
An Introduction to Communications Ecosystems

Kalevi Kilki

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For Paula

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Preface

The modern world is a peculiar mixture of technology, business, and human endeavors. Those three aspects are also the main ingredients of the communications ecosystem. Even this book forms a small part of the ecosystem. You might be reading this sentence through the Internet, or you may have found this book through a search engine, or maybe one of your friends recommended it on a social media site. Just twenty years ago, none of these now self-evident possibilities were available. Much has changed due to the emergence of the Internet and mobile networks and devices.

Yet, much has remained the same. We still try to fulfill our fundamental human needs, from instant enjoyment to long-term relationships, by any available means. Those needs and behavioral patterns are the result of a long biological and cultural evolution and, thus, are hard to alter. Communications ecosystem is a field in which actors and objects evolving at an amazing speed must interact with actors and behaviors evolving very slowly. The ensuing, almost incomprehensible process is very intriguing. Furthermore, it provides momentous business opportunities.

My intention is to provide tools for understanding how and why we use modern communications products and services and how they can be designed in a way that offers as much benefit as possible for the society as a whole. Thus, the target group of this book is those people that aim, in one form or another, to pursue that ambitious goal of common benefit. The most pressing reason for writing this book was the need for systematic and consistent study material for two core courses at Aalto University. I spent a great part of my mental resources during the last year achieving that objective. Still, I hope also that other people consider the result helpful or even enjoyable.

A book cannot be written in isolation. This book is a result of thirty years of experience in both academic and industrial environments. It is difficult to select just a few of my colleagues from those years to represent the crucial social system of professionals that helped guide me. To start with, in the eighties when I was starting my academic career at Helsinki University of Technology (now part of Aalto University) I had a lot of freedom to develop my own way of thinking thanks to Kauko Rahko, Tapio Erke, and many younger colleagues. Tapio and I have discussed numerous times during the last thirty years about the fundamental questions of networking and traffic models.

In the early nineties at Telecom Finland (now part of TeliaSonera), Juha Heinänen significantly affected the way I viewed the dilemma of traffic control in communications networks. As a result, I wrote a book about Differentiated Services and invented a couple dozen patents in the area of traffic control in packet networks. Most of those patents were invented at Nokia Research Center together with Jussi Ruutu. That was a wonderful period to work in the thriving networking industry.

Until 2002, my primary aim was to develop and to optimize network performance. But then our research group began to consider seriously the role of business objectives in the design of network services. The task of understanding and modeling the communications business continued in the research group led by Ilari Welling. However, it gradually became

obvious for us that any business could not be evaluated without a proper understanding of human needs and behavior.

During the following years, we developed many useful models to solve, at least partly, the problem of describing the relationship between the customers of services, business of service providers, and technology. Those models include the KK-law developed together with Matti Kalervo, the long tail model, and the concept of value of time developed together with Olli-Pekka Pohjola and Heikki Hämmäinen.

Yet, I remained dissatisfied because I could neither understand the full picture, nor depict the essence of human behavior. One of most rewarding forums to reflect on those issues was a Quality of Experience -seminar arranged by Markus Fiedler, Peter Reichl, and myself. Furthermore, one of my colleagues at Nokia Research Center, Jarno Rajahalme, told me about a remarkable course arranged by a great philosopher, Esa Saarinen. I was able to attend his course in fall of 2008. That course together with Saarinen's seminars in Paphos and in Venice deeply affected my insight into the nature of human relationships. In addition, Esa introduced many of the books recommended later in this book. Those who know Esa may even detect some other influences in the content of this book.

After I had twice lectured my courses, "Communications Ecosystem Analysis" and "Modeling Human Behavior", I became convinced that I had to write a decent book for the students of the courses. As I had already written one book and knew very well the magnitude of the task, I had to agree with my employer and superiors about practical arrangements. I am very thankful to Aalto University in general and to Heikki Hämmäinen, Riku Jäntti, and Raimo Kantola in particular for supporting my writing endeavor. In addition, a significant part of the work has been done in the MoMIE-project funded by TEKES (the Finnish Funding Agency for Technology and Innovation) and industrial partners.

Jarno Rajahalme, Benjamin Finley, and Juuso Karikoski gave many useful comments during the writing process. Benjamin also had the substantial role of proofreading the final draft of this book. In addition, discussions with Marko Luoma about the challenges of managing real networks have been crucial for me in keeping my thoughts about networks as realistic as possible. I am grateful for their help, as well as for the help of students who commented on the version used as course material in fall of 2011. Furthermore, numerous other colleagues have indirectly affected the content of the book—I thank all of them. As to the other important authors in the field of communications ecosystems, see Table A.3 in this book. Their books and articles have been vital for me in providing a solid basis for stating anything about those topics that I have limited or no professional expertise with.

I dedicate this book to my beloved wife Paula. Without her precious support, I would never have been able to write a book like this.

Kalevi Kilkki
Espoo, Finland
July 2012

CHAPTER I

Introduction

Any broad area of activities, such as communications technology and services, can be approached from many directions and by using various metaphors. Ecosystem is a metaphor, while machine, market, and factory are other examples of metaphors. The mind draws different pictures based on different metaphors, and different pictures lead to different kinds of reasoning. An ecosystem is something dynamic and lively while a machine is deterministic and mute. Market means exchange of products and money. Factory has a productive purpose. Although my background is in the area of networking technology, my preferred perspective is that of an ecosystem. Why? In a way, this book as a whole provides an answer to that question.

To clarify the position of this book, it should be noted that in this book “eco” does not primarily refer to biology, but to the lively nature of a communications ecosystem. The ecosystem consists of numerous more or less independent actors with their own properties, interests, goals, conventions, and behaviors. The result of all the interactions between actors and the interactions with everything that can be called environment forms a highly energetic system. The ecosystem generates some observable and expected products, like mobile phones and social media applications. However, if we want to grasp what is really going on in the ecosystem, we shall not limit ourselves to the narrow perspective of tangible outcomes, or even to a combination of technical and economic outcomes or perspectives. This book is based on the claim that in order to understand what is really happening in the communications ecosystem, we must be able to understand human needs and how those needs can be served by means of technology and economy.

It will likely become obvious for any reader of this book that the author is interested in philosophical reflection. Typical questions to be addressed is, what is the deeper meaning of something, and why are things this way and not that way? Similarly, let us take a wider perspective, is a characteristic approach to solve challenging dilemmas. A wide perspective means that a distant point of view is required. Because of that distance, I need some supporting tools to make any credible and accurate observations about the subject. In practice, other books with relevant insight are the most reasonable instrument.

Books also provide many special concepts. Andrew Pickering (1995, p. 215) has used the term “eclectic multidisciplinary” in a way that might describe the standpoint of this book. This kind of special concept, however, is hardly helpful without additional explanation. Multidisciplinary is something that is obviously needed in this effort to give a reasonable overview of communications ecosystem: any expert in communications ecosystem must have at least a modest knowledge about several disciplines and elementary knowledge in many other areas. Before reaching a necessary level of knowledge, the student encounters hundreds of similar concepts, often expressed by pairs of terms or even longer terms often referred to by

an incomprehensible acronym. For instance, BusinessDictionary defines over 20 000 terms in the area of economics. System theory adds many more, while the area of networking technology is extremely productive in creating acronyms (see IANA Considerations for Three Letter Acronyms, RFC5513, <http://tools.ietf.org/html/rfc5513>).

My interpretation of *eclectic multidisciplinary* is that a scientist or student observes a certain system methodically from the viewpoint of several disciplines, such as economics, sociology, and technology. Moreover, in this case we assume that the scientist accepts the norms, rules, and interests of every discipline, although they might be somewhat inconsistent with each other. As a result, the scientist produces several, probably incommensurable, pictures of the same system. The scientist may create elaborate economic, technical, and sociological models of a communications ecosystem. That is an excellent achievement, but not sufficient when we try to draw an overview of the ecosystem.

Thus, the aim of this book goes beyond pure eclectic multidisciplinary. My objective is to give a consistent overview of the area of communications ecosystem as a whole. This book provides both an analysis of specific parts of the ecosystem and a synthesis that brings together the parts in a systematic manner. Synthesis is sought by means of the following instruments:

- A common set of key concepts to harmonize the terminology used in the book.
- A universal criterion for a more and less preferred state of affair. While each discipline gives its own answer to the fundamental question of what better means, my statement is that we can define a universal criterion for assessing what we prefer in general for the society as a whole. The universal criterion serves as a common yardstick over all domains and disciplines.
- Seven rules for communications ecosystem experts that guide the thinking particularly in cases of complicated topics—and almost all important topics are complicated.
- An approach in which key phenomena are described by relatively simple mathematical models. Many of those models, such as the long tail model, are applied on several domains.
- Reference material, mostly books, selected especially for communications ecosystem experts. Each chapter except Glossary provides a recommendation of three relevant books both to enhance the knowledge of a particular topic and to provide a wider perspective of the communications ecosystem.
- A short story to evoke genuine feelings. The main purpose of the story is to demonstrate how different aspects discussed in this book are completely blended in our everyday life, although they are formally addressed separately within every discipline.

These instruments for enabling a useful synthesis are exploited throughout the book, in a way, as a horizontal dimension, if we define the ordinary book chapters as the vertical dimension. The common instruments encourage us to keep in mind the holistic perspective inside the chapters dealing with specific issues. Remember also that you need to train the usage of any instrument to make it useful for you. Moreover, without appropriate training a powerful

instrument might become a dangerous asset (consider, for instance, economic instruments such as the heavy use of credit default swaps that helped cause the recent financial crisis).

Structure

It is an immense challenge to design a workable structure for a book to address the numerous aspects of an ecosystem. Many readers have a tendency to read books from the first page to the last page, unless they decide to cease their reading before the end of book due to a boring or too difficult topic, or low quality. Thus, why should the author do anything else but write the book in the same order that he considers the best order to read the book? My answer is: because the author does not know what is the best order, and, besides, the best order might be different for readers with different backgrounds and with different ways of thinking. Nevertheless, a conventional book has to have the pages in a certain order.

Thus for alleviating this problem, Figure I.1 shows a kind of terminological map for this book. As to the following chapters of this book, almost any order of topics could be both justified and criticized. The book could start with technology, because the target audience of this book is assumed to master that domain better than the other domains. System theory could be a good starting point because it forms the theoretical basis for the ecosystem analysis. Furthermore, economics is the most important topic for many people as it defines the nature of interactions between actors forming the communications ecosystem. Finally, we may start with human needs because they form the driving force of the ecosystem as a whole.

The book is organized to the following chapters using letters as abbreviations:

- I Introduction,
- H Human Benefit,
- U User Behavior,
- T Technology and Networks,
- M Management and Control,
- A Analysis and Science,
- C Customer Satisfaction,
- E Economics and Business,
- S Systems and Society, and
- G Glossary and Index.

I have used four somewhat unconventional books as sources of inspiration when designing the overall architecture of the book: *The Tree of Knowledge* by Humberto Maturana and Francisco Varela (1992), *Platform for Change* by Stafford Beer (1995), *Orbiting the Giant Hairball* by Gordon MacKenzie (1998), and *Gödel, Escher, Bach* by Douglas Hofstadter (1999/1979). My goal has been to use all viable methods to illustrate the important ideas. In addition to written text, I use figures to give a visible form to the ideas, tables to organize them, and mathematical formulations to systematize them.

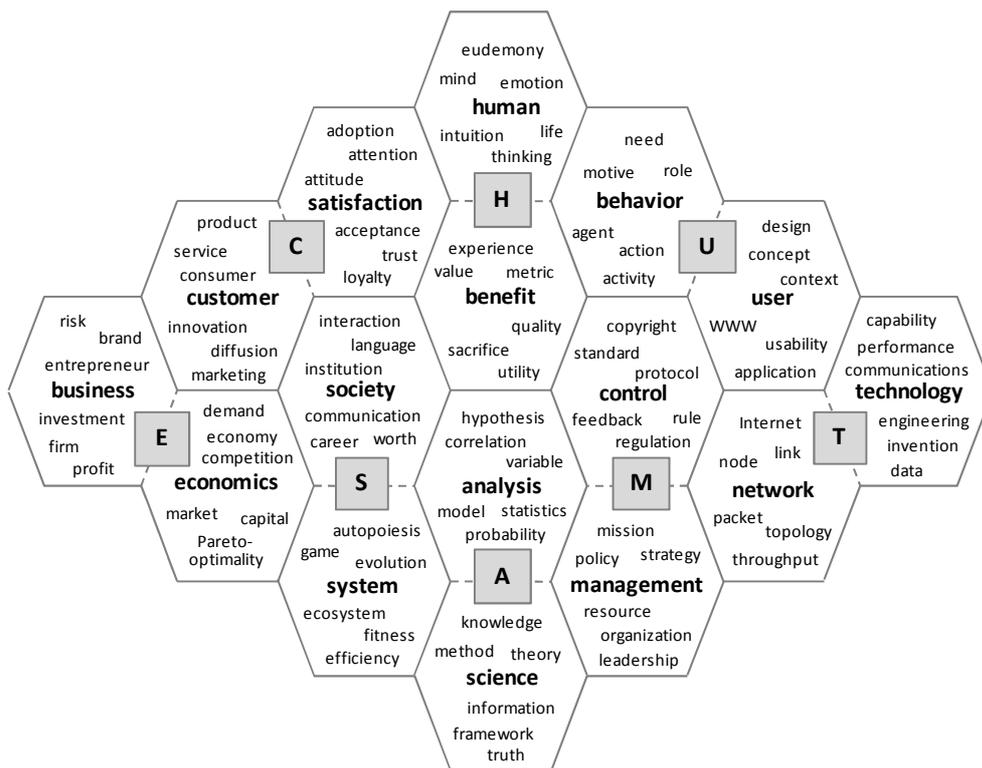


Figure I.1: Terminological map for communications ecosystem.

Finally, a story about two students, Henri and Irene, is revisited throughout the book. A piece of the story in the beginning of each chapter illustrates the topic of the chapter from the viewpoint of ordinary students that may later become experts in the field of communications ecosystem. The main objective of the story, in addition to the possible entertainment value, is to repeatedly remind the reader that the topic of the book is not just an academic exercise to be observed and studied, but that communications ecosystem is something that we are living in. That fact is both an advantage and a challenge from the perspective of systematic analysis.

When you read stories, you can exercise your ability to see the connections between different domains of human activities: economic, technical, human, social, and so on. A story, as told or written by an author, directs reader’s attention to a specific aspect, for instance, to fairness, success, or failure. A great example is the legendary story of Odysseus that ingeniously portrays human nature. Odysseus can be seen from many perspectives as Steve Talbott (2004, p. 1 - 18) has shown in his insightful essay. In the same manner, I strongly encourage you to regularly alter your viewpoint, because there is no single correct perspective to any complex phenomenon. Note also that the story in this book may include hidden meanings—some of them are unintentional, because all stories tend to evolve by themselves without intentional development. Here is the start of the story:

Henri walks out of the main building of Aalto University after a lecture. He is immersed in his own thoughts and hardly notices anything. The lecture was mind-boggling, not an ordinary lecture about some facts of reality but rather a well-composed story about the meaning of life. We, indeed, tend to put most of our efforts into coping with our everyday duties, mostly ignoring the effects of regular, small deeds on the path called life. The lecturer, a philosopher by profession with the nickname of Dr. Leopard, illustrated his message by both real anecdotes and fictitious examples, often related to some relationship challenges.

I spend most of my time trying to achieve something, instant pleasure or something more practical and lasting, but are all those endeavors important and do they serve my innermost needs and objectives? What is really important in my life? Should I somehow change my habits? These are Henri's thoughts as he walks towards his student apartment.

Yet, he has many other issues to be considered, and gradually he returns to his normal routines. First Henri remembers that he has only a couple of days left to finalize his assigned report on innovation processes in the IT sector. As a software engineer, he appreciates clean and efficient code and crafty applications with nice features. Regardless of this attitude typical for a software engineer, he has noticed during the innovation course that there is much more than programming skills that finally define the success of a piece of software.

His original plan was to consider an application that tries to optimize the departure time from home under certain conditions. For instance, a student might have a date with his girlfriend at 7 pm in a downtown café. There are all kinds of parameters that affect the real outcome of the event and, thus, need to be taken into account in the optimization process. Buses are sometimes behind schedule, the trip takes more or less time, the student may have an important task to be done soon, and sitting alone in the café might be more or less enjoyable. Moreover, the girlfriend might be either punctual by nature or not, which means that being late might be a real disaster or just a nuisance.

Henri had invented twelve parameters to describe the situation and had already devised a probabilistic model that determines the expected outcome from the student's viewpoint. If all the parameters are known, the optimization process is quite straightforward. Moreover, as an extra feature, the application would sound an alarm ten minutes before the person shall leave home in order to maximize the person's expected benefits.

Henri had already spent a lot of time to develop the model. He even programmed a preliminary version of the application, though with a cumbersome user interface. Now he has to make a business plan for a fictitious startup company that would commercialize the application. For that purpose he must consider issues like whether anyone is willing to pay for the application, who would be the main competitors, how many person months are required for the development of software, what kind of marketing is necessary, and so on. Henri has

to select among various business strategies, create a reasonable plan for the application developers, and carry out a credible business analysis.

Models of life

Some years ago, I said to a colleague, as a joke, that I cannot end my modeling task until I have constructed a model for the meaning of life. During that time, my colleagues and I were struggling with explaining why some new communications services were successful while many others were failures. Now the ecosystem model described in this book includes a concept that essentially is a measure for the value of life.

It is surely beyond my capabilities to solve the deep question of the true meaning of life. However, anyone who tries to construct a credible model to describe everyday behavior of real people will encounter the fundamental question, what does genuinely motivate people? Without understanding the motives of actors, any model describing human behavior remains terribly superficial. There is also another related but separate question: what shall we, in the end, consider a preferable outcome from the viewpoint of society as a whole? You may think that there is no need to consider the viewpoint of society, if your main aim is to optimize the business of private firms or to support the development of new technologies. Alternatively, you may think that it would be nice to understand what is preferable for the society, but that that is absolutely too challenging a topic for you to think about.

I had similar thoughts some years ago. Now I believe, however, that it is better to build an extensive model that takes into account the viewpoints of both an individual citizen and the society as a whole rather than to build numerous separate models. One reason is that some of our deepest motives are directly related to the society in general, and if we ignore those motives, we jeopardize the relevance of the model. As a result, the role of modeling in this book can be illustrated in Figure I.2. Any model shall be founded on our understanding about the behavior and motives of individual people. In addition, the model shall be able to describe the society as a system. Note also that this extensive modeling approach is not in conflict with the practical objective of developing business or technology, because the results obtained by the model can be used to evaluate business plans, the usefulness of technical inventions, and other similar matters.

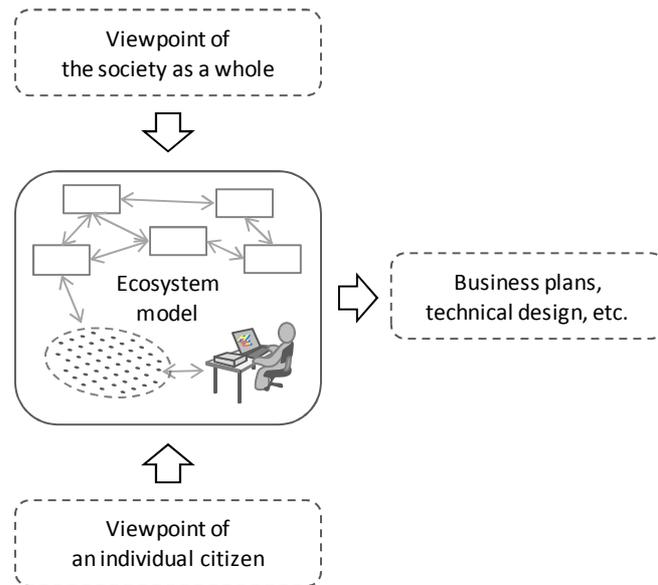


Figure I.2: Ecosystems models and viewpoints.

Terminology

The multidisciplinary nature of communications ecosystem poses a major challenge for the terms used in an introductory book. Even though I use, whenever applicable, general concepts that have one primary meaning over all domains, an inescapable fact is that each discipline defines terms in its own way. Think, for instance, of such common terms as value and quality. Those words are used in essentially different ways in different domains, leading sometimes to serious misunderstandings.

Another type of terminological problem is that essentially the same phenomenon is named differently in different domains. For instance, I use the term *network effect* to describe how the number of active users affects the benefit and cost of a service or application for an individual user. However, there are many other terms to describe essentially the same phenomena; for example, (network) externality is used in formal discussions, and side or spillover effect in less formal discussions.

If you want to become an ecosystem expert, you must be aware of this terminological diversity or even inconsistency. Thus, it is highly recommended to study the special terminology used in different domains using various special dictionaries publicly available in the Internet. Moreover, this book proposes a basic set of terms defined in Chapter G. Some terms have a special meaning including *communications ecosystem expert*, *value of time*, *net benefit*, *gross benefit*, *zero-benefit level*, *context factor*, *eudemony*, *sense of coping*, and *sense of significance*.

Then as to the acronyms, I try to avoid using them excessively, because acronyms tend to make the reading process more difficult. Still, I introduce one acronym just for this book, namely CEE as an abbreviation for communications ecosystem expert. When writing this book

I assume that you, the reader of this book, are pursuing a professional expertise in the area of communications ecosystem.

Skills and intelligences

Now you may ponder whether you have suitable properties to become a CEE. What kinds of requirements would I like to pose for a prospective student? The most important requirement is a genuine personal motivation. If you are primarily seeking a job with a high salary, CEE is hardly the best choice. Note particularly that there is no established social system for CEE's to support a project towards prosperity and fame. Hence, you must mostly rely on your own competence, find your own path through the ecosystem, survive, adapt, and maybe somehow reproduce by teaching or writing. Still, I could imagine that a motivated and skilled CEE would be able to make an outstanding career in the realms of service providers, device vendors, consultation companies, and regulatory organizations.

The career of a CEE can also be taken as a calling or vocation. There will surely be enough interesting challenges for numerous scientists, researchers, consultants, practitioners, teachers, and authors. If you want a fresh perspective on the dilemma between job, career and calling I recommend the extraordinary book by MacKenzie (see the book list at the end of the chapter).

Then you may be interested in knowing whether your skill profile is suitable for a CEE career. To answer this question we may use the framework of multiple intelligences proposed by Howard Gardner (2006). In Gardner's framework, each type of intelligence has an identifiable core operation and it is triggered by special information. Thus, intelligences have a strong biological basis. According to Gardner, there are eight types of intelligences: logical-mathematical, linguistic, musical, spatial, interpersonal, intrapersonal, bodily-kinesthetic, and naturalistic. Furthermore, Gardner is somewhat ambivalent about the existence of the ninth intelligence called existential issues or Big Questions.

The main argument by Gardner to support his insight about separate intelligences is that in every brain there are relatively autonomous areas for each of these intelligences in a way that proficiency in one type of intelligence does not predict much about the other intelligences. Standard intelligence quotient (IQ) tests measure logical-mathematical and linguistic intelligence, which makes IQ score narrow from the viewpoint of multiple intelligences. Even in the case of ordinary logical-mathematical and linguistic tests, the context-free setting might create a bias that favors certain kinds of persons.

The intelligences are illustrated in Figure I.3. You may try to memorize different system intelligences not as a list of terms, but as a figure. You may even memorize them by creating a poem or a song.

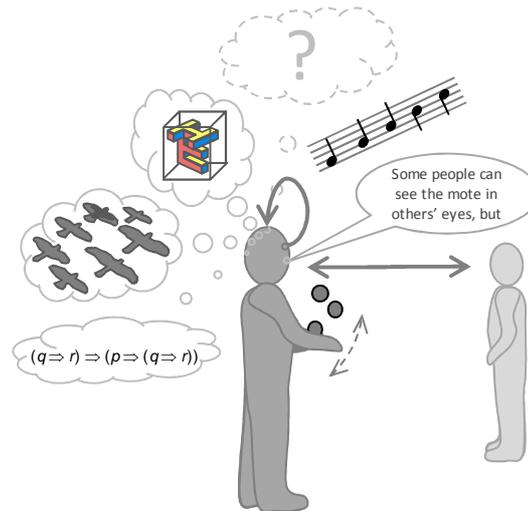


Figure I.3: Multiple intelligences illustrated.

Some people have so-called laser profiles, which means that they are exceptionally intelligent in one or two areas while other types of intelligences are either on normal level or below average. However, most of us are normal persons without any truly special intelligence. As to the requisites for CEE, I tend to think that a clear laser-profile might be harmful, unless the person is fully aware of the possible problems the special intelligence may produce. Working in a complex ecosystem (that is always multidisciplinary by nature) certainly requires multiple skills, at least in the areas of logical-mathematical, linguistic, and interpersonal intelligences. Thus, if you recognize clear weaknesses in any of these areas, you shall direct some effort to develop your skills. In general, intelligences and skills must not be considered fixed but something that can be developed throughout life. This important matter has been proficiently discussed by Carol S. Dweck (2006). Her key concepts are the fixed mindset and the

growth mindset: a mindset in which a person believes that he or she can cultivate his or her basic qualities through effort.

Whenever possible, nurture the growth mindset because that usually provides significant long-term benefits.

You may also attempt to find ways to compensate for weaknesses by exploiting some of your stronger areas of intelligence. According to my experience, skills in the intrapersonal and naturalistic areas can be useful when trying to understand the motives behind human behavior and when collecting information about various phenomena in the ecosystem. Consequently, you may compensate for weaknesses in the three main types of intelligence useful for a CEE. Moreover, the scope of CEE is so wide that a creative person might be able to utilize all types of intelligences in the spirit of MacKenzie (1998).

Some readers may read part of this book just for curiosity. Some others might be interested in the broader perspective and still aim at a more specialized career, for instance, as a researcher in a technical domain or business manager in an economic domain. That kind of motive is, of course, totally acceptable. Besides, everyone has an active role in communications ecosystem as a customer of services and as users of devices. Particularly, if your aim is not to become a CEE, my advice is to read this book in a free order; you may just read those chapters and sections that you are mostly interested in, and in any order you like. As an extreme approach, you may just open the book on a random page and read a paragraph or take a look at a figure—maybe there is something just for you.

Seven rules for communications ecosystem experts

The main content of the book can be condensed into the following seven rules. The rules have two motives. Firstly, the rules can be used as instruments to perceive connections between domains when reading the book. Secondly, the rules form an easy to memorize set of ideas that can be exploited whenever you need to weigh up complex real-life situations.

1. Rule of human benefit

Remember that human benefit is the driving force of all human ecosystems.

The most special term used in this book is

eudemony: a measure of the more preferred state of affairs.

The total eudemony of a society is defined by adding up all individual eudemonies within the society. Anything that increases the eudemony of an individual person is beneficial for the person, and anything that increases the total eudemony of the society is beneficial for the society. The formal question to be answered is: what would be the effect of an action or activity on the human benefit defined by means of eudemony? Although the route can sometimes be long and obscured, without the driving force provided by human benefit any activity or organization will eventually die. Human benefit can be conveyed through the ecosystem by various means, such as money or social capital. Discern and cultivate those flows.

2. Rule of metrics

Define carefully your own metrics and understand the metrics used by others.

A metric defines what is better or worse when something is analyzed and particularly when decisions are made. Thus eudemony is the metric for assessing human life, while profit could be used as a metric for business undertakings and performance as a metric for technical devices. Be, however, aware of the fact that the true

metric used when a person or organization makes a decision is not always the same as what they claim to apply. The true metric is revealed by the decisions that are made rather than by invented explanations. Select your own metrics carefully and intentionally, in both your private and professional life, and act according to those metrics. In that way, you can follow your heart and avoid endless games that you need to play if you apply different metrics in each particular situation or context.

3. Rule of all-inclusive evaluation

Assess individual behavior by means of your innate capability to simulate emotions and include all involved people in an impartial manner.

Every human being able to act appropriately in social situations has an innate capability to feel emotions when observing the behavior of other people and even when visualizing imaginary situations. First, use that capability to assess the benefit an action would create for the people that are directly affected by the action. Nevertheless, you must not limit the effort of emotional reflection to the most obvious individuals, because almost any action affects various groups of people. A small negative effect on numerous people often exceeds a big benefit achieved by one or a few people. Thus, you must not compare the merits of two actions or state of affairs by just assessing which one is able to create the most intense positive emotion (or sometimes, the least intense negative emotion) among all people somehow involved in the case. You must always consider the effects of any action to all involved people in an impartial manner, and take the number of people properly into account.

4. Rule of systems thinking

Take always also a holistic system viewpoint because in reality everything happens as a part of a bigger system.

The mind is sometimes amazingly efficient at grasping the feelings and behavior of another person. That capability can be used, according to the third rule to evaluate the total effect of an action. However, in most cases we are bad at modeling the overall behavior of large systems in which parts are continuously interacting with each other. Thus, whenever feasible, use your insight to select or build a simple model that is able to describe realistically the main aspects of different actors and their relationships. Then, use the model to assess the behavior of the ecosystem as a whole. Yet, remember the fundamental limitations of models, “All models are wrong” as John Sterman (2002) expresses it. Still you shall create an intuition about how systems work in general. The gathered insight and capabilities can be applied in a wide variety of cases, in other words, models and structures are often portable.

5. Rule of ecosystem evolution

Remember that an ecosystem can hardly ever be developed in a systematic and predictable way.

Our innate mental capabilities have evolved in a way that we are extraordinarily sensitive to the intentions of other people. That capability might even be the most important reason why we have big and energy-consuming brains. This fact leads easily to an assumption that a person can also intentionally change the nature of a larger system or an ecosystem. On the contrary, all ecosystems evolve in a more or less unpredictable way, which means they cannot be intentionally developed towards a predefined target. What is possible for us is to make interventions and then observe how the ecosystem will respond and evolve. Note also that a similar intervention performed later on may bring about different consequences.

6. Rule of positivity

Develop your manners in a way that your primary attitude towards yourself, other people, your environment, and life in general will be constructive and benevolent.

Positivity and cooperation are the wise ways of being selfish, because according to many studies they improve your own well-being, your personal relationships, and the success of the group in which you are working. This does not mean that you should intentionally suppress all negative emotions and always cooperate independent of the behavior of other people. Instead, it is important to let the emotions emerge and tell their message. But when you have understood the message, let the immediate emotion in most cases fade away. Only then, you can consciously decide how to react to the message told by the emotion. Your decision can and should be made based on your best insight about the future consequences of the action you will select. From that perspective, a neutral or positive reaction might appear better than an immediate negative reaction. Then if your decision is to promote cooperation with the other person, be as clear and consistent in your behavior as possible in order to build a flourishing relationship.

7. Rule of multiple intelligences

Use your multiple intelligences and capabilities in diverse and creative ways.

According to Howard Gardner, there are eight (or nine) intelligences: musical, bodily-kinesthetic, logical-mathematical, linguistic, spatial, interpersonal, intrapersonal, naturalist, and perhaps existential intelligence. Particularly, do not rely only on your strongest intelligence, because when analyzing ecosystems you must be able use various methods and perspectives to cope with diverse challenges. You certainly need some logical, linguistic, and intrapersonal abilities, but by some creative effort

and training you can, as a CEE, utilize all the skills you have: observe your own emotions, collect relevant information from all kinds of sources, make a mathematical model, create a story based on the results, present it with your colleagues by exploiting the physical space and your artistic capabilities. Finally, assess whether the whole effort was worth it—probably it was. Then move on towards the next challenge.

Further reading

Finally, I recommend three books in the end of each chapter for further reading, that is, 27 books in total. Each book has been important for me by providing some new knowledge, insight, perspective, or instrument to deal with the complexities of the ecosystem as a whole or with some special problems within the ecosystem. There is no limit to improving your skills, and there are always a larger number of interesting and relevant books that you will ever be able to read.

However, I do not assume that every reader reads exactly those recommended books; rather the objective is to use a limited set of books and articles as the main reference material. Because of the extensive nature of the topic, the total number of pages to be read (about 8 000) appears to be large. Nevertheless, if you want to become an expert of communications ecosystems you must read much more than this book. By reading a modest amount of 100 pages per week, it will take about one and a half year to read all the recommended material. My advice is, for anyone aiming at becoming an ecosystem specialist, to study relevant literature systematically, and maybe even literature that does not immediately appear relevant. This endeavor also requires that you are ready to examine the thinking of authors that you do not agree with, and become familiar with topics that you do not consider interesting (at least before reading).

Moreover, my tentative recommendation for a prospective CEE is to collect a small library of books at your own expense. Why? There are several reasons. First of all, the main sacrifice is anyway the time you need to spend reading a book. If you spend 15 hours reading a book that costs 15 Euros, it equals one Euro per hour. That is a small fraction of your value of time. Thus, in order to optimize the outcome it is better to maximize the benefits of the time consumed for the activity instead of minimizing the initial investment. Your own books are always available, you can put whatsoever marks you want in them, you feel more professional, and finally, it is more likely that you read a book if you have paid for it yourself.

Book recommendations

H. Gardner, 2006, *Multiple Intelligences*, New York: Basic Books.

The core message of this ingenious book is that we have multiple skills that can be intentionally developed. A successful career as a communications ecosystem expert requires not only the capability of exact reasoning but also many other skills particularly in the area of social interactions. Howard Gardner provides both a systematic

framework to consider different skills and practical advice on how to develop your skills.

J. Joyce, 1934, *Ulysses*.

Ulysses serves here as a reminder that it is highly recommendable to enhance your creativity and challenge your thinking by reading great fiction books. Joyce's classic book definitely is challenging, but I can guarantee that it will leave traces on your mind. You can read *Ulysses* also as a terrific analysis on the nature of human experience. Finally, I have used it as a source of inspiration in the short story written for this book.

G. MacKenzie, 1998, *Orbiting the Giant Hairball, a Corporate Fool's Guide in Surviving with Grace*, New York: Penguin Books.

This is a great book for those of you considering your future career. Could it ever be possible to fulfill your deepest wishes and use your creativity in large organizations? The answer of this unique book is yes—it probably means a continuous struggle, but the result could be very rewarding.

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