INVENTING AS A BUSINESS

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Abstract

In the United States, income from patent licensing is overtaking that from manufacturing. The business of inventing is orders of magnitude more profitable than manufacturing. We analyze various elements of an invention business and propose a business model for high-value invention business that overcomes the economic inefficiency of current practices. This model may be of interest to inventors, entrepreneurs, and capitalists.

Introduction

An important economic phenomenon has been developing in the American economy. Economic value generated by intellectual property is overtaking that created by manufacturing. Licensing fees, just from patented inventions alone, were $150 billion globally in 2003 and are growing in double digits on an annual percentage basis [1]. Currently, United States corporate income from patent licensing exceeds $100 billion [2]. In comparison, in the latest year for which IRS statistics are available (2002), U.S. manufacturing taxable profits were $120 billion [3]. Income from these two activities is approximately equal now. Now consider the expenses required to produce these incomes. For manufacturing, expenses are mainly labor, overhead, materials, and equipment amortization. For patent licensing, expenses are mainly salaries to inventors and legal professionals. Without going into a detailed analysis of the ratio of these expenses, we believe that they differ by at least several orders of magnitude. If that is so, ROI for patent licensing will be at least several orders of magnitude greater than the ROI from manufacturing, because the incomes are approximately the same.

Today, the development of patent licensing into a major economic activity is in the same category of attractiveness to inventors, capitalists, and entrepreneurs as was Henry Ford's offer a hundred years ago to pay $5/day for labor versus the commonplace $1/day.

In this paper, we present a basis for creating a high economic value invention business. First, we limit inventors' products of economic value to patents and explain the basis for this constraint. Then we examine the various levels of creativity involved in making inventions and how they relate to the resulting inventions' value, and we examine the interrelation between inventors and business firms. Next, we examine a chain of activity along the path of technical progress and demonstrate, using Schumpeter's theory and the basic economic premise of specialization, that it is more economical to separate the activities of inventing, getting patents, and licensing into a separate invention business, vis-à-vis the activities of innovation and diffusion. Finally, we compare the basic business elements of an invention business with the elements of business models for mutual funds and real estate development. We then propose a high economic value business model for an invention business with strong economic and other (not by bread alone) motivations for inventors, capitalists, and entrepreneurs.

1. Patents: The Product of Inventors

The products of economic value of inventors are patents. Article 1, Section 8, Clause 8 of the Constitution of the United States of America states that "Congress shall have Power to promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." As further defined in the law, a patent is

- An exclusive right granted by a state
- To a person
- For a fixed period of time
- In exchange for the regulated *public disclosure* of certain details
- Of a device, method, process or composition of matter (known as an invention) which is new, inventive, and useful or industrially applicable.

These are the most important characteristics of patented inventions.

A. Patent is a document

The term "patent" originates from the Latin word *patere,* which means "to lay open" (i.e. make available for public inspection) The term *letters patent* originates from royal decrees granting exclusive rights to certain individuals or businesses.

A patent provides the patent owner the right to *exclude others* from making, using, selling, offering for sale, or importing the patented invention for the term of the patent. A patent is, in effect, a limited property right that the government grants to inventors in exchange for their *sharing the details of their inventions with the public*. The grant of a patent does not require that the inventor or/and owner use it, i.e. produce, license, or otherwise. Rather, a patent is a negative right that gives the patent owner the right to exclude others from making, using, or selling the invention. Hence, when a patent owner issues a license, in reality he agrees not to exercise his negative right to preclude the licensee from making, using, or selling the invention.

What is the economic rationale for granting patents? In accordance with the original definition of the term "patent", it is argued that patents facilitate and encourage the *disclosure of inventions into the public domain for the common good*. Awarding patents generally makes the details of new technology publicly available for exploitation by the public after a patent term expires, or for further improvement by other inventors who may, in turn, patent their improvements. Furthermore, when a patent's term has expired, the public record ensures that the patentee's idea is not lost to humanity.

As objects of intellectual property, patents and patent applications can be freely transferred. A patent or patent application can be transferred as the result of a financial transaction, such as an assignment, a merger, a takeover or a spin-off, or by operation of law, such as through inheritance or in a bankruptcy.

It is important to note that the legal proceedings devoted to enforcing such exclusive rights are centered on comparing an unauthorized making, using, or selling of an infringing device, method, process or composition of matter with the *claims* in the patent, not with any writings or prototypes or products of the patent owner. This process of determining infringement is summarized in Table 1.

Table 1. Patent Infringement Analysis

Patent Claim Elements	**Infringing Product**	**Non-Infringing Product**
Element 1	Present	Present
Element 2	Present	**Not** present
Element 3	Present	Present

The most important part of the infringement analysis is the comparison of the elements of particular patent claims with elements of an infringing product. If not all elements of a particular claim are present in an accused product, there is no infringement of patent. Conversely, if all elements of a claim are present in an accused product, then the accused product is found to be infringing on the patent owners' rights.

To obtain a patent, an inventor must at least show that the invention in his patent application is novel and inventive (i.e. not obvious) and must provide sufficient detail that the presented claims, as they are explained in the patent specification, would enable a person of *ordinary skill* in the art to implement the invention without undue experimentation.

B. Patent claims are "new combinations" of known elements

Each patent recites the inventor's claims, either for devices or processes. Each claim recites different elements and how they interact with each other. Any single element in a claim is known. Going back to basics, every physical invention is based on the known 94 elements in the periodic table. All inventions and their claims use known elements. What inventors claim as new and not obvious is the *combination* of certain known elements and their interrelationships. This conclusion is supported by rulings of the courts. In re Fine, 837 F.2d 1071 (Fed Cir. 1988). "Virtually all inventions are 'combinations' and .. every invention is formed of 'old elements.' Only God works from nothing. Man must work with old elements." An example of a combination of known elements and its differentiation from prior art (what is known or obvious) is shown in Table 2.

Table 2. Microwave Oven
(All elements in each column were known at the time of invention)

Oven	**Microwave Oven**
Container	Container
Food in container	Food in container
Electric heater	Microwave heater
Heater heats air	Heater heats food

All elements in the microwave invention were known at the time of invention. The same is true for other inventions, such as nylon or the telephone. What is new is combining them to form a *new* system.

C. Patent specifies invention in detail

Many years ago, the U.S. Patent Office required a model of the invention to be submitted, to show how the invention worked. That requirement was abandoned because of the requirements of

enablement, best mode, and definiteness, which obviate the need for a physical model. Nonetheless, the inventors must assure themselves that what they claim in the patent and lay open to the public can be practiced by persons of ordinary skill in the art without undue experimentation. Otherwise, the claimed invention, as described in the patent, might be found to be invalid. This provides inventors with a motivation to ensure that their descriptions and resulting claims will be supported by practice. This self-auditing process includes, at one extreme, making what is claimed in its entirety. This is the most expensive approach. The next level down is making only those portions of the claimed invention that define its novelty over prior art reflected in some claim elements. This is a less expensive way. A third way is to use digital models of the elements to make digital prototypes of either an entire claimed invention or only the parts that are novel. This is the preferred way if such models exist because, as a rule, this is the least expensive method for an inventor to ensure the enablement of his invention. On Fig. 1, we present the role of prototypes in the process of getting a patent.

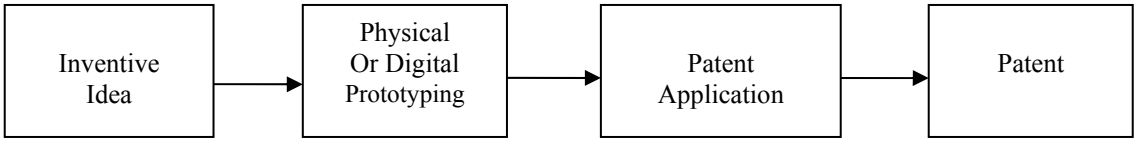


Fig. 1. Role of prototyping in the patent process

In summary, the inventor's product of economic value is a document (a patent), granted by a state, that can be licensed, traded, exchanged, or sold, as with any property, in exchange for other property, such as cash, stock, and other valuable assets.

2. Levels of Creativity of Inventions as a Basis for Value Differentiation

In 2004, the U.S. Patent and Trademark Office granted utility patents as follows: 84,000 to U.S. domiciled entities and 80,000 to foreigners (35,000 – Japan, 10,000 – Germany). This resulted in approximately 164,000 patents, but their values differ dramatically. Some will protect the next generation of blockbuster drugs or clean energy technology. Others will never be commercialized. The question is what activities lead to high-value inventions. Throughout this paper, we take the *value* of an invention to be the total financial benefit derived by all of its users. This subject is dealt with extensively in numerous publications by TRIZ practitioners. TRIZ is an acronym for Russian words that, when translated; yield the phrase "Theory of Resolving Inventive Problems" [4]. (An inventive problem is a problem that has been solved in a novel way). It was pioneered by G. Altshuller. TRIZ consists of an algorithm and numerous tools that have been developed on the basis of the heuristics of thousands of inventions. It brings statistics into inventive decisions that are made under conditions of uncertainty. This is a powerful method, as is demonstrated in research conducted by Nobel Prize winner D. Kahneman in relation to general decision making under uncertainty [5]. The use of TRIZ enables desired inventive decisions to be made much more effectively: either faster, or of higher level and value, or both.

According to Altshuller, there are five levels of creativity of inventions that, among other differences, also define invention value distribution statistics. These levels of creativity depend on several variables, among them being the magnitude of trial and error before finding a solution, the number of various fields of knowledge involved in a solution, and the use of scientific discoveries. With a dramatic increase of issued patents, their quality has decreased and the relative ratio of high-value

patents has fallen accordingly, but the absolute number of high-value inventions has increased. With this qualification, we provide below a summary of the levels of creativity, and relevant statistics from the original statistical analysis by G. Altshuller.

Inventions of Level 1 Creativity

These are slight modifications of existing systems (as used here, "systems" refers to products comprised of elements that taken together form a whole that solves a particular problem or provides a particular benefit). Previous industry specific design experience on the part of the inventor-designer is *essential*. In this sense, design experience means knowing how existing elements are customarily *combined*, and not *knowledge* of such elements. Inventions such as these do not resolve any system conflicts. They are design compromises, localized within a single subsystem. They are also contained completely within a narrow specialty, and are within the reach of any practitioner. It takes 1-10 iterations of trial and error to come up with such an invention. Approximately 32% of all inventions are of this type. An example is replacing a metal cap on a pressurized container with a plastic cap that has internal ribs. While these are inventions only in a legal sense, they are designs from an engineering standpoint. They result in *library* patents having little or no strategic or economic value.

Inventions of Level 2 Creativity

These inventions resolve some system conflict that may have already been resolved in other systems (e.g., a problem related to cars is solved by a technique developed for trucks). Previous industry specific design experience on the part of the inventor is *helpful*. It takes 10-100 iterations of trial and error to come up with such an invention. Approximately 45% of all inventions are of this type. An example is the invention of the intermittent windshield wiper. These inventions are *maintenance* inventions that are typically made at the end of a cycle of technology development. They have small value (the resulting patents) that resides with incremental improvements, the goal of which is to maintain products already on the market.

Inventions of Level 3 Creativity

These inventions resolve system conflicts by an original approach within one discipline (e.g., mechanical engineering, chemical engineering, etc.). Previous industry specific design experience on the part of the inventor is *neutral*. These inventions radically change at least one of the system's components. It takes 100-1000 iterations of trial and error to come up with such an invention. Approximately 19% of all inventions are of this type. Examples are disk brakes and fuel injectors. These inventions are *late growth* inventions, practiced primarily by innovative companies at the high end of the number of iterations of trial and error and by large volume producers at the low end of the number iterations of trial and errors. They allow companies to extend the life of products during the second half of a technology lifecycle. These inventions will have a certain value (the resulting patents), because improvements arising from them mainly increase the amount of products sold.

Inventions of Level 4 Creativity

These inventions give birth to new systems using *interdisciplinary* approaches. An example of such an interdisciplinary approach would be to solve a chemical problem using electrical technology. For such inventions, any industry specific design experience on the part of the inventor actually *interferes*

with the creation of the desired invention. This is often characterized as the problem of how to think "outside the box". The developed concept can usually be applied to many other problems at the lower creativity levels. These are *growth* inventions. It takes 1,000 to 10,000 iterations of trial and error to come up with such inventions. Less than 4% of all inventions are of this type. Examples are automatic transmissions, electrostatic painting, and microwave ovens. They allow innovative companies to create technological branches in given industries. These inventions have substantial value (the resulting patents), because improvements that arise from them will increase significantly, not only the amount of product sold, but also the profit per item.

Inventions of Level 5 Creativity

These are pioneering inventions that, in many instances, are based on recently discovered phenomena. It takes 10,000 to 100,000 or more trials and errors to develop them. Previous design experience of the inventor is *detrimental* to finding a desired invention. Less than 0.3% of all inventions are of this type. These are *launch* inventions, because they launch either new industries or new sectors in industry. Inventions that revolutionize existing industries are at the low end of number of trial and errors, with examples being jet engines and microcomputers. Inventions that create new industries are at the high end of trial and errors, with examples being movies, the telephone, xerography, and the transistor. Over 95% of such inventions are created by passionate inventors *outside of operating businesses*. "… [O]f the 52 watershed inventions between 1745 and 1972 … only three were made in large enterprises: the transistor, nylon, and the microwave oven. This explains why many references to corporate innovations cite nylon and the transistor. These are almost the only enterprise watershed innovations." [6]. Inventions of this type are the most valuable and the patents granted on them have the highest economic value.

In the examples above, we introduced a value, namely the number of iterations in the trial and error process. This value is estimated using morphological analysis [4]. All prospective elements of a prospective invention must be listed and then all *forms* of each element also must be listed. The number of combinations of forms of each element in a prospective invention determines the number of iterations of trial and error. Some of these combinations lead to the desired inventions. In Table 3, we summarize data for these levels of creativity.

Table 3. Value vs. Creativity Level

Creativity Level	Technical Improvement	Patent Value	Number of Trial & Errors	% of All Patents	Design * Experience Of Inventors	Examples
1	Slight Modification	Insignificant	1 – 10	32	Essential for the inventive process	Plastic cup with ribs
2	Resolve some technical conflict within one specialty	Small	10 – 100	45	Helpful for the inventive process	Intermittent windshield wiper
3	Original solutions within one discipline	Certain	100 – 1,000	19	Neutral for the inventive process	Fuel injectors for engines
4	New systems based on multiple disciplines	Substantial	1,000 – 10,000	Less than 4	Interferes with the inventive process	Microwave oven
5	Revolutionary systems for changing or creating industries	The highest	10,000 to over 100,000	Less than 0.3	Detrimental to the inventive process	Telephone, airplane control, lasers

* Design experience means knowing how existing elements are customarily *combined*, and not *knowledge* of such elements

It is evident from the analysis of the levels of creativity of inventions that the highest value results from inventions in levels 4 and 5. The inventors creating at these levels are typically either working within innovative companies on level 4 or alone in a small dedicated group on level 5. In both scenarios, a typical inventor is not a professional because he invents only occasionally. This is contrary to the economy of mass production. Further in this paper, we will present a rationale for a business model that can overcome this inefficiency.

3. Rationale for Inventing as a Distinct Economic Activity

A. The Schumpeter model

A part of the rationale may be derived from the teachings of Joseph Schumpeter [7,8]. In "The Theory of Economic Development", he concluded that the basis of capitalist economies is progress derived from the process of creative disruption [7]. This process is fostered by new business arrangements, which he calls "new combinations." The creation of these new combinations drives the need for capital. "For it is clear a *priori* as it is established historically that credit is primarily

necessary to new combinations… The capitalistic credit system has grown out of and thrived on the financing of new combinations …"

Some portions of such new combinations are inventions. Because of the central role these new combinations play in a capitalist economy, Schumpeter examines how they propagate to the market.

After such new combinations become known, "[t]he carrying out of new combinations we call "enterprise"; the individuals whose function it is to carry them out we call "entrepreneurs." "How different a thing this is becomes clearer if one bears in mind the impossibility of surveying exhaustively all the effects and counter-effects of the projected enterprise. Action must be taken without working out all the details of what is to be done. Here the success of everything depends upon intuition, the capacity of seeing things in a way which *afterwards* proves to be true, even though it cannot be established at the moment, and of grasping the essential fact, discarding the unessential, even though one can give *no account* of the principles which this is done." "…new combinations are, as a rule, embodied, as it were, in new firms which generally do not arise out of the old ones but start producing beside them … in general it is not the owner of stage-coaches who builds railways."

Schumpeter further observes that "As a matter of fact, capitalist economy is not and cannot be stationary. … The fundamental impulse that sets and keeps the capitalistic engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates."

In our modern language, such new enterprises are called "innovators" [9]. Schumpeter observes not only when innovators start, but also when innovators complete their mission and who it is that then carries forward a newly created enterprise. "Once *established*, they [new combination enterprises] must be properly incorporated in the circular flow [of economic life]." The circular flow in economic life is described fully by Schumpeter in Chapter 1 [7] and, generally speaking, is "…running on in channels essentially the same year after year. …this circular flow and its channels do alter in time …only … continuously, that is by steps which one can choose smaller than any assignable quantity, however small, and always within the same framework." In modern language, these enterprises in circular flow are called "diffusers" [9].

As a rule, establishments in the circular flow of business life do not need capital, because they generate it internally from one circle of their life to the next. In principle, they do not need a capitalistic economy; moreover this economy causes, in some instances, their economic performance to be inefficient. Schumpeter observes that "In the [capitalistic economy] endless moves and countermoves are necessary and decisions have to be taken in an atmosphere of uncertainty that blunts the edge of action, whereas that strategy and that uncertainty would be absent from the [socialistic economy]." Schumpeter defines a socialist economy as consisting of spheres of economic life owned and controlled by the public. Today, economists describe many of the goods and services provided by the publicly controlled business entities as public goods (public roads, public health, etc.).

"The socialist [public] management could steer a course approximating the long-run trend of output, thus developing a tendency which … is not foreign to big-business policy. Socialization means a stride *beyond* big business on the way that has been chalked out by it or, what amounts to the same thing, that socialist management may conceivably prove as superior to big-business capitalism as big-

business capitalism has proved to be to the kind of competitive capitalism of which the English industry of a hundred years ago was the prototype."

It is important to note that in developed societies of our world, socialist and capitalist economies co-exist. One example of public involvement in providing a basic public good is energy. In many countries, electricity is provided either indirectly by the government (through extensive regulation of private enterprise) or directly through government ownership. An example of the former is the U.S. regulation of electric utilities. An example of the latter is the nuclear power-based electric power grid owned and controlled by French Government. Such big businesses or public utility companies cannot rely on the abilities of a single individual, and for this reason require bureaucratic management. The leadership in bureaucracy is provided by individuals with the political skills necessary to identify and implement solutions that the affected constituency will accept. As a rule, such skills are acquired through training and experience.

In sum, after a period of innovation, external capital is not required for big business to continue to use an innovation, however uneconomical, in a capitalistic economy. In the event that production becomes large enough to move *beyond* big business (or is a necessary public good that otherwise would not be efficiently produced), it can become more economical for the public to take control of it, such as was described above for the public utility business.

In Fig. 2, we present three stages of technological progress.

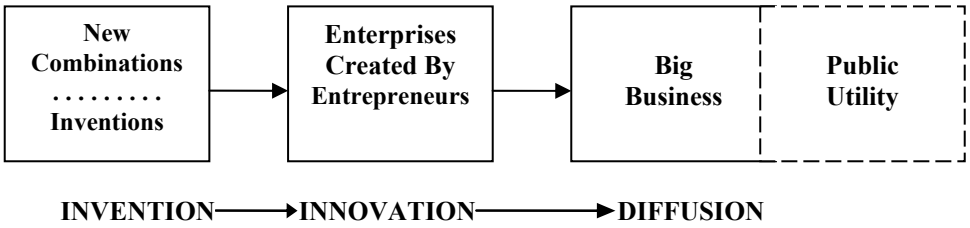


Fig. 2. Technological Progress

Schumpeter's observations from long ago receive modern confirmation, as described in [19] by Profs. Markides and Geroski of the London Business School: "The skills, mind-set, and competencies needed for discovery and invention not only are different from those needed for commercialization; they conflict with the needed characteristics. This means that firms good at invention are unlikely to be good at commercialization, and vice versa….Who says elephants can't dance? Just go on a diet and lose some weight of that excess weight, learn a few tricks, and off you go!...Indeed, one can credibly argue that the [innovation] outsourcing model is in fact the one that has been adopted historically by large firms, albeit in an unplanned and haphazard way…. In effect, we are arguing merely for adding a consciousness to what previously has been an unconscious, random process."

B. The Source of New Combinations

What is not observed by Schumpeter is how new combinations appear. We will attempt to fill this void with respect to inventions. Schumpeter defines them as follows [7]: "1) The introduction of a new good —that is one with which consumers are not yet familiar—or of a new quality of a good. 2) The introduction of a new method of production, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity

commercially." There are other new combinations in markets, supplies, and organization, which we will not address in this paper.

To begin our analysis, we will now compare the characteristics of innovators and diffusers with those of inventors. We will concentrate specifically on high-value inventions that are material to the disruptive progress of our capitalistic economic system, primarily of creativity level 5 and some of level 4.

The first characteristic of the inventors on these creativity levels is to use their *hereditary ability* to create new combinations of elements known to them. It is important to note that this hereditary ability is only an enabler. It is highly improbable that the inventions of level 4 or 5 could be made without hereditary ability to invent. When present, these abilities must be supplemented by others like desire to improve the world, curiosity, extensive memory functioning, scientific inquiry, etc. to expose this inherited trait. Inventors on these levels do not need to have design experience from any particular company to make such inventions. Companies, in order to succeed, must focus narrowly on its technology and market. However, this narrow focus is contrary to the requirements on creativity for level 4 and 5 inventions, which are of necessity multidisciplinary.

An example of such an inventive process was described by Helmholtz [4]. While Helmholtz described the creative process of scientific discovery, it is applicable to any creative process, inventing being one of them. "Each time, I first have to turn my problem over on all sides, examining it in such a way that all its turns and intertwining are strongly *stored in my memory* and could be again recalled by heart, *without the help of notes*. To reach that state is usually impossible without long preliminary work. Then, when my tiredness is gone, it is necessary for one hour of complete physical refreshment and feelings of wellness – and only then the good ideas come. Often, they come in the morning, after awakening, as mentioned by Gauss." Here are the three phases of the inventor's creativity: search, waiting period, then illumination.

It is this *illumination,* which appears suddenly and after an undetermined amount of waiting period, that is the inventor's most characteristic ability. It is hereditary in nature, similar to other unique human traits such as singing, composing music, playing ball, being a military commander, or being an entrepreneur. This illumination results from an inventor's internal "program" stored in his subconscious mind as he does not realize its workings, only the results. The frequent case of ideas "[coming] in the morning, after awakening" is additional proof of the subconscious operation of the mind. This "program" needs knowledge data, and not in notes, but in memory. Otherwise, the "program" can't process the data. That is why Helmholtz tells us that he "turn[s his] problem over on all sides".

The second characteristic of inventors at levels 4 and 5 is that they are curious people, encyclopedic in a certain sense, and accumulate large amounts of data in their memory over long periods of time. This knowledge is about devices, methods, systems in the state-of-the-art in several industries, level of scientific achievement, areas of needs, and technical and scientific barriers. It takes a good part of an inventor's working life to accumulate enough knowledge for creating new combinations. This is one of the reasons that a large number of world famous inventions are created by mature inventors. This vast knowledge, being acquired, resides in a conscious part of the inventor's memory so that he can recall it without notes. This is the inventor's *search* database.

The third characteristic is how much of a *waiting period* an inventor needs to process data in his conscious memory using his innate "program" in his subconscious mind. The prevailing method of inventing is to use trial and error. Inventions on levels 4 and 5 require tens of thousands of such attempts. In the past, it took generations of inventors to find one of the right new combinations. In the last 30 years, a set of new inventors' tools (TRIZ, as mentioned above) was developed to shorten this time quite significantly, i.e. to enable inventors to use their time more efficiently [1]. Efficient use of time enables the inventors to use their hereditary creative abilities many times, i.e. to become professional inventors. In Table 4 we summarize the key differentiators between the various economic activities in the chain of technical progress as seen in Fig. 2.

Table 4. Key Differentiators of Technical Progress Activities.

Differentiator	INVENTION	INNOVATION	DIFFUSION
Value created	Invention and patent	Established enterprise	Products and/or services
Capital requirements	Minimal and secondary	Substantial and primary	Not essential or not required
Human Factors: Key personnel	Inventor	Entrepreneur	Bureaucracy
• Key trait	Intuition to create new products, materials, processes	Intuition to create new enterprises under uncertainty	Political skills
• Length of experience	Substantial	Not essential	Essential
• Special training	TRIZ	Not essential	Organizations and politics

C. Maximized Economic Efficiency

The next issue is how to combine these three very different activities in the most economically efficient manner. There are a limited number of combinations of these activities, shown in Fig. 3.

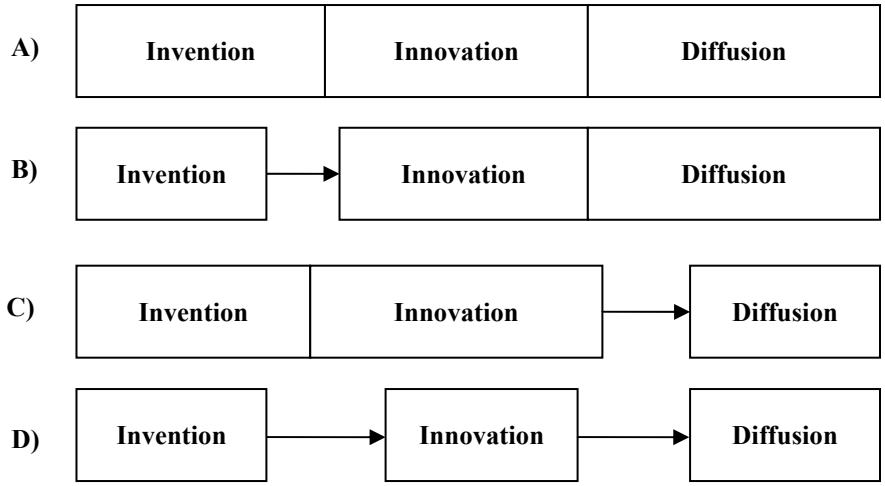


Fig. 3. Business entities by activity

These options are:

- A) To combine all three in one entity
- B) To combine the Innovator and the Diffusor in one entity and leave the Inventor in a separate entity
- C) To combine the Inventor and the Innovator in one entity and leave the Diffusor in a separate entity
- D) To have all entities separate.

Option A is a typical socialist (public) model when interrelationships between entities are controlled by a central authority and not by market forces. Even the innovative part of this entity, being taken alone, is economically incompatible with such a model. The innovation activity belongs to a capitalist economy and the diffusion activity does not. Statistical analysis of the correlation between increased R&D spending and improvements in profitability in 30 global 500 companies demonstrated that there is almost no correlation [10]. Just because of this issue alone, Option A is uneconomical.

Option B is uneconomical for the same reason as Option A. The most economical implementation of the diffuser requires traits of public economy, but the innovator is inherent in a capitalist economy.

Option C is frequently used in a capitalist economy, but is an uneconomical combination. In one implementation, the inventor becomes an entrepreneur; however, it is extremely rare that one person has a gift of two different intuitive and innate abilities. For this reason, it is ubiquitous that the inventors are unsuccessful in creating enterprises using their inventions. Even Edison wasn't a successful innovator. In another implementation, the innovator absorbs the inventor and, as a consequence, the inventor ceases to be one. The narrowly focused enterprise cannot provide support to an inventor with either the breadth of designs or the innovative pursuits for his other potential inventions that are not so narrowly focused. On the other hand, the presence of the inventor creates an NIH (Not Invented Here) situation that precludes the innovator from using inventions from the outside. In this situation, neither the inventor nor the innovator is an economical beneficiary after combining their activities.

Option D is a truly economical market-driven model. All entities are separated into their respective fields, and interact via market forces. The economics of such a division is also supported by one of the pillars of modern economy – specialization and division of labor. Henry Ford, by converting craftsmen into narrowly specialized production line workers, created a remarkable product economics that became the cornerstone of American prosperity in the 20th century. This division flowed into other economic activities, starting with dividing engineering in separate disciplines. Our conclusion is further supported by the analysis presented in [10] and corroborated in [11], to the effect that in 30 Global-500 firms there was "almost no correlation between increased R&D spending and improvement in profitability."

In Fig. 4, we depict a market model for business entities that participate in a chain of technical progress.

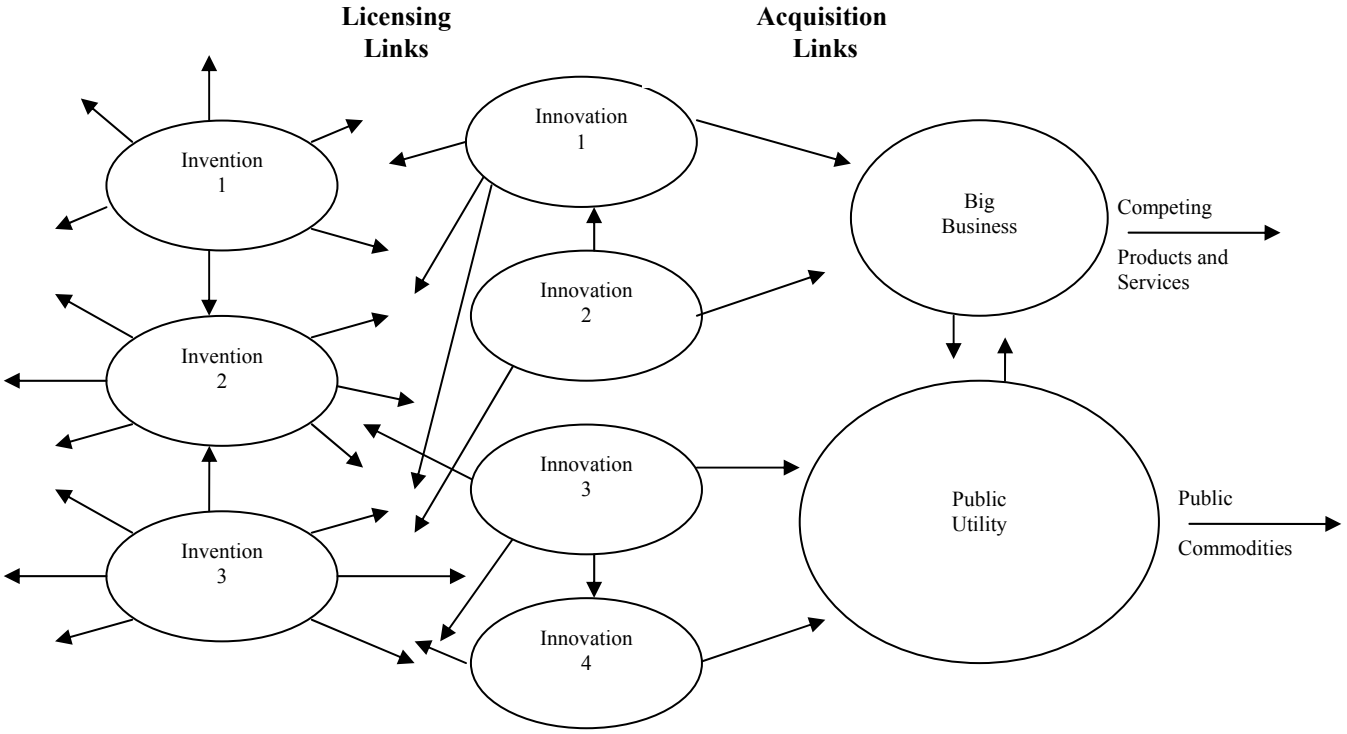


Fig. 4. Market Model for Business Entities in a Chain of Technical Progress

In a market model, the inventors realize value from their inventions by licensing their use, both to numerous innovators and to other inventors in various markets. The innovators realize value by first creating their unique enterprises, using many licensed inventions, and by selling such enterprises on a competitive basis. The diffusers, in the case of big business, realize their value from profits on the products and services delivered from acquiring, operating, and growing in size such innovative enterprises. Or in the case of public utilities, a more economical delivery of such utilities is realized by the public.

In the market model, each entity engages in only those activities directly related to its core competency so that it can realize the highest economic value from its own activities. The inventor can become such a separate business entity in capitalistic market if he specializes, by becoming a professional inventor. This means that the inventor produces a continuous stream of inventions, rather than simply inventing occasionally. Such a business model is not new and is present in various forms in our capitalist economy. We present a few examples in Table 5.

Table 5. Invention Business as a Separate Business Entity

Market	INVENTION	INNOVATION	DIFFUSION
Automobiles	Dolby	Makers of tape players	Car makers
Electrical	Ovonics NiMH batteries [12]	Sanyo	Ford
Image processing	MPEG LA [13]	Set top boxes	Comcast, Dish
Cell phones	Qualcomm's CDMA [14]	130 suppliers	Nokia, Motorola

These examples support our conclusion that it is economical to create a purely invention-focused business. Further examination of these examples reveals that they are substantially unique as a business organization. This leads to the issue of what constitutes an economical business model for an invention business.

4. Foundation for a Business Model of an Invention Business

Here we act as Schumpeter's entrepreneurs, planning for the creation of new enterprises using "new combinations" of business elements. First, let's collect all elements for this business presented in this paper. As for any business, the key elements are people, products, production, sales, profit, operations, and capital.

Elements of an Invention Business

Products

The invention business must have products for sale or rent. It is clear from the foregoing that the products of the invention business are patents. Patents, being properties, can be sold, rented (licensed), mortgaged, etc. The State protects them from trespassing or misuse without the explicit consent of the owners.

The rationale behind the transferability of patents and patent applications is that it enables inventors to "sell" their rights and to let other people manage these intellectual property assets, on both the valuation and enforcement fronts. As The Economist put it,

> "*Patents are transferable assets, and by the early 20th century they had made it possible to separate the person who makes an invention from the one who commercializes it. This recognized the fact that someone who is good at coming up with ideas is not necessarily the best person to bring those ideas to market.*" -- The Economist, *A market for ideas*, October 20, 2005

This idea that patents are properties by themselves, i.e. separate from both their inventor and from the products made by the patent owner, has recently come under assault [15]. Claims based on the rejection of this idea do not have any legal standing today, but is it possible that this may change in the future? For possible insight into the future, let's examine the criticisms that have been leveled at the idea that patents themselves constitute property.

The first criticism is that patents acquired from inventors are inferior in their property rights. This is tantamount to attaching an inventor to his patent, otherwise making him a part of the property. This is a nostalgic idea that did not work well either in Tsarist Russia (peasants attached to the land) or in the United States (slaves owned by their masters), and this practice of using people as properties was abolished in the USA in 1861. The Thirteenth Amendment to the U.S. Constitution is very clear on this subject and is extremely improbable that it will be reversed.

The second criticism is that the patent must be attached to a product made by the patent owner and producing revenues in order to enforce the owner's exclusive right. This is a fantastic idea to have a business with products and revenues in all markets where the invention applies, such as all the 130 licensees of Qualcomm combined. It is absurd and for this reason alone will not find ways into at least the American legal system that is based on argumentation from formal and informal logic

standpoint. This way of argumentation originates from canons of Roman rhetoric and survived over 2000 years of testing. So, it is extremely unlikely that it will be changed now.

In conclusion, the invention business has inventions as its products, byproducts of which are patents, which guarantee the value of the inventions and which consist of documents that lay open to the public the details of the underlying invention. It is not incumbent with attachment of either people or products using such patented inventions. Patent has all the attributes of property with respect to ownership, transferability, and trespass.

Production Activity of an Invention Business

The main production activity is to *produce* inventions and to protect them with patents. These inventions are of such creative value that they can either revolutionize or create industries, primarily on level 5 with some extension into level 4. A supplementary activity would be to enhance the value of such patents by *acquiring* other related patents from other inventors. These decisions are of a traditional "buy-vs.-make" type.

The key "productive assets" are those inventors that have a *hereditary ability* to invent combined with substantial *knowledge* of multidisciplinary technical and market environments, and with use of inventing activity enhancement tools such as *TRIZ*. Each invention adds to the inventor's knowledge base, thereby enhancing his chances of finding new inventive solutions on the same high creativity levels 4 or 5.

Business activities of an Invention Business

The most important of these is the sales activity, which is licensing patents to other business entities, primarily to those that can be characterized as innovators. Of all the ways in which monetary value may be realized from patents, licensing to all innovators in need of inventions described in the patents creates the highest value.

Management in the earlier stages of establishment must be based on a single entrepreneur who is not any of the inventors. Over time, management can become bureaucratic as long as the inventors make decisions on what they will invent (produce). On this subject, this is what Schumpeter [7] teaches: "Yet innovations in the economic system do not as a rule take place in such a way that first new wants arise spontaneously in consumers and then the productive apparatus swings round through their pressure. It is, however, the producer who as a rule initiates economic change, and consumers are educated by him if necessary; they are, as it were, taught to want new things, or things which differ in some respect or other from those which they have been in the habit of using."

Capital of an Invention Business

The invention business is not particularly capital intensive, compared with the capital needed to create an enterprise that will produce and market an invention. Among all entities in the progress chain, the invention business has the highest ROI and the lowest absolute amount of created new capital. It is exactly opposite to big business, which has the lowest ROI and the largest absolute amount of created new capital.

The invention business needs external operating capital to survive, until its licensing revenue generates sufficient internal capital. This capital, being relatively small, can be provided by insiders and other individuals that are close to the insiders. Alternatively, entrepreneurial capitalists can become involved in providing this capital, as they did 50-70 years ago by funding new technology innovators. Whitney & Co. comes to mind.

To create a business model for this collection of elements, let's look at other businesses with similar elements. Such businesses must have as their foundation the acquisition and management of properties. Two such businesses come to mind. One is the mutual fund business, and the other is the development and management of real estate.

Elements of a Mutual Fund Business [16]

Products consist of shares in pools of financial securities. Each mutual fund management company creates and manages numerous pools of such securities, so the purchasers of shares have a variety of fund securities to choose from.

Production activity is to create, and trade, in pools of securities of similar businesses with a goal of increasing the value per share. Key "productive assets" are "stock pickers", individuals that have hereditary intuition about what and when to buy and sell, also known as fund managers. Like inventors, fund managers also need education and experience. These fund managers produce financial gain.

Business activity is principally to trade shares of pools of securities to individuals or other legal entities. Management in the earlier stages of establishment is based on a single entrepreneur who, as a rule, is not any of the fund managers. Fidelity comes to mind, with Peter Lynch and Edward Johnson.

Profit for the fund managers and the entrepreneur comes from the fees that they charge each fund.

Organization is the realization of economy of scale. Each fund is organized as a trust with its own Board of Trustees. Each fund enters into a contractual relationship with the Management Company to advise on the buying and selling of securities, on actual market operations, and all business operations including the use of personnel. So, the Management Company provides all these services on an as needed basis and therefore allows each fund to incur only a portion of the expenses that it would otherwise incur. In its turn, the Management Company has many contracts and can employ its personnel and facilities economically, due to the volume of operations.

Capital is initially provided by capitalists, typically at least partially from the entrepreneur acting in the role of a capitalist.

Elements of Real Estate Development and Management [17]

Products consist of shares in pools of funds used to buy, develop, and sell real estate. Traditionally, such pools are limited partnerships. Each partnership buys, develops, and sells different kinds of real estate: for example, commercial and industrial buildings, condominiums, toll roads, and golf courses.

Production activity is to decide what property to buy and what improvements to add. This activity is carried out by an entrepreneur, frequently called a real estate developer. In addition, he organizes a Management Company for business activities.

Business activities are numerous. Naturally, the most important one is selling the improved properties. Operational activities include purchasing properties, zoning, making architectural designs, managing construction, and renting or leasing.

Organization is the realization of economy of scale. Each project is organized as a limited partnership with the Management Company as a General Partner. The partnership collects funds from its partners, primarily from limited partners, buys and improves property, and sells it for profit. The partnership enters into a contract with the Management Company to operate the partnership. This creates economy of scale for both entities. The partnership will pay for services only on an as needed basis, and the Management Company, by having numerous contracts, can employ its personnel and facilities with high efficiency due to the volume of operations.

Profit from each partnership is divided between the limited partners and the Developer-Entrepreneur. In a typical arrangement, limited partners get profits first up to a certain amount, and the developer gets residual profits. This creates a substantive incentive for the developer, and, by doing so, provides better assurance to the limited partners in their financial gain.

Capital required initially is insignificant and traditionally comes from the entrepreneur.

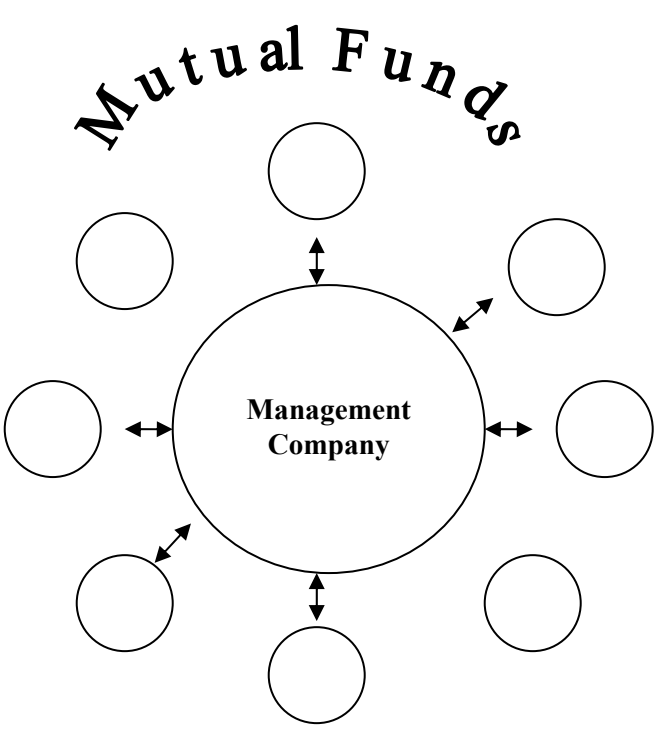
5. Combining Business Elements into an Invention Business

To begin with, our ideas of creating an invention business are not new. There are many live experiments in this field, the best known of them being “Intellectual Ventures” [18]. We hope to add value to these developments.

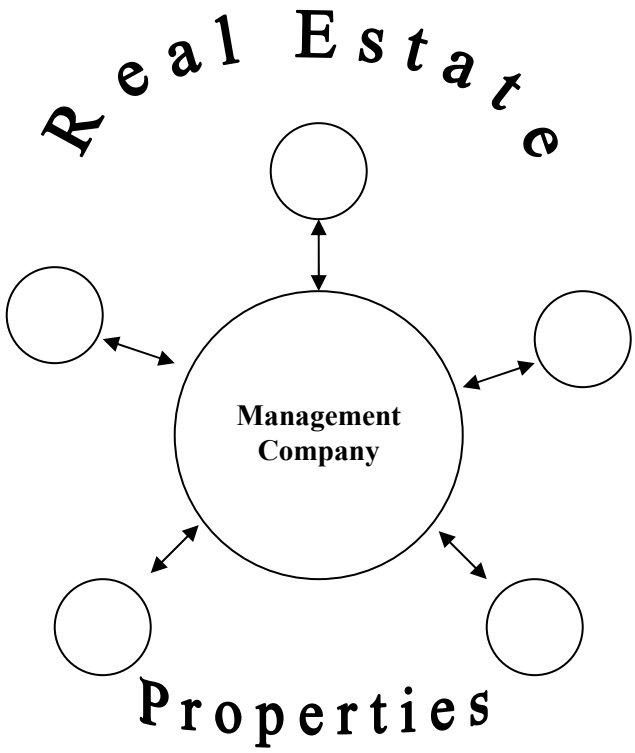
We summarize our observations in Table 6 and the associated Fig. 5.

Table 6. Comparison of Elements in Selected Businesses

Element	Invention business	Mutual fund business	Real Estate business
Product	Patent [property]	Fund shares [property]	Real estate property
Production activity	Invent and Patent	"Buy low, sell high" financial securities	Buy and build or improve
Key personnel	In-born inventor	In-born fund manager	In-born developer
Management	Entrepreneur	Entrepreneur	Developer-entrepreneur
Sales activities	Licensing (rent) as primary and sale as secondary	Buy and sell fund shares	Sale as primary and rent as secondary
Organization		Fig. 5a	Fig. 5b
Profit sharing		Fee to Management Company	Residual value to entrepreneur
Capitalists	Insiders and their associates, entrepreneurial capitalists	Outsider capitalists and Entrepreneur	Entrepreneur



Fg. 5a. Organization of a mutual fund business



Fg. 5b. Organization of a real estate business

Now, let's compare the information in Table 6 and identify what is common and what is different.

Commonalities:

- Product is property in all three cases.
- Production activity is common in the need for unique innate abilities and experience of key people.
- Management is the same in all three cases – the entrepreneur.
- Sales are common between the real estate and the invention businesses.
- Organization of the mutual fund and real estate businesses is very close to each other.

Differences:

- Business life of properties
- Liquidity of all properties
- Sales of mutual fund shares are accompanied by redemptions
- Profit sharing as a function of risk and liquidity
- Sources of capital as a function of volume

First, let's use this comparison to fill the void of organization and profit sharing in the prospective invention business in the direction of higher economic value.

Organization of the invention business

Because the organization of the mutual fund and real estate businesses are similar, we can apply it to the organization of the invention business. This business needs a Management Company and separate business entities for each unique set of inventions that can buy inventions, develop them, and sell or license them. Such entities can be organized as invention LLP – ILLP. This arrangement is economically beneficial to all parties.

Profit distribution between all assets contributors in the invention business

There are three distinct groups of major contributors: the inventors, the capitalists, and the entrepreneur or operational management, in order of value.

The inventors are key personnel and the financial gain of the invention business depends so much on their ability and intuition that is at least comparable to that of a real estate developer. This is a basis for sharing profits between the inventors and the capitalists in the same way; the capitalists get their returns first, up to a certain ceiling, and the residual profit goes to the inventors.

The entrepreneur or management in the invention business provide a service very similar to that in the mutual fund business and for this reason the profit sharing may be on a fee basis, very similar to fees charged by a management company in the mutual fund business.

Now, let's address two other important matters of value of the invention business: liquidity and risk.

Liquidity

Among all three entities, mutual fund products are the most liquid and can be both purchased and sold on an open market. The liquidity of the real estate business is confounded by the marketability of developed properties, and can vary a great deal as a function of extraneous circumstances.

Liquidity in the invention business is much closer to that in the real estate business. When patents are licensed to innovators, the current or future stream of income creates a condition for liquidity. The time interval between an ILLP formation and a first license is not much different from a similar interval in real estate business.

Risk

Risk reduction by all contributors of assets in the invention business is achieved in a traditional way; by diversifying. The organizational model proposed for the invention business is a near ideal conduit for diversification. The inventors diversify by creating multiple inventions covering diverse markets, and the capitalists diversify by investing in various ILLPs. The capitalist can realize even lower risk by diversifying between various invention businesses.

CONCLUSION

In the preceding analysis, we laid out a foundation for a high value business model for the inventors. Needless to say, it is a starting point, and undoubtedly it can be modified to obtain better results.

These are the foundations:

- Patents are products
- Inventions shall be on the creativity level 5 with some extension to the level 4, and protected by the patents
- The inventors must have hereditary creative ability in industrial arts, substantial multidisciplinary knowledge, and TRIZ training
- There must be an entrepreneur that is not an inventor
- The preferred way of realizing value is to license to different innovators in different markets
- Organization is a "star" type, as in mutual fund or real estate development businesses, and comprises multiple business entities each with a unique set of inventions, and a management company. These inventions come primarily from the inventors of the management company, and secondarily from third parties.
- Management Company operates this "star" type organization in the same way as management companies do in either mutual fund or real estate business. The inventors, the entrepreneur, and operational management constitute the management company personnel.
- Profit sharing is on a fee basis to management and on a residual basis to inventors
- Capital sources – insiders, their associates, and entrepreneurial capitalists; all acting as capitalists.

This model for an invention business may be appealing to all business contributors, due to its high-value opportunity.

Inventors will be able to create new industrial arts in a professional way, day in and day out, and by doing so accumulate co-ownership in a large number of patent properties. The invention business creates the foundation for inventors to be busy, i.e. to be in business. And they do not need to become entrepreneurs to be in business. They could realize large financial gain. The more valuable the inventions they make, the greater the disproportionately large residual economic value they will receive.

Capitalists can realize the highest ROI among all classes of investments they make, with a minimal amount of capital at risk, and experience a great deal of excitement from participating in acts of creation.

Entrepreneurs can realize a great deal of satisfaction from creating enterprises with new combination of business elements. While such activity is mostly not patentable and is to some extent in trade secret category, still the entrepreneurs can generate success income that is dramatically larger than in other entrepreneurial activities, per similar amount of entrepreneurial efforts.

In summary, the proposed invention business model offers high economic value to the inventors, the capitalists, the entrepreneurs and management.

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