1 Foil

With a little over a quarter of a century in the technology business, I thought I might be able to offer some insight into where technology is, and where I think it is going, and maybe offer some advice on how to maximize your career potential.

I still do technology, and am the Chief Technology Officer or technical advisor on the Board of Directors of several companies.

2 Foil

In the last 25 years, technology has changed a lot. There is certainly more of it, but it has also changed qualitatively[22].

Now, it changes faster, becomes obsolete faster, and this has an impact on how product development teams do their work[15].

3 Foil

It used to be that the ambitions of a young engineering graduate was to join a large company, like GM, or IBM, (with me, it was Texas Instruments,) and work your way up through project management to middle management, and, with luck, into the executive suite[6].

Things have changed. In many of these companies, middle management does not exist, or is in the process of being down sized[6].

The reasons are, probably, many, but global competitive pressures, and modern electronically meditated management concepts are probably the most significant reasons[6].

Long term company and employee loyalty are largely a thing of the past-whether this is positive or negative depends on your point of view-but the reality is that professional mobility is an issue that will have to be addressed in your career[6].

Most of you will have 5 major career changes in your 40 year, or so, professional career[6].

By this, I don't mean changing companies, I mean changing professions[6].

4 Foil

Participation in global markets has redefined the concept of the corporation[6][19].

There is more impetus on the financial dynamics of a company[6].

As a note in passing, the 2 research and development laboratories that created the electronics industry as we know it today, ATT Bell Laboratories, and Sarnoff Laboratories, no longer exist.

This means that if a company is to survive, it will have to manage long term technological strategy, through incremental developments, that can be deployed in the marketplace on very short time intervals, and still be consistent with long term, strategic technological direction[6][5][13][21][10][16].

How to do this is the responsibility of the new technologist.

This means that the new technologist, besides being technically competent, must, also, be a “wizard” in finances and management[13].

It is very common today for a development team in North America, to be developing a product that will be manufactured in the Orient, and marketed in Europe[6][13].

For the most part, the many members of a modern product team will never have met the other members of the team[2][25].

So, in addition to financial and management acumen, the new technologist will have to be skilled in computational science-because computer mediated cooperative work is the way things are done in the global industrial marketplace[25].

5 Foil

Here's the bottom line.

Managing technology will be increasingly difficult, and you will spend a lot of time just "staying abreast" of new developments[26][2].

It used to be that large corporations could be expected to manage your career, through training, moving you around in the company to enhance your perspective, and so forth[6].

Not any more. You will have to do that, on your own.

Not only will you have to keep abreast of the issues of technology, but you will, more and more, have to be aware of the global issues of technology-including ethical issues[26].

To do that, you need a strategy.

6 Foil

When I graduated, (and no, Archimedes was not my thesis advisor,) I had a kind of academic view point of the application of technology.

I thought I was a technology applier. That won't work any more.

The world is more technologically sophisticated and complex now[26].

I would propose that you consider yourself a technology broker.

Not only do you understand technology, and how to apply it, you also understand the larger picture of how to integrate it into a corporate vision, and how the corporation fits into the global marketplace.

These are much more formidable issues.

This means that you will have to find new applications of existing technology for the global marketplace, as opposed to developing new technology through basic research-leave that to the Government and Universities.

Note also that the brokering of technology does not only mean for the products the company manufactures.

It also applies to internal agendas within the company.

For example, if the company needs to enhance its management capability in its foreign operations, computer mediated work would probably be the way to do it, and implementation would be the responsibility of the technology broker-even though you are, perhaps, in charge of the product development team[3][4][1][9].

When I graduated, a middle level management position in the aerospace industry was probably about the best that could be hoped for as career potential. Maybe, with luck, a few years in the executive suite.

Opportunities are different now.

I would highly recommend that you set short term goals of moving into project management, and then assuming organizational P&L (profit and loss,) responsibilities as soon as possible in your career.

These opportunities are available to you, as never before.

7 Foil

I would like to make some general comments about how to address the mobility issues of your career.

It is increasingly important that you maintain your personal network of people and contacts within the industry.

This network will be your most valuable asset throughout your career.

Chances are high, in the contemporary corporate environment, that you will, at least once, be “an expediency for corporate flexibility,” a polite term for down sized.

You will use your network to “make a place for you” somewhere else.

I’ll elaborate on the other essential uses for your network in a moment.

You will also have to maintain your technical resources.

By this I mean University contacts, contacts within professional institutions, contacts with the technology centers, for example, like the National Laboratory System, that you can rely on for technical advice and opinions.

I can not overemphasize the importance of maintaining these two things.

Many promising careers have prematurely ended for lack of attention to these two things.

8 Foil

I want to elaborate. Bear in mind that the company probably hired you for access to your network of contacts.

It is an asset to the company, and you can expect the company to foot the bill for it.

(As a passing note, everything is negotiable-when you sign on with a company, if Human Resources says they have a policy that they don't pay for such things, discuss it, before you sign on the dotted line, with your direct manager.)

Throughout your career, you should negotiate to be in charge of the company's technical agenda.

Some would call this technical leadership.

I prefer the word power[17].

Make no pretense about it, it is a political environment inside a corporation[11].

I want to make some comments about the last item in this foil.

If you study the history of Silicon Valley, you will find that Terman was a student of Vannevar Bush, and Bush made a lifelong commitment that industry and the university system should operate in a very close, synergistic fashion[14].

Terman took such an agenda to heart.

Several of Terman's students, the Varian brothers and Hewlett and Packard, to name a few, under Terman's encouragement, would go out of the academic environment and start companies, then move back into the academic environment, sometimes to study, sometimes to do research, sometimes to teach. Then back into industry.

We don't see much of this anymore. And that's a problem.

A problem that you can fix. To the advantage of your company.

9 Foil

Much the same can be said about your technical resources.

The National Laboratory System is a gold mine of techno-know how.

There is 850 gigabytes of technical archives that is available to any US company that has signed up with the technology transfer programs with the National Laboratories.

Need to know how to manage technical projects to budget with on-time delivery?

See the Management Sciences section of the Los Alamos National Laboratory archives.

Want to know how to do it globally, and electronically mediate it?

See the Information Sciences archives at Lawrence Livermore[20][12][24][8][23].

Need some advice on implementing it?

Put a university department on stipend, and bring a professor in to lecture the executive staff on the essential concepts.

By the way:

As a quick example of how to “link up” with the National Laboratory system, I used Mosaic (2.4Tue,) on the Internet to search for technology transfer.

The handout material you have was ordered out of the results of this search.

The total time was a little under 3 minutes, and I was linked up to folks that could handle my request.

10 Foil

Which brings me to the next thing I want to talk about.

How do you make the strategy successful?

Note that in the preceeding foil, what I described was a win-win scenario.

The university won. The company won. The laboratory system won. And, not coincidentally, you won.

Modern management science, (see the NASA archives,) has concluded that only a few members of an organization "make things happen."

Whether they are called "consensus makers," the "hidden organization," or just "operators," is a semantic issue, but whatever you want to call them, you want to be one of them.

In modern organizational architectures, like you will probably be in, there is enormous authority vested in the team[7]. That is why they are called "self directed teams."

Making the team work is what it is all about.

The people that do that are the people that are visible to upper management.

By the way, as a note in passing, you must also be your own PR agent-no one will do that for you, either.

What separates the “operator” from the others is an instinct to work to a higher level agenda and an intuitive grasp of strategic concepts.

(They also have an uncanny ability to avoid ego involvements-they win wars, not battles.)

11 Foil

Let me talk a little bit about that.

Much of the application of science is very tactical.

You should develop the ability to think strategically, at higher levels-and further into the future[10][21].

Be aware of the implications of what you are doing.

It is not easy to explain the difference between tactical and strategic thinking, but the “operators” can see a far bigger picture than the others.

Develop that capability.

The “operator” is the least vulnerable to ethical issues.

Also, as an engineer, a lot of what you have been taught is deductive reasoning.

Deductive reasoning is a powerful concept.

If you look at the “operator,” however, (like Vannevar Bush, or Frederick Terman, for example,) these people had developed a very mature capability to reason inductively[10][21].

These people do not play zero-sum games[18]. (In point of fact, they instinctively avoid playing such scenarios.)

They have larger agendas that are win-win games, where the whole is larger than the sum of the parts.

(An information-theoretic concept where the information contained in two pieces of data is larger than the sum of the two pieces of data.)

It is difficult to understand the difference between inductive and deductive reasoning.

Let me give you an example:

A man walks into a hardware store and tells the clerk that he wants a drill.

The clerk thinks, “we have wood drills, metal drills, concrete drills, etc., I wonder what he wants?”

The clerk is using deductive reasoning.

What does the customer want?

The customer wants holes.

That is inductive reasoning.

12 Foil

Lastly, expect that you will continously need to increase your skill set.

(I have been a university student for 20 years.)

Firstly, I would suggest financial acumen, and I don't mean accounting.

I mean being able to understand a P&L statement.

(You would be surprised how many project managers can not do that-but not as surprised as they frequently are.)

Secondly, I would suggest that you keep current on the ever changing landscape of management concepts[21][10].

The fields of management, and organizational architecture, are in a state of transition, and it is hard to keep up with the changes.

One way is to join the mailing lists on the Internet from professional management organizations, like BPR-L, the business process reengineering conferences, or the learning organization conferences.

It takes less than 5 minutes a day to stay current.

Finally, I would recommend that you understand what computational science is all about.

(No, I don’t mean being able to install Windows95, or run Excel.)

I mean be able to use a computer to search for optimal solutions to problems.

13 Foil

And where does this career path lead to?

Ultimately, to a startup, or the executive suite-if you are successful in mastering this stuff, and are lucky enough.

Luck may not have to much to do with it.

If you look at the strategic and inductive thinkers, they have this uncanny ability to “position” their careers, ie., be at the right place, at the right time, with the right stuff.

Kind of the hallmark of inductive, strategic thinking.

What skill set do you have to add to be a successful entrepreneur or executive?

First, you have to understand the difference between supervising and managing the activities of people-which, from an inductive standpoint, are not related, in the least.

In management, you set up systems that regulate the activities of people.

Supervisors tell people what to do.

Second, and closely related, you have to become comfortable with managing the actions of people through policy-and setting up organizational charters is an acquired art form.

References

[1] Richard H. Baker. *Networking the Enterprise*. McGraw-Hill, New York, New York, 1993.

[2] C. Gordon Bell and John E. McNamara. *High-Tech Ventures*. Addison-Wesley, Reading, Massachusetts, 1991.

[3] Mary E. Boone. *Leadership and the Computer*. Prima Publishing, Rocklin, California, 1991.

[4] Claudio U. Ciborra. *Teams, Markets and Systems*. Cambridge University Press, New York, New York, 1992.

[5] James C. Collins and William C. Lazier. *Beyond Entrepreneurship*. Prentice-Hall, Englewood Cliffs, New Jersey, 1992.

[6] William H. Davidow and Michael S. Malone. *The Virtual Corporation*. Harper Business, New York, New York, 1992.

[7] Kimball Fisher. *Leading Self-Directed Work Teams*. McGraw-Hill, New York, New York, 1993.

[8] Irene Greif, editor. *Computer-Supported Cooperative Work: A Book of Readings*. Morgan Kaufmann Publishers, San Mateo, California, 1988.

[9] Ray Grenier and George Metes. *Enterprise Networking: Working Together Apart*. Digital Press, Bedford, Massachusetts, 1992.

[10] Michael Hammer and James Champy. *Reengineering the Corporation*. Harper Business, New York, New York, 1993.

[11] Donald F. Heany. *Cutthroat Teammates: Achieving Effective Teamwork Among Professionals*. Business One Irwin, Homewood, Illinois, 1989.

[12] Robert E. Kraut Jolene Galegher and Carmen Egido, editors. *Intellectual Teamwork: Social and Technological Foundations of Cooperative Work*. Lawrence Erlbaum Associates, Hillsdale, New Jersey, 1990.

[13] Michael S. Scott Morton, editor. *The Corporation of the 1990's*. Oxford University Press, New York, New York, 1991.

[14] James M. Nyce and Paul Kahn, editors. *From Memex to Hypertext, Vanaver Bush and the Mind's Machine*. Academic Press, New York, New York, 1991.

[15] Marvin L. Patterson. *Accelerating Innovation*. Van Nostrand Reinhold, New York, New York, 1993.

[16] Tom Peters. *Thriving on Chaos*. Alfred A. Knopf, New York, New York, 1987.

[17] Jeffrey Pfeffer. *Managing with Power*. Harvard Business School Press, Boston, Massachusetts, 1992.

[18] William Poundstone. *Prisoner's Dilemma*. Doubleday, New York, New York, 1992.

[19] James Brian Quinn. *Intelligent Enterprise*. Free Press, New York, New York, 1992.

[20] Richard T. Watson Robert P. Bostrom and Susan T. Kinney, editors. *Computer Augmented Teamwork*. Van Nostrand Reinhold, New York, New York, 1992.

[21] Peter M. Senge. *The Fifth Discipline: The Art and Practice of the Learning Organization*. Doubleday, New York, New York, 1990.

[22] Preston G. Smith and Donald G. Reinertsen. *Developing Products in Half the Time*. Van Nostrand Reinhold, New York, New York, 1991.

[23] Lee Sproull and Sara Kiesler. *Connections*. MIT Press, Cambridge, Massachusetts, 1991.

[24] John Stark. *Engineering Information Management Systems*. Van Nostrand Reinhold, New York, New York, 1992.

[25] Don Tapscott and Art Caston. *Paradigm Shift*. McGraw-Hill, New York, New York, 1993.

[26] Shoshana Zuboff. *In the Age of the Smart Machine*. Basic Books, New York, New York, 1984.