post, of adding comments to post and thus giving birth to a kind of ephemeral message board. Group blogs with reputation systems transform one-to-many publishing nodes into a many-to-many social network of social networks. The blogosphere is only beginning to break out into the mainstream, comparable to the Internet in 1994.

STRATEGIC PRINCIPLES

Structure | Social software supports scale-free network growth.

Rules | Simplicity of application interfaces help support social norms.

Resources | Social software concretizes personal relationships into social capital.

Thresholds | Social proximity is an important threshold indicator.

Feedback | Social metadata provides useful feedback on group status.

Memory | Social archives provide group memory.

Identity | Social software is a vehicle for establishing multiple personal brands.

EXAMPLES (CONT.)

Social-networking software provides a way to quickly forge or find new social connections and contacts. Each social networking tool has its own procedures for how to join or link to another network or make new contacts. Examples include including Friendster, Linked-In, Ryze, Tribe, and Flickr. Attempts to create a standard for decentralized, user-controlled social-network sharing, such as friend-of-a-friend (FOAF) protocol are another effort to integrate social-networking software with other applications in a way that preserves individual control of personal information.

Mobile presence tools transfer online presence media such as instant messaging buddy lists to the realm of mobile devices; they move social-networking systems into a dimension of right here and right now: whom do we know nearby, and which of the people nearby would we want to know?

7 SOCIAL ACCOUNTING SYSTEMS: MECHANISMS FOR BUILDING TRUST

WHAT THEY ARE

Social accounting systems are mechanisms for building trust among strangers and reducing the risk of transactions. They include formal rating systems, automatic referral systems, and collaborative filtering to establish the reputation of individuals and organizations as well as products and knowledge.

EXAMPLES

Transaction rating systems, epitomized by eBay, facilitate billions of dollars' worth of transactions for people who don't know each other and who live in different parts of the world.

Rated reviews, such as Epinions, create "webs of trust" as readers rate reviewers (and other raters) and reviewers get paid on the basis of their reviews.

Self-evaluating online forums, such as Slashdot and Plastic, enable participants to rate the postings of other participants in discussions; the best content rises in prominence and objectionable postings sink.

Reputation is the lubrication that makes cooperation among strangers possible. It's so important that some evolutionary psychologists see it as a possible explanation for the development of speech. Robin Dunbar, for example, points to gossip as a way to extend reputation beyond the small group; speech, then, is little more than a mechanism for gossip.[16] Social accounting systems extend this capacity for gossip with digital technology.

Cooperation on a Larger Scale

The most profoundly transformative potential of social accounting systems is the chance to do new things together—the potential for cooperating on scales and in ways never before possible. Limiting factors in the growth of human social arrangements have always been overcome by the ability to cooperate on larger scales: the emergence of agriculture 10,000 years ago, the origin of the alphabet 5,000 years ago, the development of science, the nation-state, and the growth of telecommunications are all examples of techno-cultural innovations that have enlarged the scale of cooperation, allowing the human population to expand and radically altering the way people live.

More recently, electronic communication networks have transformed the centuries-old institution of banking. Today's global institutionalized trust system of credit cards and ATMs, backed up by instantaneously available credit databases, authenticates millions of financial transactions every day—enabling a vast expansion of global commerce.

Escape from the Prisoner's Dilemma

Social accounting systems also offer a means to escape from social dilemmas like the traditional Prisoner's Dilemma game. This game pits self-interest against cooperation, and the choice turns on the question of trust: Does Prisoner A trust Prisoner B to keep a mutual silence pact?

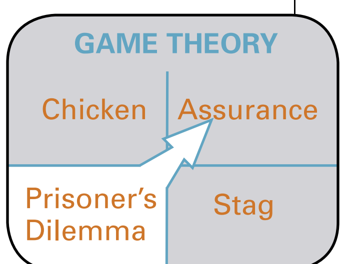
The true solution to the problem is to turn the Prisoner's Dilemma game into an Assurance Game in which players win by building their reputation as trusted partners. Social accounting systems build this reputation in a variety of ways, from formal, centralized rating systems to distributed collaborative-filtering mechanisms.

Risk as a Design Criterion

The choice of system depends on the risk involved. Automated collaborative filtering works best in low-risk situations—for example, the decision to buy a book or a movie ticket. Amazon.com and other e-commerce sites thus use collaborative filtering to make suggestions to regular customers.

When choices involve larger amounts of money or less certainty about the transaction, more explicit and formal rating systems work better. For example, eBay's reputation system answers this need with remarkable success.

Thus, as the currency of social accounting changes from knowledge or social recognition to money, the technology forks into two lineages of systems: those that deal with recommendations or other forms of knowledge and those that deal with markets.



STRATEGIC PRINCIPLES

Structure | Multiple sources of information and multiple paths to the sources increase trust.

Rules | Transparency shifts emphasis from punishment to prevention.

Resources | Trust increases the value of a market.

Thresholds | Aggregated statistics of behavior and ratings reduce the noise in an info-rich environment.

Feedback | Extending the "shadow of the future" reinforces cooperative behavior in the present.

Memory | Visible histories of interactions create an externalized, sharable memory.

Identity | Simple, quantitatively-derived icons represent complex historical behaviors.

EXAMPLES (CONT.)

Automated recommendation systems, such as Amazon's, aggregate customer choices to develop suggestions for products based on similar interests and tastes.

Implicit recommendation systems use statistical analyses to provide "best fit"—for example, Google's search engine lists first those Web sites with the most links pointing to them.

8 KNOWLEDGE COLLECTIVES: ONLINE KNOWLEDGE ECONOMIES

WHAT THEY ARE

Knowledge collectives are emergent online communities, structures and processes for "information hunting and gathering." They extend the capabilities of online communities to support collective knowledge gathering, sharing, and evaluation. They are notable for their scale and their ability to create ad hoc distributed knowledge enterprises.

EXAMPLES

Wikis are easy-to-edit group Web pages. They enable groups to create large, self-correcting knowledge repositories like Wikipedia. Anyone can edit any article; a complete archive of previous versions makes it easy to restore old versions, so it's easy to repair errors and vandalism.

Knowledge collectives offer an alternative way to organize a knowledge economy. Rather than treating knowledge as private intellectual property, they treat it as a common-pool resource, with mechanisms for mutual monitoring, quality assurance, and protection against vandalism and over consumption. Using some of the same tools as social accounting, they fundamentally transform knowledge sharing by drastically lowering the transaction costs of matching questions and answers. They draw on informal social processes to build collective knowledge and know-how.

Knowledge as a Common-Pool Resource

Informal online aggregation of useful knowledge goes back to the lists of "frequently asked questions" (FAQs) posted to some Usenet newsgroups, starting the 1980s. These lists of questions and answers, accumulated through years of archived online conversations, represent an early attempt to both create a common-pool resource from the informal social interactions of individual knowledge holders—and to protect this commons from over consumption. Experts contribute knowledge as long as the conversation retains their interest, but they stop contributing if newcomers' questions dominate the conversation. FAQs discourage newbies from besieging more knowledgeable posters with questions that have already been answered.

Beyond their defensive function, FAQs constitute a new kind of encyclopedia with collectively gathered and verified, and webs of knowledge about hundreds of topics.[17] In recent years, experiments in collective knowledge gathering have grown explosively, yielding several new forms of knowledge economies—Web logs, wikis, online collective publishing sites, and social bookmarking systems—all of which treat knowledge as a common-pool resource. In some cases, these resources far outdistance privately managed compilations.

Mutual Monitoring in Knowledge Economies

Elinor Ostrom has pointed to mutual-monitoring mechanisms as one of the fundamental requirements for successful institutions of collective action. In the world of knowledge collectives, mutual monitoring is achieved in several ways. Wikipedia, a project started on January 15, 2001, grew to over 1 million articles in more than 100 languages by September 2004.[18] To assure quality and protect against vandalism on such a large scale, Wikipedia uses the notion of "soft security." The integrity of the system is maintained by making a complete revision history accessible to all.

In online collective publishing systems, the quality of the content is also assured by mutual monitoring. In the publishing community Kuro5hin, all content is generated and selected by registered users who submit articles to a submissions queue and vote on whether submissions are published on the front page, in a less prominent section, or not at all. (In addition, the Scoop software that founder Rusty Foster developed is open source and freely available, spawning a next generation of publishing communities.)

Small-World Knowledge Networks

Knowledge collectives build on the age-old social game of accruing social status by distributing high-quality recommendations. Social bookmarking extends this practice in a way that can help build small-world knowledge networks (with the advantages of fewer degrees of separation). For example, del.cio.us is not only a knowledge-sharing tool but also a social software system: it matches users who bookmark the same pages or use the same keywords. Combining these two functions could be the key to growing organizations that take full cognitive and social advantage of knowledge collectives.

STRATEGIC PRINCIPLES

Structure | Personal knowledge structures aggregate to form broad-based knowledge communities.

Rules | Mutual-monitoring mechanisms assure quality and protection of resources.

Resources | Individual contributions and the collective value of the knowledge community are mutually reinforcing.

Thresholds | The cost of repair is less than the cost of damage.

Feedback | Ad hoc taxonomies reveal and reinforce emergent knowledge networks.

Memory | A complete history of revisions allows quick, cost-effective recovery from abuse of the resource.

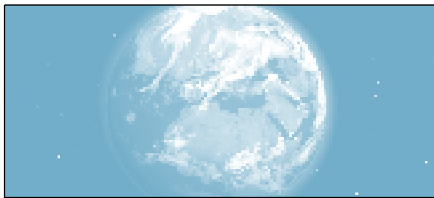
Identity | Personal reputation requires both personal contributions and peer review of others.

EXAMPLES (CONT.)

Social bookmarking allows people to share their Web bookmarks with others. Pioneered by del.icio.us, the software creates shared lists of bookmarks, grouped by keywords that users create—called "folksonomies" to distinguish them from more formal taxonomies.

Gaming communities are online communities that swarm to solve immersive games or puzzles, using online tools to win prizes. Collective Detective and Cloudmakers are examples.

Collective online publishing is a fusion of online conversations, online publishing, and online reputations systems form an alternative model for refereed publication. Slashdot and Kuro5hin are early examples. OhmyNews, with 26,000 citizen-reporters, tipped the Korean Presidential election.



Learning from Cooperative Technologies: Seven Guidelines

Every technology of cooperation holds a lesson for those who would like to experiment with cooperative strategies. Taken together, they suggest some basic guidelines for these experiments:

1 | Shift Focus from Designing Systems to Providing Platforms

Technologies of cooperation each reflect an important shift in the structural qualities of cooperative organizations—a shift from explicit design of systems to providing platforms for tool creation and system emergence. Wikipedia, eBay, FreeCycle, Open Source, synchronous swarms, and smart mobs were not designed, but rather they emerged from the intentional creation of tools and platforms for interaction and value exchange. This is an important distinction because it also shifts the role of leadership and management from an authority who explicitly shapes direction to a catalyst and periodic intervener who sets conditions and frameworks for interactions. Two key structural issues are scalability and modularity. Cooperative technologies tend to create modules (discrete pieces/kernels of code, sub-group social networks, geospatial focal points, and multiple identities) that can be combined to create larger scale social, transactional, and networked systems.

2 | Engage the Community in Designing Rules to Match Their Culture, Objectives, and Tools

Rules are an important way of framing the interactions and scope of behaviors in a cooperative system, and the community should be engaged in this kind of rule making. Rules originate from the community's own context, and should serve a specific purpose. In open source, the value of technical rationality, for example, frames the rule, "let the code decide" in matters of forking and code design. This is in keeping with the objectives of the open source community, whose goal is to create the best and most elegant software possible. If rules are not contextually meaningful they are bound to create friction, erode trust, and lead to possible defections. As Elinor Ostrom suggests, rules need to be flexible and adaptable, allowing the possibility of the creation of new rules if necessary—and local communities are more likely to observe peer-agreed contracts than coercive laws enforced by distant authorities. When individuals are able to engage in the creation and enforcement of rules, such as mutual monitoring, peer-level security mechanisms, and contribution to FAQs and other visible documentation of rules, the system of rules become more internalized within a group.

3 | Learn How to Recognize Untapped or Invisible Resources

A key attribute of cooperative systems is how they manage and value resources. Often assets may seem too small to be worth anything or too distributed to be harnessed, yet cooperative practices are quite effective at aggregating small contributions into larger, highly valuable resources. They also are capable of converting or translating private resources into public ones that provide broader wealth. Sometimes resources may not be visible or may not appear to have clearly measurable value. Through group-forming social networks and social-accounting systems, such resources are able to find measurable value in meaningful group contexts.

4 | Identify Key Thresholds for Achieving "Phase Shifts" in Behavior or Performance

Developing a competency for identifying, tracking, and monitoring various threshold points will be particularly important for managing cooperative systems. The technologies of cooperation exhibit specific kinds of thresholds that seem to be important in creating qualitative shifts in performance or behavior: ease of participation; scale of participation and reach of networks; degrees of separation within networks; costs of disruption and repair; signal-to-noise ratios; granularity of analysis and sense making, and the range of risk and uncertainty. Often standard thresholds—such as system capacity and bandwidth—are transformed by technologies of cooperation into something else. These are particularly important threshold shifts to track because they point to the emergence of new value and wealth in the system.

5 | Track and Foster Diverse and Emergent Feedback Loops

Feedback loops help create the deep memory needed for adaptive learning. Regular communication allows for actors to share information and adjust behaviors. Cooperative technologies tend to be open and peer-to-peer, allowing for feedback loops from all types of actors and layers in an organizational system. Feedback loops can be as simple as establishing frequent e-mail communications or setting up team or enterprise wikis and blogs. They can be more complex and involve setting up automated, real-time data gathering across organizational systems like work flows and production processes. As with thresholds, developing a competency in detecting diverse feedback loops and their relative value to the system will help increase the level of cooperation. Together with thresholds, feedback loops can provide important triggers to help moderate conditions in an organizational system, reducing defection or increasing the likelihood of cooperation. Often individuals themselves are an important source of feedback, as in the user producers of peer production systems. Metadata created by social software tools or tags and taxonomies created by users of knowledge collectives are other examples of feedback that provides a picture of the status and quality of cooperation in an organization and the resources being created.

6 | Look for Ways to Convert Present Knowledge into Deep Memory

Historical record and memory help to create a foundation for learning and future action. Memory is really at the core of becoming adaptive and flexible to the external environment, even as it rapidly changes. Cooperative tools such as auto archiving of the Wikipedida, social records symbolized in power seller icons in eBay, and visible histories of interactions all help create deep memory that members of an organization or system can rely on to guide future actions (establishing the "shadow of the future," as Robert Axelrod suggests) and to increase the opportunities for cooperation and the likelihood of a positive outcome.

7 | Support Participatory Identity

A key word related to identity in cooperative systems is participatory. The various technologies of cooperation all leverage and support different ways for individuals to express themselves through participation and contribution. As Steven Weber remarked (in a personal interview November 2004) about diverse motivations for participating in open source style efforts, "People actually want to be productive in the Freudian sense, in the erotic sense that Freud understood. Human beings like to leave their impression on the world and create things." Cooperative endeavors provide individuals that opportunity to satisfy their deep human need for productivity through participation and the creation of resources, artifacts, and value. Tools that help assess, track, make visible, and manage multiple identities related to production and participation will help stimulate cooperative systems.

A Final Note

Throughout this report we have been discussing how a range of technologies can shape cooperative strategy and lead to new social forms that will introduce a new set of strategic choices. A key point that shouldn't be omitted here is the role of competition. One clear lesson from this research is that cooperative strategy does not replace competitive strategy; the two are inter-related and co-evolve. A key challenge is learning to understand the dance between the two strategies, their respective range of choices, and the conditions that urge an organization to follow one or the other at a particular time period and environmental context.

For example, we've learned that a common strategy is to compete under conditions of scarce resources, but what are the conditions that would compel an organization to cooperate to multiply resources? We've also learned from symbiogenesis that species engage in symbiotic relationships to avoid competition and to develop new ecological niches that offer new relationships to other species and to new kinds of resources. Thus new social forms present new choices. Sometimes organizations may develop symbiotic relationships to carve out a new market niche and compete over a new resource. Sometimes competition on a local level spurs cooperation on a larger level, and vice versa. The point is that the goals and contexts that drive desires to compete and cooperate are always in flux, and thus competition and cooperation will likely become a pair of evolutionary strategies for organizations.

Endnotes

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