

The Dynamics of Information Revolutions: A Causal Loop Model

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Information revolutions change the world by taping into a positive feedback loop. If we can identify the loops we can understand where they might be going and what their limits might be. We need to know the difference between a short-term trend and a long term dynamic. We need to know where this information might be pushing us so we can know if it is where we want to go.

Trying to look at a category, as broad as information revolutions, to identify patterns requires an approach that will give a broad but well specified picture – a way to understand the positive feedback loops that create the growth and also to understand the countervailing loops that come into play in various ways. I believe that causal loop diagrams can give us a clearer picture of this kind of broad, messy problem.

Introduction

The screech of the amplifier when the microphone is placed close to it, falling in love, an arms race, all examples of positive feedback. Positive feedback is the push that drives a system off the chart, over the top – boom and bust. When we have something important invested in a system with positive feedback we win or lose big. Positive feedback is a characteristic of information revolutions. Information revolutions push systems to extremes. A small difference is amplified by information, which changes the system, which is then amplified again – a positive feedback loop in the classical sense.

How do we start? – Methods

There are several steps in understanding the complex phenomena of information revolutions. In each step we will find a clue to why one group is successful and another is not. The steps are:

- Identify the General Dynamic of Information Revolutions
- Examine the Impact of Limits and Timing on the Dynamic
- Examine the Impact of Change and Fear on the Dynamic
- Identify the Dynamic of Addictive Loops which Exacerbate Differences
- Competition and its impact

By looking at each of these issues and collecting clues from each we can stitch together a patchwork picture of where we are now and why and where others are in relation to us.

How do we know it works? – Evidence

Once we have the beginning of a causal loop model of the dynamics of an information revolution we can see how that model fits other information revolutions. This will help us establish a theory of how information revolutions work. Then we can apply the theory to today's issues and today's information revolution.

Zoom Out – the super system level

As a case study I will use the information revolution following the introduction of the printing press to Europe – **Printing Press Information Revolution** – to establish the general dynamic on an international scale.

A highly generalized picture of the flow of history for the information revolution following the press is presented in Table 1 Summary of the Printing Press Information Revolution.

Table 1 Summary of the Printing Press Information Revolution

Dates	Spain	Holland	England
Feudal – Pre press City States	Small kingdoms – City states	Backwater	Manor and guild economy, city and town are equal to centralized government
Press Introduced (1450) 1450 – 1500	Expansion and unification – colonialism, the age of exploration. Active Press	Colony – The Netherlands of Spain	Centralization and expansion to Kingdom
1500 – 1550 Expansion – The Renaissance State – The Reformation (1517)	The Inquisition Printers move to Holland	Growth of literacy & Mercantilism – Feudal Economic State	Encouragement of Printing under Henry VIII
1550 – 1650 Holland's Golden Age – Absolutism	Extractive economy	Revolution (1566) The Golden Age	Bloody Mary 1553-1558 – Printers move again Pre-capitalist production begins under Elizabeth
1650 – 1700 Economic dominance shifts to England – The emergence of the Nation State	Economic collapse	Slowdown of economic growth	Early forms of Capitalism boom – England begins to dominate the economic world

Zoom In – the system level

I will use the information revolution following the introduction of the telegraph and telephone – **Electric Information Revolution** – as a source for clues on organizational restructuring. A highly generalized picture of the flow of history of the information revolution associated the telegraph and telephone is presented in Table 2 – Summary Electric Information Revolution in the United States.

Table 2- Summary Electric Information Revolution in the United States

Dates	History of Organizational Change	Technological, Political and Economic Events
1830 – 1840	Organizational structure unchanged since 15th century	Invention of the telegraph First railroad building boom – all of less than 50 miles
1840 – 1880	Beginnings of organizational change in rail and communications based on structure of telegraph switching networks. Railroads not rationalized go out of business during the depression.	First organizational chart created by Daniel McCallum – 1855 Invention of the telephone – 1876 Civil War Depression – 1870
1880 – 1920	Spread of managerial hierarchies out of communications and transportation to distribution and production	Depression – 1889
1920 – 1929	Expansion and consolidation of hierarchically managed organizations	Long Boom – Economic dominance switches from London to New York
1929	Depression weeds out organizations not restructured into managerial hierarchy	Crash of 1929

[note: On the international level during the Electric Information Revolution economic dominance shifted from Europe, especially London, to the United States. During the early years of the revolution England successfully used the telegraph and railroad to administer her Empire but she did not adopt the telephone when it was introduced and did not change the organizational structure of business.]

Focus – the individual level

At the most focused level there are changes in how people relate to each other and in their perceptions of themselves, their families and their world. I will draw on both previous information revolutions for examples of change at this level. A general picture of some of the trends for individuals in information revolutions is presented in Table 3 – Trends for Individuals in Information Revolutions.

Table 3 – Trends for Individuals in Information Revolutions

Cause	Population	Effect
Economic restructuring	workers	increased professionalism and specialization, dislocation
	women and children	increased dependency on the family, decreased access to economic opportunity, increasingly seen as needing protection, increasingly grouped together as non-participants
	individuals	increasing individual identity associated with professionalism – ethnic group, religion, family or class becomes less and less important for individual identity
	families	decreasing size, decreasing economic participation, decreasing stability
access to a wider world	all	increasing innovation, increased need for education to be full participants in the society

	various sectors	increased awareness of social problems leads to conservatism, xenophobia, desire to return to a simpler age – FEAR
	other sectors	increased awareness of social problems leads to liberalism, reform, concern for the restructuring of social institutions, politicization and organization for the purpose of reform

What Are the Dynamics of Growth in an Information Revolution? – Model

To answer this question we need to start with basics. We have to go back and imagine a simple system and then think about what an information revolution does.

To start with a simple system, consider Figure 1- A Simple Economy. It shows that an increase in capital investment leads to an increase in growth. Which after some lag while the investment works through the system results in more investment.

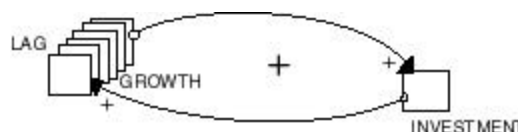


Figure 1 Simple economy

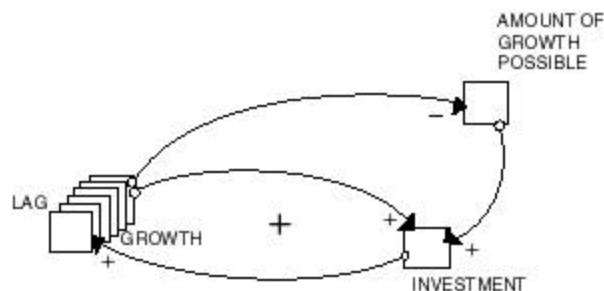
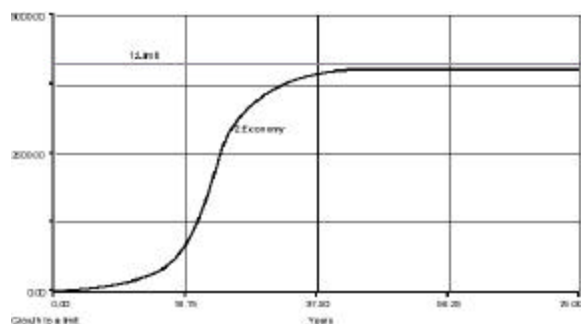


Figure 2 Limit to growth

Now we know that this is too simple; that there are always limits to growth, market limits, economic limits, production limits, even in the case of farm production, ecological limits. Thus we need to show a limit to growth resulting in Figure 2 – Limit to Growth.

If this was all there was to our system we would have a graph that looks like Graph 1 – Growth to a Limit.



Graph 1 Growth to a Limit

Because we want our economy to grow so we need to think in terms of what makes limits change. A new technology makes it possible to produce more. A new management strategy reduces the costs of production. Innovation raises limits.

Innovation, in turn, is limited by the success of innovation because of the law of diminishing returns and because people do not hunt for new strategies when old ones are working.

This is why we are always in danger of fighting the last war or solving last year's problem. This gives us the dynamic shown in Figure 3 – Innovation. As the economy grows there is an increase in success – economic growth. As success increases there is a decrease in innovation

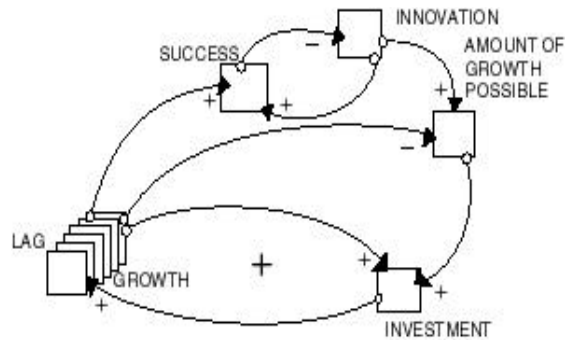


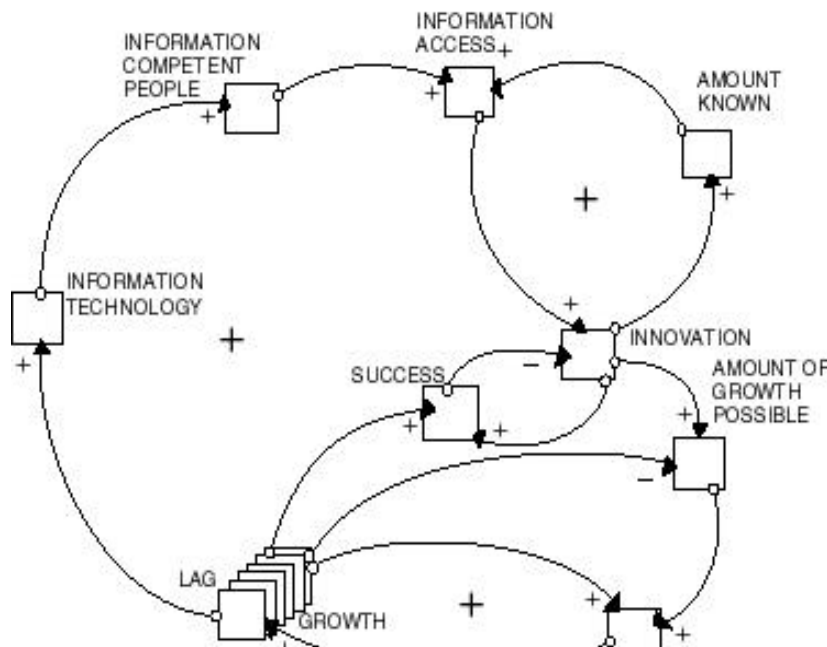
Figure 3 Innovation

Information access increases innovation. I define information access as a factor of the amount known and the number of informationally competent people.

The amount known is increased by the amount of innovation creating a powerful positive feedback loop. The number of informationally competent people in the society is increased by information technology that is in turn increased by the wealth of the society. This powerful growth loop is shown in Figure 4 – Information Access.

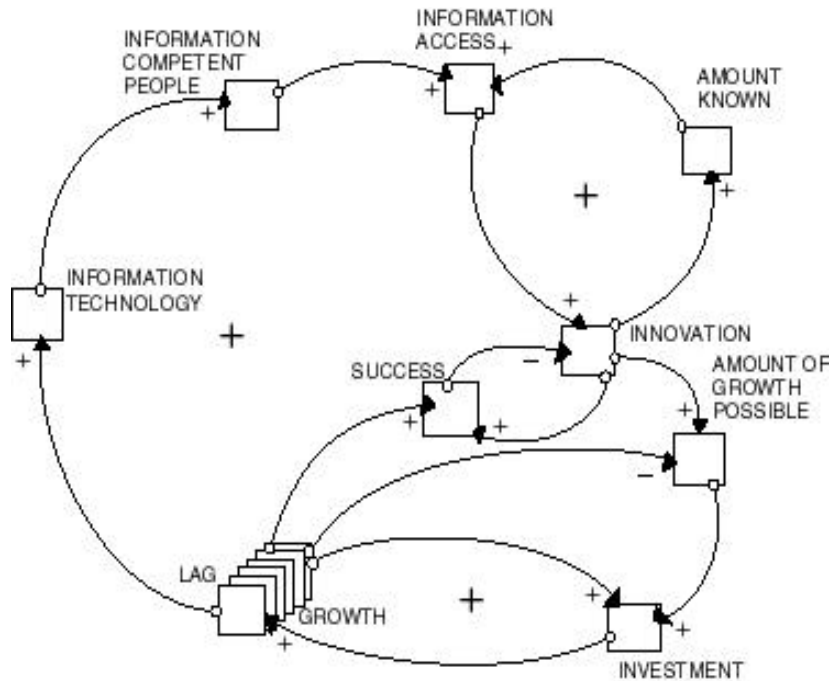
Discussion and Example

The model shows, success tends to decrease innovation. If you are successful in the way you are doing things you are unlikely to look for new ways of doing it. Therefore it is important for there to be people who are not successful who push the limits of innovation. Microsoft has been pushed by the success of Netscape. If left to their own devices Microsoft would not have developed Internet technology. Both Bill Gates and Mark Andreeson (the developer of Netscape) made their initial innovations as college students, not as members of successful elites. They are now members of an elite and need to be pushed by other up and coming innovators.



Clue: The Depth of Information Penetration

The clue here is information access (Figure 4 – Information Access) and the depth of information penetration. If only the elites have access to the benefits of information technology and the freedom to innovate the dynamic quickly reaches a limit. Thus it becomes particularly powerful if all members of the society have equal access to information technology and the freedom to



innovate. It is a simple matter of numbers. An example is presented in Table 4 – Innovation and Depth of Information Penetration.

Figure 4 – Information Access

Table 4 – Innovation and Depth of Information Penetration.

	Green Group	Blue Group
Innovation constant	0.1%	0.1%
Population	10000	10000
Information Penetration	10%	50%
Innovators	10	50

There will be more competition between the 50 in the blue group than between the 10 in the green group. This will push the blue group so they will innovate more.

The Down side

There is also a down side to information technology and to information revolutions. We must examine the positive feedback loops that have a negative impact; those connected with limits and timing, change and fear, and the exacerbation of differences.

Limits and Timing

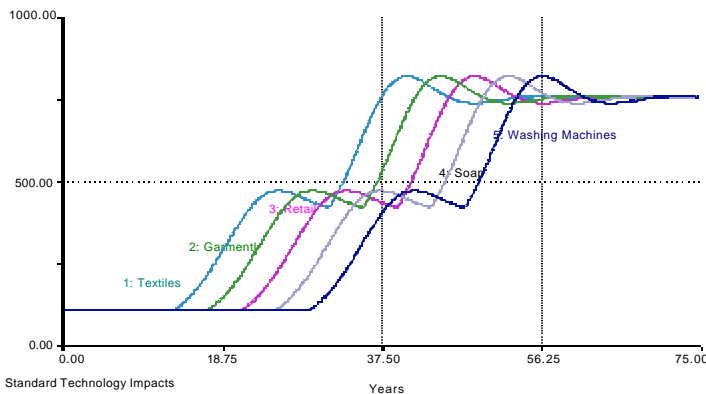
First, information revolutions also have their limits. The impact of reaching the limits to growth due to an information revolution are likely to be bigger, and more profound, than reaching the limits of a more standard innovation.

Let's do a thought experiment that compares the impact of some major standard technological innovation with the impact of a major change information technology. The cause and effect are organized in to columns in Table 5 – Innovation in Standard Technology. Time moves down the table.

Table 5 – Innovation in Standard Technology

	Cause	Impact	Sector
time 1	A new loom is introduced	increase in the amount of cloth produced for the same investment.	textiles
time 2	cheaper cloth	increase in the clothing produced for the same investment	garment making
time 3	cheaper clothing	more clothing bought	retail sales
time 4	more clothing to launder	increased demand for soap and laundry	soap making
time 5	innovation in washing machine technology	etc.....	washing machines

In this simple example we can see that innovation is good for the overall economy – more employment leads to more consumption then to more production. Once the increased efficiency has been realized there will be a period when the cloth manufacturers have not realized that the limit for that technology has been reached there will be a slight overshoot of investment-fueled growth and then an adjustment. This too will ripple through the entire economy.



Graph 2 – Impact of standard technology innovation on 5 sectors

If we were to graph this little economy it would look like Graph 2 – Impact of standard technology innovation on 5 sectors. The economy is benefited over all. There may be local layoffs as production increased with the same or fewer employees. When the sector of the economy reached its limit the economy as a whole is still strong and if people are displaced in one area they can look for work in another.

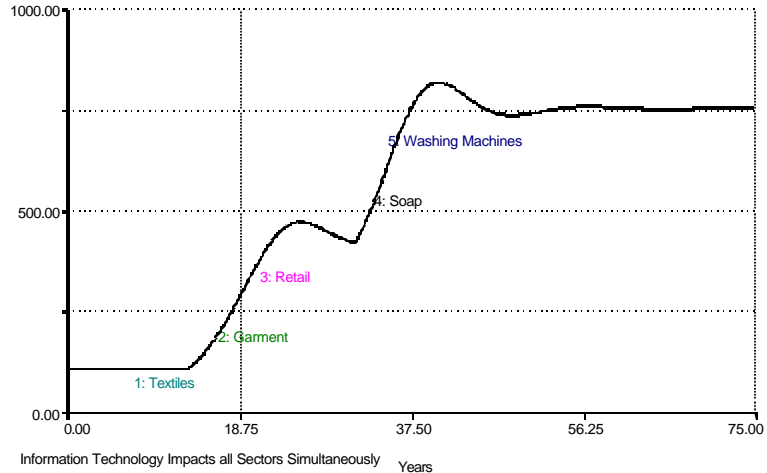
Now let us do the same thought experiment with information technology and see, in Table 6 – Innovation in Information Technology, how it impacts our little economy.

Table 6 – Innovation in Information Technology

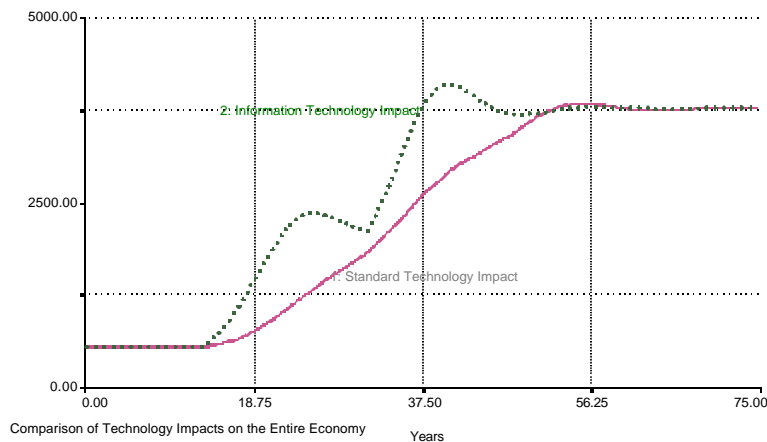
	Cause	Impact	Sector
time 1	innovation in information technology	savings in transactions costs	textiles, garment making, retail sales, soap making, washing machines

All of the improvements are made at the same time period. If we were to graph this little economy it would look like Graph 3 – Impact of information technology innovation on 5 sectors. All the graph lines are on top of one another. If we create a curve that represents the sum of standard technology impact and compare it to a curve that is the sum of information technology impact we get the two curves in Graph 4 we see that even though both kinds of innovation have the same ultimate limit, the information technology growth is faster, the overshoot is higher and the adjustment is more severe

In the curve representing the summed impact of standard technology the overshoots and adjustments are smoothed presenting a picture of steady growth.



Graph 3 – Impact of information technology innovation on 5 sectors



Graph 4 – Comparison of Technological Impacts of Standard Technology and Information Technology on the Entire Economy.

In our thought experiment we have only looked at how it works without taking into account how people would react. If this scenario were true the down swing would be exacerbated two reasons:

- 1) There is no sector to take up the slack. All sectors grow, overshoot, and adjust at the same time. People are less likely to find jobs once they lose one since all sectors are experiencing the same phenomena.
- 2) When investors see the marked down turn of the economy they are less likely to keep investment coming in at a constant rate as they do in the model. They would be more likely to pull out of investments driving the economy down further.

Examples

This may account for the long cycles of major depressions identified by Kondratiev (in Modelski, 1987). There are small fluctuations and adjustments that we think of as standard growth and adjustments but they in turn are part of a much larger pattern of long-term growth and depression.

After the introduction of the press there was a long period of growth – the boom of the 16th century – followed by what historians call the crisis of the 17th century (Mousnier et al, 1987).

The telegraph saw a major railroad and telegraph boom followed by the crash of 1898. (Attali and Stourdze, 1977)

The telephone brought another long boom during the 1920s that ended in the crash of 1929.

How will this information revolution boom end? Are we at the first crash of a long decline or are we in an adjustment period?

Clue: Boom and Bust the Impact of Simultaneous Impact

The clue here is the long boom and the sharp down turn and adjustment that comes from simultaneous impact of information technology.

Change and Fear – Model

This, appropriately enough, brings us to a consideration of fear. Information revolutions create change and change provokes fear.

Depressions create fear.

Information Revolutions lead to reorganization of economies. Reorganization of the economy leads to reorganization of businesses and to layoffs. Layoffs create fear.

Information revolutions bring more news to people. People are pushed to think about people who are not like them and to deal with crime and violence in places far from their homes. As information permeates their environment they rely less and less on their own perception of their neighborhoods and rely more on the media representation of the world in general.

Reorganization of society leads to social unrest and social unrest leads to fear.

People who have more information access and more access to each other are better able to innovate. Innovations are not limited to businesses. There are innovations in religion, the reformation was a religious innovation of the print information revolution, and fundamentalism was an innovation of the telegraph information revolution.

Family structure changes as a result of different economic conditions – changes in family structure, gender definition, and identity create fear.

All receive more news about a wider world. Some feel threatened and respond to that new information by trying to get back to the “good old days” to how things were before. Many analysts feel that the response in the last election was a response to fear. Interestingly enough the places most likely to be affected by terrorism did not vote their fears possibly because they are inured to fears. Those least likely to be affected by terrorism seem to have fear it more.

Others feel the need to reform the society or the world, thus creating more innovation. They may also be acting out of fear but the response is different.

The response to change determines how the information revolution pushes the economy, the culture and the world.

If we go back to the system we developed in the first part. The growth system shown in Figure 4

Information Access. As it stands it is a powerful growth system. Now we need to consider the impact of the sense of threat many people experience because of innovation. This leads to Figure 5 – Innovation Increases Threat.

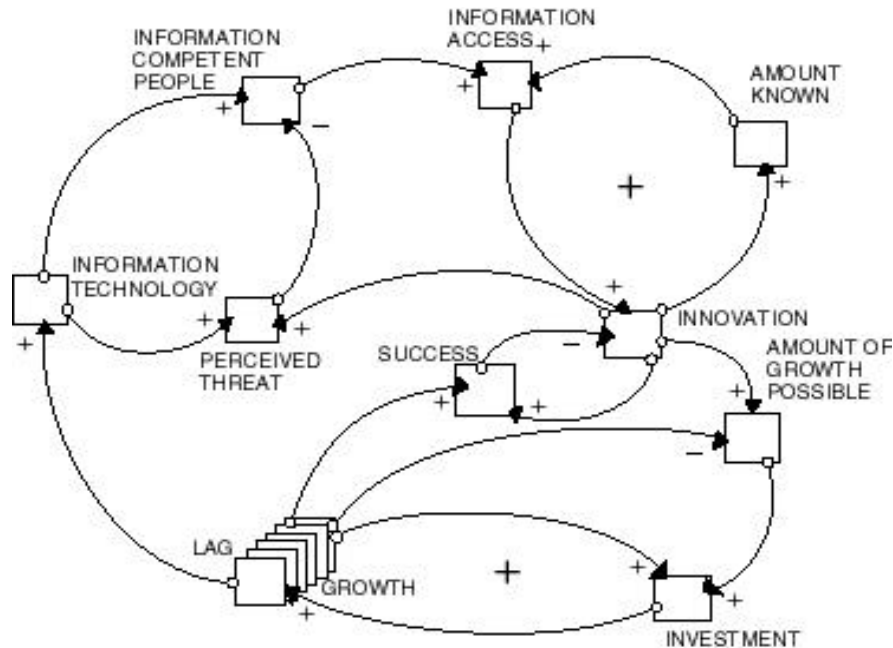


Figure 5 – Innovation Increases Threat

In previous information revolutions people have responded to their sense of threat by failing to adopt or suppressing the information technology.

When this happens the competition from the groups that do adopt information technology changes the dynamics of the system as a whole. This happens on individual, local and national scales.

Individual – more people with access to interactive information technology leads to more innovation, more of a feeling of empowerment, and a greater sense of individuality. Innovation in social, gender, familial and religious life is more likely where there is greater depth of information penetration.

Business – the businesses that adopt information technology and restructure accordingly are able to produce more product per investment and take over market share

Nation – the countries that adopt information technology and restructure accordingly are able to administer more efficiently. This in turn can lead either to an expansion of the area administered – colonialism, or consolidation and centralization, or to greater efficiency in governing.

Examples

Religion, the Press and Economics – Spain, Holland, and England

During the information revolution following the introduction of the printing press the Spanish responded to the threat of innovation in religion by controlling what books were printed and shutting down presses.

The printers, in turn, moved to Protestant Holland, which was then the Spanish Netherlands, and other Protestant countries. There they were able to print whatever would sell. The consequence of this is that the Protestant countries, with their glut of printers, developed a literate merchant and crafts producing class who invented first mercantilism and then capitalism. Spain, and other Catholic countries where the press was controlled, retained their old class, educational and economic structure. They lost out to the more efficient Protestant countries in both economic competition and in war (Whitney-Smith, 1991a).

The Telegraph, Telephone and Economics – England, and America

During the electric information revolution associated with the introduction of the telegraph and telephone Britain was an effective user of the telegraph and used it to establish and administer her empire. Her businesses and government became complacent and did not feel the need to adopt the telephone. As a consequence she lost economic dominance as American businesses expanded and restructured during the early days of this century. An expansion made possible by the telephone.

But the shift of economic dominance is not the whole story of the impact of fear. In both Britain and the United States there was a moral conservatism that produced Victorian morality, prohibition and xenophobia. People in the United States wondered if it would be simpler just to “know nothing”. These groups were instrumental in passing laws from prohibition to restrictive immigration laws, to the establishment of public schools and child labor laws. Some of these people are seen today as reformers and some as crackpots but in many ways both were responding to their sense that the world they had known and been comfortable in was changing. The public school movement was intended to teach immigrant children how to become "Americans". Religious Fundamentalism comes out of the same sense that modern people need to be called back to God. The way people responded to their expanded picture of the world determined how they acted.

Clue: The Impact of Fear – Reaction or Reform

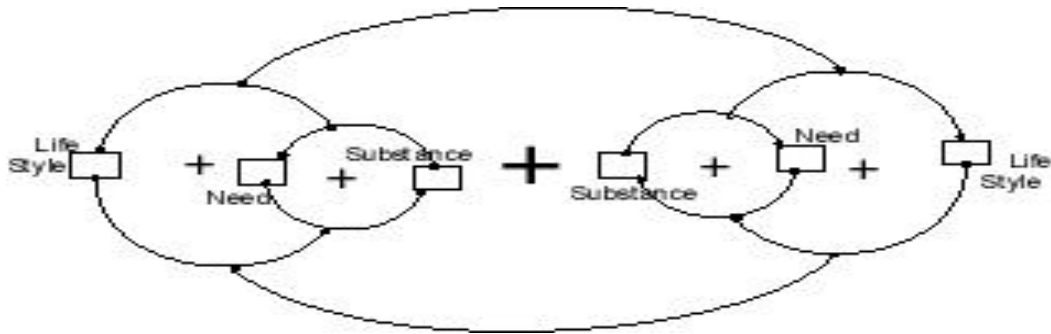


Figure 6 – Positive Feedback Exacerbates Differences

Exacerbation of Differences – Model

This leads us to a consideration of how information revolutions push so that small differences are exacerbated so that over time they become large and unbridgable differences.

The form of the interaction is addictive, loops that are linked together in yet another positive feedback loop. The model is presented in Figure 6 – Positive Feedback Exacerbates Differences. The way one addictive loop works is that as the person uses a substance the need for the substance increases. As that entire loop increases the life style of the addict becomes more powerful and more ingrained. As the life style becomes ingrained the addictive loop gets stronger and harder to break.

The way this works in economies is analogous. As a group begins to change in response to a new information technology they become more addicted to that way of producing goods and services. They become less able to go back to the way of life they previously followed. They have increasing need for raw material to feed the improved production. Those who have not adopted information technology are less able to compete in the new information world. They are can, however provide raw material for the emerging way of production in the rival economy. As they sink their energy into extractive activities they are less able to create that kind of economy for themselves. In addition there are attractive goods and services becoming available and that requires money. Money can be obtained through greater extractive practice.

Examples

Spain, Holland, England, Money and Land Reform

Above we talked about why capitalism developed in the Protestant countries rather than in the Catholic countries. The initial difference between Spain's economic and organizational structure and those of the Protestant countries was slight. In fact, Spain was the wealthiest and the most advanced. She had gold and silver from her New World colonies. But her new world gold went to buy goods from Holland and England.

As Holland and England became addicted to the new way of organizing trade and production costs went down and quality went up, a good and economic addiction. Spain increasingly found that imported

goods were better and cheaper than locally produced goods. The upper class Spanish became addicted to Dutch and English goods. This wrecked the existing feudal crafts production.

One of Spain's economic ministers Gonzalez de Cellorigo lamented:

Our republic has come to be an extreme contrast of rich and poor and there is no means of adjusting them one to another. Our condition is one in which there are rich who loll at ease or poor who beg, and we lack people of the middle sort, whom neither wealth nor poverty prevents from pursuing the rightful kind of business enjoined by Natural Law. (in Elliott, 1967, p.196)

Because Spain needed money and there were no crafts people to tax agriculture and pastoralism were the only, stable, income sources. Farmers were part of a barter economy and were unorganized. Shepherders were part of a cash economy and had an organizational presence, the *Mesta*. There was more money to be gained from shepherders than there was from farmers. This encouraged the throne to make laws that favored the *Mesta*, giving them monopoly rights to large tracts of land. Thus the land tenure reform lagged far behind those of other parts of Europe.

Telegraph, Railroad, Cotton and War

For most of the 19th century Americans, or as they thought of themselves, Virginians, New Yorkers, Bostonians, held world views based in their local world. Weibe writes about the culture of the time period:

America during the nineteenth century was a society of island communities. Weak communication severely restricted the interaction among these islands and dispersed the power to form opinion and enact public policy. Education, both formal and informal, inhibited specialization and discouraged the accumulation of knowledge. The heart of American democracy was local autonomy...Almost all of a community's affairs were still arranged informally (Weibe, 1988, p. xiii).

However by the end of the century and into the beginning of the 20th that had changed.

By contrast to the personal, informal ways of the community, the new scheme (of the 20th century) was derived from the regulative, hierarchical needs of urban-industrial life. Through rules with impersonal sanctions, it sought continuity and predictably in a world of endless change. It assigned far greater power to government... and it encouraged the centralization of authority. Men were now separated more by skill and occupation than by community; they identified themselves more by their tasks in an urban – industrial society than by their reputations in a town or a city neighborhood (Weibe, 1988, p. xiii).

The change was due to an information revolution.

The telegraph revolution tied the northern states together. Increasing pace of industrialization, spurring it on with new organizational forms based on the telegraph-switching network – the managerial hierarchy.

The industrialization of the North pushed the South more into cotton. Cotton to feed the mills. Cotton meant an addiction to slave labor. Initial differences between the north and south were exacerbated.

There were two worldviews: the agricultural, local, feudal worldview of the south where birth determined class, wealth and access to information, and the emerging individualist view of the north

which savored the notion of nation, progress, and individuality. Enterprise was all that was needed for wealth and class. And enterprise was built on innovation and information.

As these two worldviews and two economies diverged the differences became greater and greater until they could no longer be contained – the result – Civil War.

Like Spain the South had been pushed to addiction to extractive economic practice and the life style it dictated. The south could not support the cost of the war. They had better generals and dedicated troops but industrialization, the telegraph and the railroads and more troops won out in the end.

Capitalism, Gender and Social Change

An example of this same kind of relationship on the individual focus level is the change in the perception of women and men over the time of the information revolution following the press.

In pre-press economies the family was a productive as well as a reproductive unit. Women participated in the production process. Wives of masters were partners in the family business so that if the husband died the entire unit could continue. Women, especially widows, ran every kind of enterprise and belonged to and voted in guilds. Men and women both participated in the training and supervision of all the members of the household as part of their productive and reproductive life. A man could not become a master of his craft until he could marry because a master craft shop needed both production of the item (the master) and business management (the mistress) to succeed.

In post-press economies the reproductive unit – family relationship was different. The craftsperson was now specifically a man. The education of apprentices and the supervising of journeymen had been major part of a woman's contribution to the production process was redesigned as production moved out of the home. The attention which men had devoted to teaching their own children was now devoted to supervising many workers. Keeping track of customers, incoming materials and outgoing product became easier with the spread of literacy and numeracy. Sons were taught to read in preference to daughters since property descended through sons not daughters. Thus men kept the “books”

The relationship between men and women became less and less equal as both were isolated by their respective roles. Over time the new organization of society became institutionalized. The new social relations were seen as natural. This changed the perceptions of what it meant to be a man or a woman. Women became identified with home, privacy, interiority, emotion and biologicalness. Men became identified with business, publicness, exteriority and mind (Whitney-Smith, 1991b).

The Electric Information Revolution Continued the Change in the Perception of Gender

The lives of women and children changed as cities grew up into skyscrapers made possible by the telephone and the elevator and the suburbs grew out (Pool, et al., 1977, p.127). Women became more isolated and more economically marginalized.

Over time more goods were manufactured and more people had disposable income. Markets expanded and so did the size and diversity of the economic sector, the sector associated with and run by men. Women and children participated as underlings. They worked in sweatshops and mills as more and more of what a family wanted was to be had for cash rather than made at home. Still, until recently, most women had important economic roles and many had an independent source of income.

To keep the business sector expanding, it was important that women buy manufactured clothes and factory preserved foods rather than doing the work themselves. This positive feedback loop emphasized man as breadwinner and de-emphasized woman as bread maker.

One of the pumps that kept this feedback loop moving was advertising. Advertising did a great job of selling the American Dream. It gave people new criteria for happiness and told them it could be achieved with money.

The electric information revolution completed what the press started – the real world is the economic world. The definition of the family has changed. Women used to produce everything from thatched roofs to beer now only produce sex and children.

The entire definition of gender has changed and along with it the way we define individuals. We now define people by their occupation not by their social position or their family – we say *I am* a doctor or an engineer. We define our existence in terms of our relation to money not of our relation to each other. Until recently this was exclusively a male identification, women were still defined as wives – social relations.

Clue: Small Initial Differences Are Magnified by Addictive Loops

In each of these examples a small initial difference is magnified into addiction and co-dependence on new relationships and ways of living.

Competition and its Impact

The final thing to be talked about is the push of competition. When there is no competition and a new information technology is introduced it can be safely ignored. The dynamic becomes irrelevant. If it is adopted then there will be innovation but if there is no push of competition innovation will die down when people feel threatened or when they are satisfied with their success.

Example

China, Korea, Spain and the Press

China and Korea both had the press before Europe. In both countries the press was given and used by the ruling class. In Korea the Emperor used it to further his own social reforms. In China the civil service used the press. In neither country did the press result in wide spread innovation in the economic or social life of the country as a whole. (Needham, 1956)

The strategy of the Asian countries toward the press – government control – is the same strategy pursued by Spain but Spain was in a competitive context where as the Asian countries were not.

A Note on Competition and Information Technology

If an individual or group of individuals is able to control information technology and information access it is in their best interest to do so.

It is better to be the Emperor of Korea using the press to further his own political reforms than it is to be the King of Holland who has to deal with mercantile interests to maintain his position.

It is better to be a Spanish Grandee than to be an English weaver who is innovating in how he organizes the production of cloth.

It is better to be the head of a family owned British business who oversees every bit of production than it is to be an employee of a railroad restructuring it into a constrained bureaucratic hierarchy.

It is better to be the head of an Asian company who is maintaining his relationships with favored suppliers than it is to be a smart college student with a good idea for a new web product.

But for the system as a whole it is better to have the greatest depth of information access so that *competition from the bottom* will be encouraged.

Discussion

If we bring together our clues we can begin to think more clearly about how information revolutions work. Our clues are:

Information Dynamics and the Depth of Information Penetration

Boom and Bust – Simultaneous Impact

The Impact of Fear – Reaction or Reform

Small Initial Differences Are Magnified by Addictive Loops

Competition

We can visualize a scenario of how information revolutions work and a scorecard that will allow us to see how various countries are doing in this information revolution.

Scenario of Information Revolutions

An information technology is introduced

Amongst all groups who have access to the new technology there is a percentage of people who innovate. Some innovate by automating and extending existing practices, some by restructuring, and some by inventing something entirely new.

In some groups the elites have first access with others having access later, in other groups access is limited to the elites.

In all groups with access there is expansion and growth.

The limit to growth is reached and there is a downturn and adjustment. Where there has not been depth of information access (where access has been limited to the elites) the crash is severe. Where there has been depth of information access there are people ready to take the place of the less efficient who are weeded out during the downturn and adjustment.

Access to a wider world, innovation, dislocation and change creates fear. The initial reaction is apt to be reactionary – the desire to return to a simpler time. There are also those whose access to a wider world; innovation, dislocation and change spur them to work for reform. Where the former succeed in stopping innovation and reform there will be a cessation of growth and a downward spiral into poverty. Where the later restructuring which in turn create dislocation and change.

In groups where there is depth of information access there are two stages of growth one where the initial innovation is along existing lines done by the existing elites and one where non-elite members take over some of the economic space of those who fail during the downturn and adjustment period.

In groups where there is little depth of information access the downturn and adjustment is a crash with nothing to take its place.

The initial difference may be slight but the exacerbation of differences through co-dependence and addictive loops creates a great difference once the downturn and adjustment time is reached. For those who have made good decisions around information access and response to fear there will be further growth for those who did not there will be spiraling down into economic disaster.

If there is no competition then the depth of information access is irrelevant. In competitive contexts the most efficient group will have the greatest depth of information access.

The scenario suggests two phases of growth, one an elite stage when the existing order benefits from the savings in transactions cost to expand and one a more bottom up phase when members of the “out-group” expand into the “empty niches” left open during the downturn and adjustment period.

Score Sheet of Information Revolutions

If this scenario is true we can develop a checklist and see where we and other nations are in respect to “winning” the information revolution. The questions are:

Is there competition in the greater system?

What is the depth of information access?

What is the response to fear and change?

What are the small differences that may become addictive co-dependencies?

By asking and answering each question in turn these questions we can understand Asia’s current crisis and our own currently good economy.

Is there competition in the greater system? Certainly all groups are now in a competitive system. The isolation of 14th century China is no longer possible.

What is the depth of information access? The United States has great depth of information access – unlike the countries of the Middle East and Asia. This helps explain why the various downturns have had little impact on the economy as a whole. Not that we haven’t experienced the down side. Companies, and even industries have had to restructure. Recognition of this is why we have been willing to pay such high executive salaries.

What is the response to fear and change? For the most part Asia’s response to change has been to continue to do what had been successful in phase one growth. For the Taliban and some countries of the Middle East there has been a major reactionary response that has involved, corruption, fraud, abuse and terror.

Our response to change and fear has been mixed. Certainly there are people who have looked with longing at simpler times and want to return to them. Some have tried to legislate the morals and mores of that time. We see an increase in fundamentalist religious identification. We see an increase in anti-intellectualism and a wide spread distrust of "the other". We see an increasing effort to limit what will be taught in schools and what will be in our textbooks to "Christian" values.

Some have acted to try to control information access in the interests of protecting people, especially children from certain kinds of information – pornography. Thus far this has not been successful. And our access to information and information technology has continued. If in our reaction to terrorists we clamp down on information access this downturn will turn into a long-term stagnation and decline.

What are the small differences that may become magnified? The most dangerous possibility is the difference in the degree of information access of the underprivileged of our country and of the third world. People have access to the broadcast information technologies (radio, television, including cable) and have less access to the creative and interactive information technologies (computers and the internet). This is the worst of all possible worlds. People see the wider world, They experience dislocation and change without the power, resources or information access to act. Their reference group (on the media) has changed. In their previous reference group (the local society) they had power to act. But in the newly perceived wider, wealthy world they have less power to act then they did before. It also increases the fear factor and the feeling of helplessness as they see crime, terror, and war atrocities over and over without the access or power to even make a statement.

Further they see the elites of their own country doing better and better. The government that used to be away in the distant capital now has better administration tools and better ways of gathering, storing and correlating information. Individuals become much more exposed.

Add to this the fact that the richer countries, with great depth of information access are becoming more and more wealthy. Leaving countries with shallow and little access further and further behind.

Implications of the model

The United States would seem to be in a good shape. We score high in depth of information access and have made many of the right choices. We are confronted by some challenges:

- 1) Resisting the tendency toward complacency that comes with success.
- 2) Acting to reform and restructure when we are challenged by change and access to information about a wider world instead of reacting out of fear of the other
- 3) Dealing with effects of dislocation, change and access to a wider world and the resulting instability in our relations with other countries.
- 4) Coming to grips with the effect of the exacerbation of small differences that will increase instability.
- 5) Remembering that local self-interest may lead to addictive loops pushing us all into positions that lead ultimately to war.

Conclusions

I believe the causal loop model presented here makes the dynamics of information revolutions more clear. It provides a tool to "clean up" messy situations, especially those where a full-scale systems dynamics model would be inappropriate. Here we are not considering any policy we are trying to understand a complex situation one that might not have been explicable without some kind of model.

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