How Books Will Become Machines

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The evolution of books must be understood as part of a general evolutionary theory of cultural technologies

We shape our tools and they shape us in return. Trapped in an invisible technological loop, we underestimate the pervasive impact of the tools we use, ignorant of the fact that each technological transition can change the way we act, feel or think. Worse, our understanding of technological evolutionary dynamics is still in its infancy. We are missing the equivalent of a Darwinian Theory of Evolution for technological systems.[1] Without such a theory, technology evolves uncontrolled, impacting deeply our lives in ways we are unable to predict. Now that technological systems include various world-wide technological networks, literally producing technological personal spheres, modifying the perception of our direct surroundings, remodeling our relationships, our need for such an understanding is greater than ever.

This article is an attempt to reframe the evolution of books into a larger evolutionary theory. A central concept of this theory is the notion of *regulated representation*.[2] A regulated representation is

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[1] *Theories about technological evolution*. There have been of course various attempts to build theories and models about the evolution of technological objects. In the *Evolution of Technology*, George Basalla gives a rather complete account of these various frameworks. Part of our study is influenced by the work of the French philosopher George Simodon. In *Du Mode d'Existence des Objets techniques*, Simondon articulates the role of the *concretization* process, the way technical subsystems merge to create better integrated entities in a general evolutionary framework. This process is also at work for cultural tools and plays a major role in the evolution of regulated representations.

[2] *Definition of a regulated representation*. A *representation* is a man-made material document that stands for something else, typically a complex, highly dimen-

governed by a set of production and usage rules.[3] For instance, a map, like a book, is a regulated representation. There are conventional presentation rules to follow when creating a map, like indicating the scale or the direction of the North and conventional methods to follow in order to create the map contents. In terms of usage, one must learn how to read a map. This map-reading skill also involves many related skills for handling the map, orientating oneself in front of it, etc. These skills are either taught or learnt by imitation.

Our core hypothesis is that *regulated representations get more regular over time*. The general process of this regulating tendency is the *transformation of a convention into a mechanism*. The regulation usually proceeds in two consecutive steps, firstly mechanizing the representation production rules and secondly its conventional usages. Ultimately, through this process, *regulated representations tend to become machines*.

In the case of maps, the mechanization process has begun by a progressive automatization of the recording, gathering, storage and unification of geographical information. This corresponds to the mechanization of conventional production rules: paper maps, almost identical to those of the previous generation, but produced completely differently. The next stage is the mechanization of usage conven-

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sional event or phenomenon. Example: A picture of a scene, a sculpture of a Greek hero, a theater play, a novel. To avoid any misunderstanding we shall make clear that a representation is always based on a material reality. A *regulated representation* is a representation governed by a set of production and usage rules. These rules can be intrinsically embedded in the production process of the representation or the result of cultural conventions. Example of regulated representations: A list of names, an accounting table, a family tree, a flow-chart diagram, a map of a region, a printed book, a video, an encyclopedia, an *Excel* Sheet, a *Powerpoint* presentation. On the contrary, the production of a sculpture, a painting, a theater play are too weakly regulated by conventional rules to be considered as regulated representations. Although slightly different, this notion is inspired by the concept of intellectual technology developed by Pascal Robert in *Mnémotechnologies*.

[3] *Levels of regulation*. There are obviously different qualitative levels of regulation rules. For instance, most art forms are weakly regulated compared to other intellectual tools. They only obey general principles belonging to a given artistic school (impressionism, surrealism, cubism). Breaking those rules is an intrinsic part of the artistic dynamics. This has been well documented in various domain, notably in the evolution of poetry where stylistic evolution has followed a regular tendency of breaking linguistic and stylistic rules in order to push the reader beyond the direct semantic of the text (Cohen 1966). An associated consequence is that most art forms resist the regulation tendency typically characterizing successful regulated representations.

tions, transforming the regulated representation into a machine embedding most of or all the possible usages of the map. The digital maps we use nowadays permit a large set of operations (scaling, rotation, trip preparation, research of points of interests, etc.) and offer ways to handle multiple information layers. As machines, they offer much more possibilities than traditional ones. However, these various new modes of usage are explicitly programmed. A paper map can be used freely, including for other purposes than its original function (wrapping an object, taking a note). It is a cultural tool. A digital map can only be accessed through specific input and output commands: the specific usage rules have been internalized. It is a cultural machine.

The mechanization process may not immediately produce changes in terms of usage, but as the nature of the representation changes, technological synergies and aggregation effects happen. As maps became machines, they are progressively merged into a global mechanic system in which a multitude of maps became aggregated into a single one. This is the corollary of our hypothetical rule: As regulated representations get more regular, they tend to aggregate into unified systems.[4]

In addition, the relation of maps to time changes during the mechanization process. Maps used to be the archetype of a stable and as complete as possible document. It took years to build accurate maps. When the map gets fully mechanized, the image of a map becomes just a transitory state that can be automatically updated at any moment to reflect more accurately the state of the earth. The navigating user observes a snapshot of a continuously moving flux.

Given these new relationships with time and space, it is not surprising that, indirectly, each step of the mechanization process is likely to change *economic models* associated with the use of these cultural tools. With the full mechanization of maps and their general accessibility through any web browser, expensive geographical databases became totally free to use by the general public in just a couple of years. What is of value in the new associated economy is not the map contents but the traces of usage left by the map readers that can be aggregated into user profiles and on which various data

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[4] *Concretization process*. This integration rule is a paraphrase of the general concretization process articulated by Simondon (Simondon 1958: chapter 1) in the special case of regulated representations.

mining algorithms can be applied. *Mechanization changes where the value lies*.[5]

The full mechanization of maps is only one example among many others. Through a similar process, tables have successfully become spreadsheets, integrating their production and usage rules into a single system. Most major uses of tables, such as accounting, have now fully shifted to their mechanized incarnation. And the global mechanization of tables has permitted the global exchanges of data-sets typical of contemporary worldwide computer systems.

We shall argue that books, as regulated representations and cultural tools, share many similarities with maps and tables. Because of this, there will exist a strong technological pressure to transform them into machines. The rest of this article discusses the different scenarios of this mechanization process.

Books offer a solution to organize discourse in space

One of the most obvious differences between books and maps is that books are representations of an higher dimension. A book is a container, a volume of dimension 3, capable of hosting one-dimensional text and bi-dimensional maps, tables, diagrams and trees.[6] As a volume, *a book offers essentially a solution to organize a discourse in space*. It has an architectural function.

As any regulated representation, a given book is composed of a structuring template, common to a given family of regulated representations, and of a variable part. The structuring template of an academic book for instance typically includes a front cover, a table of contents, notes, a bibliography, an index, etc… It uses a set of typographic conventions for representing citations, proper names, etc. The reader knows how to interpret these various parts and typo-

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[5] *Mechanization changes the value of object*. I describe this general process in detail in *La Métamorphose des objets* showing with various examples how biographical data, intentional marks and unintentional traces become new economical goods that are harvested in exchange of free services.

[6] *Dimensions of regulated representations*. The idea of dimension of an intellectual technology is developed by Pascal Robert as part of the general framework he presents in *Mnemotechnologie*s. Because a book is of dimension 3 it cannot contain regulated representations of dimension 4, like videos, interactive simulation and other time-dependent machines.

graphic conventions. Such a template took centuries to evolve and stabilize.

The architectural function of books has made possible architectural discourses like long demonstrations and rich narratives. The effect of books on our culture is not limited to the discourses themselves. It is a consequence more generally of the unique capacity of the template to efficiently convey such structured ideas.

Metaphorically, the Book can be thought of as a closed space, which can be internally organized, like a house, a small garden, a church, a theater stage. The author plays the role of an architect. He can reuse classical templates and will more rarely invent new ones. He composes the space and constrains the principal paths to explore it, invites the reader to begin his journey from a starting location and suggests principal exits.

The first mechanization of the book, with the printing press technology and its subsequent development, reinforced the regularity of book templates and as a consequence its architectural function for organizing articulated discourses. The mass-produced printed book made possible the development and spreading of hierarchical demonstrations and complex narrations. It shaped our modern culture.

Books show some resistance
to their full mechanization

The mechanization of the production rules of the printed book has continued its evolution, each new innovation reinforcing the regularity of its templates. The book production chain is now fully digital, optimal in many ways, except maybe for its distribution process.

However, unlike maps and tables, the book seems to offer resistance to the second stage of its mechanization process, the formalization of its usage and the transformation to become a full machine. The end of books has been regularity announced. Despite pessimistic predictions, the Book survived newspapers,[7] the phonograph,[8] the

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[7] *The future of books in the 1830s.* 'Before this century shall end, journalism will be the whole press - the whole human thought. Thought will spread across the world with the rapidity of light, instantly conceived, instantly written, instantly understood. It will blanket the earth from one pole to the other -sudden, instantaneous, burning with the fervor of the soul from which it burst forth. This will be

telephone,[9] the television, the CD-rom and still seems to be a solid component of our culture twenty years after the invention of the web. Most contemporary debates about the future of print make the question of book resistance even more obscure because they fail to go beyond the classical argumentation opposing the relative strengths and weaknesses of digital documents versus printed ones. Like a recurring obsession, during the last hundred years our society has seemed fascinated by the idea that what is probably the most important technological tool of the last two thousand years could soon just become an obsolete technology. About every ten years, it becomes urgent to confront ideas and ask the expertise of scholars and visionaries about this issue. But as if we were trapped in a perpetual present, the circling debates do not manage to go beyond the direct confrontation between two objects, between the comparisons of two reading experiences. They present the book and ebook side-by-side and just ask: which do you prefer? By simplifying this complex problem into the direct confrontation between two objects, these debates make a reassuring move. Everything looks as if the future of the book would just be bound to a question of user's adoption. If reading a digital book is more practical, more engaging, more pleasant than reading a printed book, then the debate is closed: the printed book is dead.

Unfortunately, technological paradigm changes do not work that way. Side-by-side comparison is good for forecasting the success or failures of comparable technological products. But these comparisons do not manage to grasp the longer historical dynamics involved and the forces that drive them. Indeed, users' tastes play little roles in this kind of major technological transitions. At best, they act as

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the reign of the human word in all its plenitude. Thought will not have time to ripen, to accumulate into the form of a book - the book will arrive too late. The only book possible form today is a newspaper.' Alphonse de Lamartine in 1831, cited and translated in (Carr 2010:109).

[8] *The future of books in the 1880s.* 'Many books and stories may not see the light of print al all; they will go into the hands of their readers, or hearers rather, as phonograms' Hubert, Philippe in an 1889 essay in the *Atlantic Monthly*. The same year, Edward Bellamy predicted in a Harper's article that people will read 'with the eyes shut', carrying tiny audio players which would contains all theirs books, newspapers and magazines' (Carr 2010: 109).

[9] *The future of books in the 1930s.* This is how Paul Oltet in the 1930s was describing the future reading desktop 'The worktable does not hold any book. Instead, there is a screen and a telephone. All the books are far away, in a huge building (...)' cited in (Levie 2006).

conservatory factors that slow or block the overall technological change.

Hypotheses to explain the resistance of the Book must be articulated at a systemic level. We could for instance consider that books are much more complex cultural tools than maps as they are linked with a larger network of actors, related laws, distribution channels. As this 'ecosystem' took a long time to stabilize and as it involves a large collection of actors, it is normal that it offers some resilience to the impact of change. Likewise, it would also be relevant to say that book usage is deeply routed in our everyday habits. We are used to the conventional usage of books and other hierarchically organized printed media like magazines and newspapers. This high level of societal integration is certainly an important factor of resistance.

However, it seems unlikely that these two structural factors are sufficient to explain the relatively slow mechanization of usage in the case of books. We believe we need to explain this resistance with a slightly more elaborate explanation. It seems that books embodied in machines fail to deliver the main function of the printed book, i.e. allowing to structure complex discourses and narration. This is counterintuitive because mechanization steps usually offer more structuring options. Formalizing its conventional usage rules into mechanized processes, a book-machine should have the potential to give more power to the author-architect. In such conditions, why is there resistance to this evolution?

We believe that by entering the realm of machines, *the architectural function of books enters in direct competition with another powerful cultural tool that supports a dangerously seductive antagonistic function, the Encyclopedia and its totalizing endeavor to document the entire world.*

The Encyclopedia's totalizing function is antagonistic with the Book's architectural function

In its *Traité de documentation* published, Paul Otlet predicted: "In its new form, the book will be in continuous growth" (Otlet 1934:429). In his vision, the vocation of the Book was to extend the encyclopedic dream put forward by the *Enlightenment*, with the ambition to encompass the complexity of the whole world. To reach this goal, it has to become a network, a rhizome, a continuously

extending structure. Thus, each book could aim at becoming a world in itself, ideally as complete and complex as the real world.

Even if Diderot and d'Alembert's *Encyclopedia* is entitled *Dictionnaire raisonné des sciences, des arts et des métiers*, its ambition is to be much more than a dictionary. The encyclopedia has aimed since its genesis at being in continuous expansion in order to encompass the ever-growing world of arts, sciences and techniques. The encyclopedia is not a series of buildings; it is a never-ending building site.

In the XVIII century the encyclopedia took the form of a set of books and became one of the best-sellers of its time. But with such embodiment, the encyclopedia is curbed. Its totalizing motivation does not go well with the intrinsic bounded nature of books. These two intellectual technologies have antagonistic functions. The Book has evolved as a closed space capable of hosting sophisticated interior architecture: long discourses, elaborated narratives and other kinds of architectural thoughts that oral tradition used to transmit. On the contrary, the encyclopedia's function is to encompass the whole world, past, present, future, real and imaginary. There will never be enough pages for such an unbounded commitment. The Book offers specific paths, guided tours. The Encyclopedia offers a small-scale model of the world. Book writing is about learning to finish. Encyclopedia writing is an ever-going activity aiming at continuous improvement.

When the technology was ready, the encyclopedia happily left its inappropriate body of printed volumes, to exploit the potential of hypertexts, the digital incarnation of principles it had already invented at the time of Diderot and d'Alembert in order to escape the imprisoning linearity imposed by the codex pages. It flourished and expanded in this new world of decentralized machines like no other intellectual technology. It continued its mission, turning any closed media it encountered into encyclopedic subparts, relentlessly breaking their linearity to transform them into random-access documents.

The network has successfully decomposed music albums into single songs, newspapers into sets of articles. Now it tries to decompose the courageous books that wander into its territory as collection of chapters, sets of linked fact-sheets, units of content in the World Wide Encyclopedia.

Thus, *we can reinterpret the last four hundred years as a speed race between two technologies: The Book and the encyclopedia*. The desire to represent a specific point of view on the world against the

desire to encompass the world within a network of representations. The comfort of a closed and warm habitat versus the fascination for never ending open spaces.

Encyclopedia has won the first decisive battle of this technological arm-race. It turned into a machine faster, internalized its production and usage rules, and like any other technological system expanded to form a single worldwide system.[10] Now encyclopedism is dominating the worldwide computer, imposing its principles and rules to any newcomers.

It is very likely that the relative difficulty for the Book to become a full machine, compared to other intellectual technologies, is the dominating influence of encyclopedia in the current technosphere. From here, the mechanization of the book can go two ways: either it merges with the current dominating intellectual technology at the risk of loosing its original structuring function[11] or it continues its journey in a new closed embodiment capable of surviving in a world dominated by the technology of the encyclopedia. The regulation pressure is high and both of these fates permit to reach a higher-level form of mechanization, but the consequences for us will not be the same.

Books could become standardized resources in the encyclopedic global ecosystem

The first way to continue the book mechanization process consists in *taking an encyclopedic perspective on book contents*, introducing descriptive formalisms in order to turn structured text into well standardized resources. In the same way that every animal or plant can be described through a conventional grid system of attributes,

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[10] *The origin of the web.* The Web was born as a local solution to a local problem, but its inventor anticipated, in the original document where he describes the concept for the first time, that this technology has the potential to spread globally. This is exactly what happened. 'The problems of information loss may be particularly acute at CERN, but in this case (as in certain others), CERN is a model in miniature of the rest of world in a few years time. CERN meets now some problems which the rest of the world will have to face soon.' (Berners-Lee 1989)

[11] *Random-access books*. Some authors have been waiting for this Random-access age for a long time (see for the the non linear organization of *Mille Plateaux* [Deleuze and Gattari 1980]). To some extent, McLuhan's *Gutenberg Galaxy* is also conceived as a mosaic of arguments more than a linear demonstration.

descriptive languages like TEI and encapsulation format like EPUB permit to describe book contents as standard resources.[12] This decoupling between form and content has many advantages. In principle at least, it allows to envision texts that can change layout on demand, adapting their two dimensional incarnation to the reading interface that host them (a smartphone, a tablet, a desktop computer, a TV, etc.). Explicitly standardizing the implicit structure of books makes them searchable and browsable in new ways. And this is just the beginning. In on-going standardization steps, the encyclopedia would like to tag the semantic content of each of these resources, associating them with well defined concepts, well defined places, well defined dates, well defined citations. To reach this endeavor open standards are defined[13] and collective tagging dynamics are organized.[14] Directly mapped onto conventional ontologies, the space of book contents could become articulated in new ways, conceptual analogies between discourses could be automatically analyzed. In short, we will be able to perform advanced computation on book contents.[15]

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[12] *Standardization of electronic texts.* A synthetic view of the history of this structuring methodology is well articulated by Hervé Déjan (Déjean 2009).

[13] *Semantic web.* Tim Berners-Lee and the other members of the W3C have been arguing for a long time about the importance of producing standards enabling semantic tagging and organization of information (Berners-Lee, 1999). The web is currently a web of documents. It should become a web of well-structured data. Thus, the goal of the semantic web is organize worldwide information at a superior level of abstraction than the document unit. One current incarnation of this effort is the RDF format (Resource Description Framework) that permits to decompose the information into set of triplets. Each triplet contains a subject (the resource to described for instance an URL), a predicate (the property applicable to this resource, also an URL) and an object (also an URL). Such triplets form complex graphs over algorithms can perform various computations. The implicit encyclopedic ambition of the RDF format is to transform all the data contained in the documents of the web in a single huge database, even if in practice several databases of this sort are currently created in parallel. The success of failure of this endeavor will depend directly on the way such coding could be done in practice through an organized self-motivated collaborative process. It is not clear for the moment how this will happen.

[14] *Folksonomies.* Less ambitious and formalized compared to the standards of the semantic webs, folksonomies are emergent ontologies built locally around specific practices (tagging of photos, tagging of location, tagging of academic papers) (Peter 2009).

[15] *IEML* Even more ambitious than the semantic web, the Information Economy Meta Language developed by Pierre Lévy and his team aims at coding not the relationship between well defined data resources but to introduce a standardized

This wave of standardization will also encompass the social use of books (remember that the encyclopedia never stops). The goal is now to create open standards to describe bookmarks, dog-ears, notes, commentary, book loans. Each book-reader encounter should be documented. The whole life of a book will be made explicit. Trajectories of books and readers will form a new information mesh from which numerous correlations could be extracted.[16]

This standardization process is coupled with an on-going massive digitalization. Millions of books are currently scanned to form a huge database on the worldwide computer.[17] Digitalization is actually not a very good term to describe this content extraction and standardization process. Books are containers, and the so-called digitalization process consists precisely in extracting their contents. In this new world of data, book contents extracted from their original physical shells become digital resources among others, databases linked with other databases. While symbiotically, the standardization of all the other aspects of our cultural life is going on in parallel, book contents become linked with documented reading practices, reading places, social networks, integrating the complete and explicit representation of human society, this being the original long term goal of the encyclopedia. This certainly inaugurates the new age of *industrial reading*.[18]

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formalism for concepts themselves, that should permit to perform computation in a standardized conceptual space. The goal is to directly code the meaning of a resource (Levy 2011). This global linguistic machine has some resemblances with very old trials to create perfect 'Adamic' languages, non ambiguous, perfectly translatable: languages of the pre-Babel era (Eco 1993).

[16] *Reading analytics*. The transformation of the readers' behavior into data inaugurates the new domain of reading analytics. Reading patterns can now be analyzed, compared and maybe predicted. Through this process they also gain a commercial value. Gathering and reselling reading logs and profiling readers is becoming a new industry. It is not impossible that one day it becomes more important economically than the industry of cultural goods. That day, books will be offered for free in exchange for the harvesting and exploitation of the reader's behavior.

[17] *Geostrategic issues*. We do not talk here about the crucial geostrategic issues directly linked with this global digitalization. They are of course very important and have been subject of heated debates. (Darnton 2010, Polastron 2006, Jeannerey 2005, Racine 2010).

[18] *Industrial reading*. The term 'lectures industrielles' is used by Alain Giffard to describe this new reading regime. He traces the origin of this industrialization in the beginning of the XIX century. There is a chapter in Tocqueville's *De la démocratie en Amérique* called 'industrie littéraire' (Stielger, Giffard, Fauré 2009:200).

We cannot help feeling the power of this global bibliographic machine as it directly corresponds to one of the oldest dream of humanity: creating a library with all the books or, expressed differently, an infinitely dense book of books.[19] But we should also be aware that the dream of the Alexandria library is precisely an encyclopedic dream. The industrial extraction of book contents from books means nothing but the end of the primary function of the book: the isolation, organization and layout of contents in a confined volume. It means the total victory of the encyclopedia over the Book. This is not without consequences.

In evolutionary terms, in a closed and protected volume the Book offered room for constant innovation. Each printed book could be an isolated island. Standardized production matrices were pushing towards more regulated typographic styles and layouts, but every author and editor could still move away from these norms to create a (possibly more expansive) internal architecture. As a standalone autonomous object, a book could take parts in an infinite number of publishing experiments. Children's albums for instance have always resisted the global standardization and continuously explored new reading interactions.

It is difficult to imagine how such evolution could continue if books just became standardized articulated data part of a worldwide machine. The encyclopedia core principle is the regulation and standardization of knowledge nodes. Innovation is limited to local contents[20]. Forms can only evolve globally when a new feature is introduced at the level of the entire encyclopedia. It must be collec-

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[19] *The Book of all Books.* The 'Book of Sand' written by Borges in 1975 tells the story of the Book of all Books, a kind of monster. A theme reminiscent of another well know Borges's novel parts of his Fictions, the Library of Babel : '…This vast Library is useless: rigorously speaking, a single volume would be sufficient… containing an infinite number of infinitely thin leaves.' (Borges 1975).

[20] *How writing style will change in the encyclopedic regime* Even the way of writing are likely to be directly effected by the generalized encyclopedic regime. If search engines become the most direct way to discover books, writers will be encouraged to adapt their style and chosen vocabularies in consequences, reusing, for instance, words often searched or choosing them based on marketing considerations. We will progressively discover that writing a searchable text is not the same thing as writing a book to sell. In particular, one should be aware that the core business model of search engines is about *selling words*. The encyclopedia extends the realm of capitalism to the language itself (Kaplan 2011). This is not without consequences.

tively decided, carefully crafted before being able to spread almost instantaneously to the entire content of the database.

We do not realize yet the intrinsic conservatism of the encyclopedia paradigm because we are fascinated by the spectacle of the global information harvest. We see the human society becoming explicit and look at this crystallization process with fascination. We foresee the endless possibilities of information search on the emerging worldwide computer. Everything seems to go so fast. How can such a paradigm shifting evolution be a factor of cultural immobility? As long as the encyclopedia is growing, its cultural standardization effects will be partially masked. But what will happen, when all the books, all the concepts, all the places, all the readers will be mapped into standardized templates? Will cultural innovation still be possible within such a framework?

Books could survive by becoming closed interactive applications

The second way to continue the book mechanization process is to design a new close vehicle for its contents. Ten years ago, we imagined our future interaction with Internet through a single standardized interface based: the browser. But in the meantime, several signs showed that this amazing worldwide documentation system might not be the only use of this newly created global computer. The Internet could host other services, simpler, sleeker, more user friendly, delivering a richer and a more structured content, offering again a closely controlled user experience. We conventionally name them applications.

Applications are fully interactive programs adapted to dedicated interfaces like smartphones, tablets or desktop computers. They can fetch their contents directly from the Internet and offer access to data and flux on the Internet, bypassing the web through more controlled and powerful user interfaces. Applications can take full advantage of the device hardware that hosts them, multitouch interactions, GPS, accelerometer. In short, applications have the potential to offer more regulated user experiences than the web.

Because they offer clear boundaries, applications like books can be seen as containers. They offer an internal volume in which medias up to dimension 4, i.e. adding time to space, can be spatially or-

ganized. An application can include a video, a game, a simulation and of course the facsimile of a printed book.

Because applications can connect to remote servers, fetch contents, aggregate them in various ways, adapt to their immediate context, they are very seductive to the knowledge hunter of the Encyclopedia Age. But their nature is intrinsically different. Like the printed manuscripts published just after Gutenberg's invention, applications appear to offer just the same service as websites, with nicer user interfaces, but in fact they are animated with an antagonistic logic: the logic of closed volume and control, the way of the Book.

Most contemporary voices condemn this lack of openness. Knowledge should be open, easy to share and link: the encyclopedia ideology. They rightfully point out that without open standards, application contents might rapidly become obsolete, impossible to read with standard hardware. Protected by their application shelves, applications offer much more creative freedom and wider experiences, but isolated from the structuring norms, they do not guaranty survival to the content they host.

Book applications correspond to the second stage of the mechanization process, the mechanization of usages. By becoming applications, books internalize their interactivity. Authors and editors can thus design much more precisely the kind of experiences they want to offer. This is the way to build more immersive novels, more pedagogical textbooks, more contextual guides, deeper scholar articles, more entertaining magazines.

It would be an error to think that book applications are only relevant for hypermedia interactive contents. A book application allows designing the interactivity adapted to the goals and reading practices of documents as different as scientific articles, textbooks or novels. They permit to avoid the one-size-fits-all philosophy of the encyclopedia to offer specific solutions adapted to specific objectives. And of course they permit to invent radically new kinds of books: books that change depending on where or when you read them, books that learn as you read them, books that adapt to the news and other kinds of algorithmic books. Book applications can host rich messages and lively contents. They are modern containers, just like the codex was in its time.

Their most significant drawback is directly linked with their expressive power. Rich contents embodied in book applications can only be read on a limited set of hardware. In addition, as was the

case for the CD-rom in its time, new contents are hard to produce, so only a limited number of original titles become available. These two factors are obstacles to the generalization and ultimately to the survival of this new technology.[21]

The fate of the Book could have important effects on our cognitive skills

Profound technical changes happen silently. They run almost unnoticed in the background, preparing new technical environments that may have a tremendous impact on what we are, changing the way we act, the way we think, the way we feel.[22] The typographic regularity of the printed book changed our eyes into content extractor. We learned to forget about the fonts, the size. We developed skills to completely decouple reading aloud from reading silently.[23] We

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[21] *Lessons from CD-roms*. The CD-rom rise and fall should make us reflect on the power and the limit of closed systems. Like book application, CD-rom had all the potential to continue the way of the Book. They were celebrated as its future. As closed environments they offered great creative freedom, but they failed to build bridges with the rest of the digital environment. When the web emerged as open-ended information system, CD-roms progressively appeared as an obsolete technology.

[22] *For some time, technological change may have no effects on user experiences.* Thirty years after the 'invention' of the printing press, most of the books printed were just copies of medieval manuscripts. The 'readers' just wanted more of the same. For several decades, this paradigm-shifting technology essentially produced 'old-styled' books. Old-styled books made differently. Thus, while the user experience stayed relatively stable during this whole period, a crucial structural change happened to the Book, introducing the potential for new forms of regulatory effects to its internal structure. Not only could books now be mass-produced but most importantly they were now 'generated' out of standardized typographic matrices. Even though in the early years of this first mechanization of the book, much efforts we made to try copy the layout and style of manuscripts, this transition imposed a controlled structure to all the copies of the same book. The regularity of this new internal structure had profound effects on the way we perceive the world. It literally shaped our perceptions in an apparently irreversible manner.

[23] *The cognitive effects of silent reading.* Silent reading appeared in the middle Age but was still not a common practice by the time of the printing press. Outside the elite and the clerical communities, words on papers had still a very tight connection with spoken words. Even today, reading aloud means reenacting the text, a full body experience, very different from silent and private reading. It is impossible for us to tell precisely what it felt to read one of manuscript for the pre-printing-press reader. But we can try to extrapolate based on some of remaining

learned to read fast and efficiently. As standardized reading material progressively invaded our environment, we developed hypertrophic reading abilities and the reading experience became progressively divorced from our other senses. We got used to navigating fast and skillfully in seas of words.

The typographic structuring templates structured our mind in return. The printing press literally linearized our way of thinking. Hierarchical demonstrations and organized narrations enabled us to express things that were just not possible to articulate before the printing press. As pages and paragraphs offered clear organizational landmarks in a volume of text, we got used to positioning ourselves spatially within a discourse, to evaluate the length of journey that we need to take to reach the conclusion of a demonstration. We got accustomed to experiencing the spatial unfolding of discourses.[24]

The phenomenological experience of the encyclopedia is quite different. Inside an encyclopedic medium, the reader can only grasp its direction surroundings based on local links but cannot localize himself globally. He must act like a hunter, attentive to pattern, capable of contextual reactions. His eyes develop different kinds of skills than those used for book reading. He is in charge of his journey, responsible for taking the right path. Skimming and scanning become the norm in order to always find the right compromise between exploration and exploitation. In knowledge hunting, videos, images, simulations and games become as good materials as texts. Rapidly switching between those sources becomes an optimal strategy. The hunter makes relevant uses of specific tools like search engine, push notifications, aggregators in order to create a whole technological cockpit helping him to answer the permanently relevant question: What should I read, listen, watch or play now?

What is at stake in the battle between the Book and the encyclopedia is our way of being in the world, not only our relationship to

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reading experience with non-standardized texts, like hand-written letters. Our eyes read them 'globally' as a rich complex object during a full and complex sensorimotor experience involving more than just the eyes. For instance, we may hear their content read in our head. Because of the holistic reading experience, they are difficult to skim or scan. There's no such thing of a speed-reading technique for handwritten letters. As they are non-mechanically reproduced, hand-written letters have kept their 'aura' in Walter Benjamin sense.

[24] *The spatial turn of typography.* In the *Gutenberg Galaxy*, McLuhan demonstrated that this spatial turn inaugurated a global cultural shift. He argues that the beginning of perspective with Alberti is a side effect of printing press spatialization power.

knowledge but, in the long term, our general thinking and memoriz-ing skills.[25]

Can the Book and the encyclopedia coexist? Are Book applica-tions going to be limited as a residual art form compared to the in-dustrial production and consumption of standardized book contents? Can we predict how our cognitive skills will be shaped by this new technological ecosystem?

We can consider the current experiments with applications as la-boratories for inventing new interfaces for complex discourses. It is too early to predict whether or not there shall emerge, out of these laboratories, forms of discourses that would be seductive enough to offer a significant counterpoint to contemporary industrial readings. Timing is going to be essential. As time passes, our cognitive habits and skills are likely to adapt to the opportunity of the age of indus-trial and encyclopedic reading. More agile and less patient minds might become the norm, making it even more difficult to create se-ductive alternatives based on closed environments and deep immer-sion. If this happens, the Book, without any significant heir, will appear as a parenthesis in the long story of our cultural evolution.

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[25] *Changes in memory practices.* Technological transitions can have effect in just one generation and changes in memory practices are always their most visible cognitive consequences. The pre-printing-press reader, living in a world where texts was as rare as gold, could certainly remember much more than the man of the Renaissance. We probably know less things by heart, have less mental calculus skills than our grand-father. Our children will certainly be highly dependent on the worldwide memory in their everyday life. The more we can access, the less we have to remember.

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