

REPLICATION

-A Force of Nature or Work of Art?

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Abstract

Replication “refers to the creation and operation of a large number of similar outlets that deliver a product or perform a service” (Winter and Szulanski, 2001). Undertaking a replication strategy ideally entails identifying the recipe that proved to be successful, and apply it over and over again without another company being able to identify and imitate it. Within a resource-based framing replication may be seen as a matter of finding an Arrow type, non-rivalrous resource, possible to use repeatedly without loss of value. Replication processes in business settings have been conceptualised using a biology metaphor as main inspiration. In the paper we identify yet another replication metaphor, originating in art, and suggest that the combined use of biology and art metaphors is a way to generate a more comprehensive framework for understanding replication practices.

Keywords: Replication; Evolutionary Theory; Replica; Art; Non-rivalrous Resources; Imitation

Suggested track:

- A) Managing organizational knowledge and competence
- C) Knowledge sharing within and across organizations and cultures e.g., in off-shoring arrangements
- H) Dynamic capabilities

Introduction

Imagine a quite small, yet successful, business – say, a restaurant or a bookshop. It has come up with a concept that attracts numerous customers, and could be described as out of the ordinary in some way. As the business is successful, it will eventually seem favorable to expand and start another restaurant or shop, just like that first one, but in a different location. And once that second one is up and running, maybe another one, and another one... But obviously not all such multiplication of outlets turns out as success. Sometimes the new ones fail to incorporate the essence of the original and sometimes imitators catch up, do a better job and outperform first movers. So there is a question of how we might understand and explain success and failure in such endeavors.

The strategic approach of the imagined company could be labeled 'replication', which in Winter and Szulanski's (2001) words "entails the creation and operation of a large number of similar outlets that deliver a product or perform a service" (p.730). The first company to come to mind for most people is probably McDonald's, but there are also many examples of replicating firms outside the fast-food industry. According to Winter and Szulanski (2001), replicators can now be found in over 60 industries, whereof hotel, banking, and accounting are just a few examples. Undertaking a replication strategy, these authors state, entails not only identifying the recipe that proved to be successful, but also rapidly apply it over and over again to expand before another company can identify and imitate it. Within a resource-based framing, they contend, replication may be seen as a matter of finding an Arrow type, non-rivalrous resource, possible to use repeatedly without loss of value.

However, as discussed by Rivkin (2001), firms are here faced with a dilemma. To replicate the recipe, a company would want to have quite explicit, uncomplicated directions as to how to go about. A manual readable to anyone would probably be a windfall, especially since that would mean that nearly anyone could be appointed to carry out the mission. The hitch is that the easier it is for the original company to tell the success factors that form their concept, the easier it will be for other companies to snap them up and make them their own. Conversely, if recipes to be replicated are highly complex or less well known, difficulties may prove to be overwhelming for both imitators and the original company. Yet, many firms successfully carry on with a replication strategy, and of course there are suggestions in the literature as to how this may be explained.

To be imitated or not to be imitated...

The question of replication and imitation has been dealt with for quite some time now, and the perspective grows ever wider, from the replication of technology to the replication of whole business strategies. Kogut & Zander have written several articles about the replication and imitation of technology, capabilities, and knowledge. Some parameters they found important were how easy it was to codify and teach the knowledge (or capability) and how complex it was. In an empirical test they found that the more codified and easily taught the knowledge, the more likely it was to be imitated, and the more complex the knowledge, the more likely it was to be replicated (transferred internally) (Zander and Kogut, 1995). Reed and DeFillippi (1990) discuss the question of sustainable competitive advantage in similar terms, but they point to causal ambiguity in competencies, i.e. not knowing exactly what actions cause what outcome, as a key to repelling copycats. Rivkin (2001) made a computer simulation of a battle between replicators and imitators of a strategy. His conclusion was that if the strategy is simple, the replicator's initial advantage will not last very long. If the strategy instead is very complex and

consists of many decisions that are intricately intertwined, the replicator's knowledge of the recipe for success will only be slightly imperfect while the imitator's knowledge will be highly imperfect, but they will still both be wrong and hence fail. At moderate levels of complexity though, it seems the replicator has an advantage since he possesses the original template, which will guide him to make the right decisions.

'Replication' – biology or art?

In the *Oxford English Dictionary* we find six main meanings of the word replication. Number six has two interesting sub-meanings, a) a copy, reproduction and the act of reproducing, and b) the process by which genetic material or a living organism gives rise to a copy of itself. In assessing the writings of some of the researchers mentioned earlier, one soon identifies that they are more or less strong influence from evolutionary economics, signified by the use of concepts such as 'routines', 'selection', etc. In particular, we may assume that the seminal work of Nelson and Winter (1982), suggesting an 'organizational genetics' framework, has been influential. In its introduction we can find the following quote:

Our use of the term "evolutionary theory" to describe our alternative to orthodoxy also requires some discussion. It is above all a signal that we have borrowed basic ideas from biology, thus exercising an option to which economists are entitled in perpetuity by virtue of the stimulus our predecessor Malthus provided to Darwin's thinking. We have already referred to one borrowed idea that is central in our scheme – the idea of economic natural selection...Supporting our analytical emphasis on this sort of evolution by natural selection is a view of 'organizational genetics' – the process by which traits of organizations, including those traits underlying the ability to produce output and make profits, are transmitted through time (p.9)

It does not seem too bold an act to suggest that biology, and the replication of genes, has been the source of inspiration. The word 'replication', when describing the strategic approach of those firms that create many similar outlets, seems to be a metaphorical expression with some biological roots. Biology, and more specifically the replication of DNA, has thus been the dominant source of inspiration for conceptualizing how firms replicate. Using such a metaphorical expression, extant theories have become loaded with images, insights and assumptions from the biological world, which have stimulated our thinking. However, in addition to enriching our thinking, and being creative tools, metaphors also have the negative tendency to limit what we see (Alvesson, 2002).

In the dictionary we had one more sub-meaning of the word 'replication', in addition to the one from biology, and that was 'a copy, reproduction and the act of reproducing'. As it was illustrated by a sentence about oil painting, this led us to the art world. As witnessed by the

dictionary there are thus at least one more field, besides biology, where ‘replication’ is already used, and that is art. If we take metaphors seriously, recognizing that they can influence our way of thinking, we should examine the ones we take for granted closely, and try to understand what ‘replication’ is in a biology context. How does biology, and in particular the replication of DNA, influence the way we understand and think of replicating firms? In addition, since any one metaphor can only enlighten us so much, what would happen if we were to see ‘replication’ from an art perspective? What new insights, if any, could that bring to the theory of replicating firms?

Paper outline

We will start this paper with an exploration of replication in the biology world, focusing on the replication of DNA and genes, and the evolutionary theorizing that encompasses it. We will then apply this biological filter on what has already been written about replicating firms, to see its strengths and weaknesses. After that we will explore replication in an art context, and compare the two metaphors. We will then end with a section on potentially new insights contributed by the combined use of the two metaphors.

Replication – a biology view

Replication in evolutionary theory

In the beginning, at some point in time, Dawkins (1976, p. 17-18) tells us, a particularly remarkable molecule was formed by accident, having the extraordinary property of being able to create copies of itself. As mis-copyings were made, a variety of replicating molecules emerged, out of which some became more numerous than others. Among replicators, competing for scarce resource in the environment, the ones that have a high propensity to survive and outnumber others are those that display stability and longevity, speedy replication, and replication accuracy. So, these are the features of “good replicators”. A molecule, or a gene, within this conception has but one “wish”, to survive and reproduce as much as possible. It is a “selfish gene” as phrased by Dawkins, a gene that sees to its own interest, not engaged in some altruistic endeavors for the best of the species it may be a part of or the like. As a result, we and all other animals are best seen as “machines created by our genes”. Surviving replicators, such as genes, are thus those who are good at building “*survival machines* for themselves to live in” (p.19). Such replicators, however, do not literally survive, like all material bodies they are destroyed at each replication; “all that survive is their *structure*. They ‘survive’ only in the form of copies” (Hull, 1988, p. 406).

Replication through a microscope

In order for a cell to divide and create a copy of itself, which functions and can survive, it must accurately and completely duplicate the genetic information that is encoded in its DNA. The DNA molecule consists of two long complementary strands, and looks like a spiral shaped ladder. The 'sides' of the ladder consists of a chain of sugar molecules and phosphate groups. The 'rungs', which join the two sides, are made up of a pair of different bases that always pair up in the same way. In order for the DNA to be replicated, the two strands must first be unwound from each other. An enzyme starts the process by detaching the two bases, and as the two strands separate, each of them acquires a new 'side' and 'rungs' to replace the original ones. Since the bases are restrictive as to what kind of base they will bond with, one strand will serve as the mould for the other one, making sure that a perfect copy is made, and hence each of the two new DNA molecules will consist of one of the original strands and a new one. If something goes wrong and a mutation occurs, the consequences can be everything from lethal to negligible, depending on how the sequence of bases is changed. Since mutations are only rarely for the better, the DNA has an ability to 'proofread', erase errors, and then synthesize again in order to reduce the risk of inaccuracy. Occasionally, however, a mutation will turn out to be a positive addition which makes it possible for an organism to adapt, therefore mutations are essential in a long-term perspective.

(Source: Encyclopaedia Britannica)

According to Dawkins genes apply a kind of indirect control of the body that inhabits them. It is never the other way around. The strategy of genes is to preserve themselves unaltered and thus uninfluenced by the "vehicles" they use for their endeavors. In doing that genes do not work in solitude, but in complex aggregates, where some may be more dominant than others. The effect of any given gene then depends on its interaction with many other genes. Taken together they provide with a basic structure or design for a vehicle, in much the same way as a computer program.

The genes too control the behaviour of their survival machines, not exactly with their fingers on the puppet strings, but indirectly like the computer programmer. All they can do is to set it up beforehand, then the survival machine is on its own, and the genes can only sit passively inside. (p. 52)

As pointed out by Dawkins (1982, p. 12) such influence is not deterministic. Rather, it should be seen as "statistical", in the sense that the knowing the prevalence of certain chromosomes increases prediction accuracy by fixing some initial parameters. Genes, however, do not survive

and multiply only by affecting their proximate vehicle or phenotype environment. Instead, Dawkins (1982) argues, they reach outside their ‘own’ body and affect other phenotypes. Far from only predisposing a narrow range of functions in a local setting, they “reach long” and the phenotypic effect of a gene “needs to be thought of as *all the effects that it has on the world*” (Dawkins, 1976, p 238.).

For Dawkins, genes are the primary replicators in biology. As noticed by Hull (1988), harsh controversies in biology, however, witness that it may not be the only candidate. In principle at least, Hull argues, we may think of organisms and other entities in the biological hierarchy as replicators. They too have ‘structures’ that they might be able to replicate with some degree of copying-fidelity. In keeping with his view, we will treat this as an open question and use “replicator” as a general term for an “entity that passes on its structure largely intact in successive replications” (p. 408).

So far we have focused on replication, involving ideals of copying-fidelity or passing on structures largely intact. This would seem to contradict the idea of copying errors as a main driver of evolution. However, evolution should be seen as something that is happening, in spite of all the efforts by replicators to prevent it; “nothing actually ‘wants to evolve’”, says Dawkins (1976, p. 18). But again, we are faced here by a controversy among biologists as to how evolution is best conceived. In particular there is disagreement as to at what ‘level’ variety generation and selection processes occur, with “gene selectionists” in some opposition to those who believe that such processes rather or also go on at the “higher levels”, such as the organism, population, species, etc. As argued by Hull (1988), we probably do best in treating this as an empirical question, noticing that the most appropriate level of selection might vary among replicators over time. We should however make a clear distinction between replicators and the higher-level units they use or inhere in. In order not to favor a priori, the alleged gene selectionist perspective of Dawkins, Hull (1988, p. 408) suggests that we replace “vehicle” with the more neutral notion of “interactor”, denoting “an entity that interacts as a cohesive whole with its environment in such a way that this interaction *causes* replication to be differential”. Below we adopt this terminology.

A biology image of non-rivalrous resources

In the light of this brief introduction into replication seen from the point of view of Darwinian biology, we may now return to the information economics idea, originating in Arrow, about the much wanted non-rivalrous resources that may be used repeatedly without losing their value. Genes obviously have such a character, being able to multiply over and over again, while keeping their structure and competencies largely intact. Moreover, while genes and collection of

genes do not wish to change, copying errors, mutations, differential outcome of their effects on phenotypes, etc, generates variation, which in turn constitutes a basis for selection and retention. In a sense genes may here be seen as “knowledge” and “competence” containers, able not only to replicate, but also to “learn” and transform, out of their experience in using interactors as a way of furthering their continued survival and reproduction.

Replication in a business context - inspired by biology

Replication, involving the spatial diffusion of novel solutions, represents a relatively new addition to the variation-selection-retention triumvirate in traditional evolutionary modeling, borrowed from evolutionary biology, as noticed by Zollo and Winter (2002). Winter and Szulanski (2001), in particular, focus on this “new” issue and we mainly use this article in re-interpreting their replication-as-strategy framework through the lens of the biology metaphor. To make our interpretations comprehensible we however need first to reiterate some general ideas they build on, ideas associated with an evolutionary view of organizational knowledge and learning. Today these cover a broad range of issues, including suggestions for a theory of the firm, a theory of organizational learning, and a theory of organizational routines. These are well-known suggestions requiring only a brief presentation to be able to serve as background knowledge in our continued analysis.

First, we may then recollect that from the point of view of evolutionary economics a firm is “first and foremost an organization that knows how to do something” (Winter, 1995, p. 148). Secondly, learning how to do things is seen as heavily time and history dependent, and as often emphasized, organizational knowledge or capabilities, tend to be fragmented, distributed and embedded in organizational routines, to a great extent relying on “tacit” knowledge (Winter, 1996). The notion of routine is here a core concept and the entire firm is often referred to a hierarchy of routines (Nelson, 1991). At a micro level, a routine may be conceived as a “web of coordinating relationships connecting specific resources” (Winter, 1995, p. 149) and as such it takes on the character of a team-embodied competence. Routines are thus a key repository of organizational knowledge and firms know how to do things because they command appropriate routines.

Routines as replicators

We now return to Winter and Szulanski (2001). For them, the “routine” notion is parallel to “gene constellation” as conceived in biology, whereas the “Arrow core” refers to the set of valuable “know-how” features of a routine. The Arrow core is thus a resource that is information or knowledge-like, infinitely leverageable and non-rivalrous in use, constituting

what ideally should be passed on to additional outlets. Obviously, the routines actually in place in a specific outlet may then incorporate more or less of these Arrow core features.

However, as with genes, the Arrow core knowledge and competencies should be seen as embedded in an “interactor”, i.e. an operating firm or outlet within a certain environmental setting. As a result, successive replications will tend to have differing outcome even if the same Arrow core were in place. This makes it highly problematic to find out from past success what elements of a given practice should be seen as making up the ideal Arrow core. While some of these aspects may be salient and possible to explicitly recognise, Winter and Szulanski (2001) stress that the Arrow core tend to inhere in “routines”. Being able to identify nonrivalrous information/knowledge in such ambiguous contexts, and recreating tacitly operating routines in other settings, before would-be imitators do, is thus the challenge facing the replicating firm.

Thus, successful replicators [interactors in our terminology] learn to extract nonrivalrous information from a complex and causally ambiguous example, *before others do* [our italics]. To effectively leverage complex and ambiguous success, replicators then become adept at recreating such complex sets of routines and maintain them in operation in multiple contexts. (Winter & Szulanski, 2001, p. 741)

Copying from templates

A sine qua non for replicating firms is thus to learn and copy fast. In order to do so, Winter and Szulanski stress that firms need to have in place “centralized capabilities” to support a speedy and precise replication process. The “Centre” has a vital role in discovering the Arrow core, and see to it that it is “principled” enough and sufficiently validated to allow for commitment to full-scale replication. Apparently reaching such a capability will itself be a kind of learning process, where the centre is learning from a number of successive outlet replication efforts. It would appear, however, that this first exploratory phase, preceding full-scale exploitation, is not allowed to take much time, as replication is seen as a matter of “reaching large market quickly” (p. 740).

Considering the important role of the centre in developing replication capabilities, one might have expected the authors to advocate a more active role for the centre in transferring Arrow core knowledge to outlets, in the second, full-scale exploitation phase. The empirical study of Banc One as reported in Szulanski (2002) also appears to mirror a process where replication activities to a great extent involved central staff and explicit routines. However, consistent with the view of “routines” as constituting the core competences of a firm, Winter and Szulanski (2001) instead suggest that the best way of leveraging the Arrow core, is let the additional outlet copy an established and operating “template” outlet.

The logic behind this view would appear to be that, as a well-functioning template is a result of repeated cycles of learning (involving both the centre and local units), it may be assumed to possess many of the vital elements that make up the ideal Arrow core routine. These elements, embedded in the template routines, are not known with precision, nor are they salient upon mere inspection. As a result they cannot be “transferred” to the new outlet in a conduit transmission sense. Instead they have to be acquired through some procedure of tacit learning, such as through some kind of experiential learning, learning by doing or practice-based learning (see e.g. Wenger, 1998; Brown & Duguid, 2001; Lindkvist, 2005). Apparently this makes it necessary to involve and utilize people at the template, to work together with those at the new outlet, in transferring the craftsmanship of those who embody the knowledge associated with running the “original” to those who shall acquire the same “how to do” abilities at the “replica”.

Copying precisely

Interestingly, Winter and Szulanski (2001) argue forcefully that such copying from existing templates should be made precisely. As a core hypothesis they state:

... replication is more effective and profitable when replication tactics rely on an initial effort to copy the template precisely (p. 737)

Empirical evidence, reported in Adler (1990), Bradach (1998) and Knott (1997), showing that when replication is guided by a template that performs satisfactorily it is better to “opt for strict precision”, are here put forward to substantiate this hypothesis. Instead of venturing into “improving” on the template or change it in order to better adapt to the new environment, it is suggested that, for organizational and psychological reasons, such attempts tend to be overly optimistic.

More generally, a rationale for this hypothesis may be identified in relation to ways of dealing with complexity. Reiterating Simon’s (1962) notion of complexity of productive systems as a matter of the number of elements and interactions, we may recognize that high or moderate levels of complexity may easily result in a vast number of unforeseen interaction effects, many of which may be damaging (Rivkin, 2001; Reed & DeFillippi, 1990). Relying on an existing template where the resulting, routinized interaction effects are already proven to be either tolerable or beneficial, then appear to be a sensible option. Interestingly, we here identify a parallel view in biology, where it is often stated as a rule that new combinations and mutations almost always involve detrimental outcomes. Apparently, the same reasons, concerning the low probability of getting new interaction effects that are favorable to the system, seem to apply.

Replicating without imitation

As to the reason why replicating firms may replicate successfully without being severely hurt by imitators, Winter and Szulanski first point at their superior *access* to the template. Imitators may inspect such a template, but are denied access to the more tacit and routine-based qualities (incorporating vital aspects of the Arrow core). Rivkin (2001) is favoring the same explanation, noticing that, as long as the replicating firm “has better information than the imitator about the original success” (p. 274), a wedge between the ease of replication and difficulty of imitation, may develop. However, this advantage to the replicating firm, he continues, would seem to apply only in cases of replication involving a moderate level of complexity. In simple cases, imitators may be on equal footing with the replicating firm, and where very high levels of complexity prevail, replicating is impossible for both.

Secondly, Winter and Szulanski argue that replicating firms have a kind of learning advantage. Competitors would not have the kind of (central) organizational capabilities in place and the same absorptive capacity to learn from experience as the replicating firm. So although they could actually copy both salient and tacit features of an outlet, it would tend to come at too high a cost and involve learning at too slow a pace. But replicating firms may also earn other kinds of less knowledge-transfer related rents, due to first-mover advantages in site-selection, by having built a committed and experienced social entity. Generally the competitive advantages associated with the replication strategy are seen as differentiated from “conventional sources” such as strong brands and advantages of scale.

Some queries

The use of “organizational genetics” thinking is no doubt a very fruitful way of generating novel and interesting hypotheses about outlet replication in a business context. This perspective stresses that it might be a good strategy to rely on a kind of natural selection process to sort out what routines, comparable of gene constellations in biology, have survival qualities. Routines thus represent the outcome of a cyclical learning process, underlining their time and history dependence, as well as their character as vital knowledge containers, for “tacit knowledge”. Relying on such processes in a firm, would appear to mean that you have to believe, or hope, that what is good for the replicator, the routine, is also good for the firm as an interactor. Thus, along with the inspirational benefits of pure genetics, comes some tendency to downplay human intentionality and foresight. We do recognize that the authors stress the importance of the centre, but it is not clear to us, whether they think of this as connected to the organizational genetics idea or not. To be true, of course, not everything in their theory need to be associated with genetics, as this is only used as one, although a basic, metaphor.

A first more specific query concerns the fact that precise and template-based copying is being advocated. The problem here is neither that replication is seen as a matter of copying what is going on, i.e. the activities, in a well-functioning template, nor is it that copying exactly, without questioning or attempts at improvement during replication is recommended. Both these advice appear suitable when you do not know what it is that should be transferred and taught, and follow nicely organizational genetics ideas. There may be an additional advantage in that only a limited amount of a priori background knowledge would be required of those who should operate the new outlet. Our concern is rather that there is some contradiction between all the stress laid on fast copying, well grounded in genetics, and the fact that much of what is to be copied is “tacit knowledge”, “know-how” dispositions (Ryle, 1949; Lindkvist, 2005) or the like.

Transferring such knowledge is typically a slow process, requiring a lengthy period of face-to-face contacts (Kogut and Zander, 1992). As discussed by Knudsen (2003) it is a mistake to believe that knowledge processes can be speeded up much; as a result it is the prevalence of tacit knowledge that determines the pace of such processes. So, although the organizational genetics perspective is informative as to what kind of knowledge transfer processes are needed in Winter and Szulanski’s second fast full-scale exploitation phase, there is a problem in being able to accomplish this as fast as envisioned. It would appear that replicating firms might benefit from some kind of “shield”, making it possible for tacit knowledge to travel at its own “natural” pace.

A second query concerns how replicating firms may escape the risk of imitation by competitors. Winter and Szulanski, and Rivkin, here focus on the advantage of superior *access* to the template and the possibilities to learn faster and cheaper than imitators. Generally, we recognize that such advantages may prevail and make sense as an expression of “property rights” to close inspection and learning-based first-mover advantages. But perhaps a more basic advice to be deduced from biology is that all one should care about is whether a certain outlet is functioning well. Why this is the case is both an impossible question to answer and a useless question to ask. The fact that your outlets prosper is evidence enough that others have not been able to engage in harmful imitation, and that is enough to know. Just continue to copy templates precisely and reap the benefits of the unknown powers of the replicator routines that are apparently involved.

Now while this basic genetic inspiration may provide some reassurance for a replicating firm, one may also start to engage in foresight and wonder whether success today will “replicate” into tomorrow. For example, learning fast and cheap, may well be a good way of reaping the benefits before others do, especially if you have good first hand access to templates, where core

knowledge is tacit and non-transparent to outsiders. However, as recognized by Winter and Szulanski (2001), it may well be the case that competitors could discover the profitable routines, although to a slower pace and greater cost. Moreover, what if employees or groups of employees with long experience within successful template outlets suddenly leave and start working in competitor firms? Would they then not be able to imitate? In particular, we could hypothesize, such risks of becoming seriously challenged by imitators may emerge in later, more mature stages of outlet chain replication processes. Whereas good access and fast learning may benefit firms in the first two stages of exploration and full-scale exploitation as discussed by Winter and Szulanski, other kinds of shields may have to be in place to allow for more long term replication in a business context.

Replication in Art

A replica in art is a copy, duplicate, or reproduction of a work of art made by the “original artist” or under the supervision of the “original artist”. To gain a more vivid picture of what this implicates, we will go back in time to the Renaissance and the practice of painting. Why the Renaissance and painting, one might ask. First of all, “art” is a very large subject, encompassing many art forms and eras, and to get some descriptive precision we need to narrow down our scope. Second, replication was an important “tool” during the Renaissance, being a means for both carrying on the master artist’s knowledge and for making it possible to increase the production capacity, by freeing it from the limitations of the master only having two hands. Finally, and most importantly, this was the period when painting became an art.

The issue of how we then may distinguish between a great work or art and a forgery, has been a major one in the philosophy of art literature. We will make a brief account of this discussion of what is a forgery and why we do not appreciate forgeries. In doing that, we identify some core ideas and conceptions in these debates that we believe are informative in suggesting some additional aspect of the replication-in-business problematic.

From Craft to Artistry

In the early medieval period, painters, who we today would call artists, were craftsmen just like carpenters or potters, working as members of a team. The workshop was the place of production and training. Before the 12th century, craft skills were mainly associated with monasteries, and the work of painters consisted mainly of illustrating manuscripts. From the 12th century, many building projects started, and cathedrals became the patrons and focus of workshops. The purpose of the works of the craftsman was usefulness, and what he strived for was virtuoso skill, i.e. master control of his material (Becker, 1982). In estimating the price of a painting, the principle was very similar to that of today’s plumber’s, i.e. the costs were split up into materials

and work time. In the first half of the 15th century, the materials used was a very important issue, and when ordering a painting, the amount and quality of gold and ultramarine color to be used was one of the main factors specified in contracts (Baxandall, 1972). These paintings, which were publicly displayed in churches and cathedrals, were a way for the patrons to flaunt their riches. The more lavish the materials, the more noble and affluent the patron would seem in the eyes of the painting's audience.

By the end of the 15th century something happened. The social position of the artist changed along with the recognition that painting, sculpture and architecture were not mechanical, but liberal arts. Arts was thought to differ from crafts such as pottery or weaving, in that the practice demanded intellectual understanding of such matters as anatomy, perspective and Classical culture (Dictionary of Art, 1996). The focus changed from collectivist to individualist efforts, putting the Artist in the spotlight, regarding him (mainly) as superior to craftsmen. Giorgio Vasari, who collected the life stories of the great masters of that time, described the artist's genius as an innate factor, which contributed to the exclusiveness of the artists (Dictionary of Art, 1996). Leonardo had a similar view, regarding painting, quite chauvinistically, as the noblest of the sciences.

Those sciences that are imitable are of such a kind that through them the disciple can equal the master and produce comparable results. These sciences are useful for the imitator, but they are not of such excellence as those that cannot be passed down in this way as if they were heritable goods. Amongst these, painting has first place. It cannot be taught to someone not endowed with it by nature, as can be done with mathematics in which the pupil takes in as much as the master gives out... Painting alone retains its nobility, bringing honors singularly to its author and remaining precious and unique. It never gives rise to offspring equal to itself (Leonardo da Vinci, in Kemp (1989), p. 19)

The products of the studio became more firmly associated with the reputation of the master, although they were still made by a group of people. One sign of this change was that contracts for paintings would shift their focus from the materials used, to specifying more clearly how much involvement was expected from the master, and what was to be done by his apprentices and assistants (Baxandall, 1972). The great masters came to be precious ingredients of paintings themselves.

Such contractual arrangements, including both the work of the great artist and that performed under his supervision, in his workshop, provided a way to increase production while still being able to benefit from the recognition assigned to the individual artist. For example, Lucas Cranach had a very productive workshop in Wittenberg, acquiring several assistants and pupils every year, and delegating more and more of the execution of paintings to the workshop. A

telling example is that he managed to deliver 60 double portraits of Fredrick the Wise and John the Steadfast within a single year (Dictionary of Art, 1996). The staffing and working system in his workshop were intended for fast production, and the author of the Cranach chapter of *The Dictionary of Art* even speculates that some aspects of Cranach's style may actually have been developed to facilitate standardization and make the 'replication' of the work easy.

The studio of Rubens was also quite a productive one. Many young painters wanted to become his pupils, and the work was based on the traditional division of labor of the Renaissance workshops. Rubens' cooperation with his assistants was often so close that it became impossible to distinguish their respective hands, and, according to an archducal privilege, he was exempted from having to report their names (Dictionary of Art, 1996). One of the studio assistant's main tasks was to replicate original works by the master, for example portraits of princes and other people of nobility.

Generally, apprentices would learn to be good craftsmen by working in their master's workshop, but some would inhabit special gifts and develop into great artists themselves. In his youth Leonardo da Vinci was apprenticed to the great artist Andrea del Verrocchio. The story, according to Vasari (1998, 1568), goes that Verrocchio, who was finishing a panel showing Saint John baptizing Christ, put Leonardo to work on an angel, which was a minor and quite unimportant part of the painting, and hence a suitable job for a young apprentice. However, this young boy did not only paint an angel, but painted an angel that eclipsed anything the master had done on the painting. After this event, so says Vasari's story, Andrea del Verrocchio never again touched a brush or paint.

What is wrong with a forgery?

The change from craftsmanship to artistry is what constitutes the 'replica'. The replica, as opposed to a copy, has some contact with the original artist and before the transition there was no 'original artist', and hence the distinction was not necessary. Another distinction triggered by this transition was the one between an authentic picture or replica and a forgery. As the former were highly valued it became an alluring option to produce fake copies of the artist's works. So, relying on the art literature, how can we distinguish a forgery from a great work of art?

A "natural" starting point would then be to consider whether a forgery is an aesthetically inferior work of art. Goodman (1976, p. 99) here invites us to ponder the following scenario:

Suppose we have before us, on the left, Rembrandt's original painting *Lucretia* and, on the right, a superlative imitation of it. We know from a fully documented history that the painting on the left is the original; and we know from X-ray photographs and microscopic examination and chemical

analysis that the painting on the right is a recent fake. Although there are many differences between the two – e.g., in authorship, age, physical and chemical characteristics, and market value – we cannot see any difference between them; and if they are moved while we sleep, we cannot then tell which is which by merely looking at them. Now we are pressed with the question whether there can be any aesthetic difference between the two pictures...

Goodman (1976) himself argues that practice and training sensitizes us to the extent that what we may actually detect aesthetic differences between the two. For him, the “aesthetic properties of a picture include ... also those that determine how it is to be looked at.” (p. 111). Such a view thus implies that “subtle perceptual differences count significantly in our aesthetic experience of paintings” (Morton and Foster, 2001, p. 155). Be that as it may. Our main interest in the forgery debate is more motivated by some additional explanations that have been put forward.

What these authors have in common is the idea that pure aesthetics cannot explain forgery. Sagoff (1983), for example asks the question “are the original and the forgery, then, equally accurate, equally skillful, ingenious, suggestive, or creative as representations?” (p. 146) and answers it with “No”. A painting is, Sagoff argues, an attempt to accurately depict and understand nature, and then the mission of the artist is to create a believable image “despite the fact that not one individual shade corresponds to what we call ‘reality’.” (Gombrich, quoted by Sagoff, 1983, p.146). The artist solves the problem by finding, through his or her paint, the symbol that represents that reality. The painting is then a kind of record of the advances that have been made in finding accurate symbols, e.g. finding out what colors and shadows to use in order to create the illusion of a drop of water on a leaf. Here we can see the difference in value of an original and a forgery (or copy), because if a painting is a record of a problem solved, then a copy of it is less exciting since it merely repeats the solution of a problem that has already been solved.

The painting, as a record of that discovery, advances a theory concerning the way in which we see things or the way they can or are to be seen. ... painting is an experiment and serves to advance a psychological and artistic theory of sight. ... only the original makes a contribution to theory. ... the value of an art work consists ... in the amount that it advances understanding. (Sagoff, 1983, p. 148, 151)

Lessing (1983) has a similar way of reasoning in his answer to the question ‘What’s wrong with a forgery?’. He renounces the assumption that the difference between the original and the forgery lies in the aesthetic value, i.e. that a forgery lacks aesthetic value and thereby is an inferior work of art, because if that were the case, he argues, it would not be such an embarrassment to art critics when the work of art they praised so highly in the past turns out to be a forgery. It is still the same painting, only now attributed to someone else, and that slight

modification should not matter if the difference between an original and a forgery lay in the aesthetic value (beauty) of the picture.

So what is wrong with a forgery? For Lessing forgery is closely related to the notion of originality and creative art. Technique cannot be forged since it is public but originality is a different matter.

It is not Vermeer's technique in painting light, which van Meegeren forged¹. That technique is public and may be had by anyone who is able and willing to learn it. It is rather Vermeer's discovery of this technique and his use of it, that is, Vermeer's originality, which is forged. The light, as well as the composition, the colour, and many other features, of course, were original with Vermeer. They are not original with van Meegeren. They are forged. (Lessing, 1983, p. 68)

In performing arts we usually do not speak of forgeries; the fourth performance of *Hamlet* this season is no more forged than the forty-fourth. However, Lessing argues, should an actor perform the role of Hamlet with the gestures, movement and vocal interpretation of Laurence Olivier in his performance of the role, it would be a different matter, since that would itself be an original and creative work of art. In practice, both creative and performing arts will thus vary in the degree to which they possess the elements of technique and originality.

The originality we ascribe to creative art refers to novelty or achievement. It is not limited to one particular work, but may cover the entire production of either one artist or one school, e.g. Leonardo da Vinci or the Renaissance. This kind of originality depends on the historical context of the artist or school, i.e. the achievement will only be an achievement if made in a certain period of the history of art. Technical mastery is not enough, there has to be creative genius as well.

Vermeer's art represents a genuine creative achievement in the history of art. It is the work not merely by a master craftsman or technician but of a creative genius as well. (Lessing, 1983, p. 74).

To create is to discover something new – to reveal in a timely and timeless aperçu some aspect of the world or some relationship of which we were previously unaware and, by so doing, to change forever our experience of the world and of ourselves. When a great poet has lived,' writes T.S. Eliot, 'certain things have been done once and for all and cannot be achieved again.' The crucial word here is 'achieved'. They can perhaps be done again, but they cannot be achieved again. Beethoven's late style is a discovery and an achievement. Someone coming later can only imitate

¹ In 1945 the artist Han van Meegeren confessed that he was creator of a number of paintings that had been sold as highly acclaimed paintings by 17th century artist Vermeer, causing much embarrassment among convinced art critics. (For the whole story, see e.g. Werness (1983) Han van Meegeren fecit, in Dutton (ed) *The Forger's Art*, University of California Press)

it. And it is for this reason that forgers and copyists are considered to be artisans, not artists. (Meyer, 1983, p. 82).

So far we have thus come up with a fairly clear view of what is a great work of art and what is not. In that answer the originality of individual creator and his or her accomplishing something novel, something new to the world, something we did not know before, are among the defining characteristics. But why do we so highly value originality and look down on forgery?

Why do we admire original artists?

In our view, Meyer (1983) here suggests an interesting answer, focusing on our Western culture mindset in relation to the genesis of art works. According to Meyer (1983), we have a set of beliefs that are the basis of all our thinking and behavior, and these beliefs, which are implicit and unconscious and deeply ingrained in the Western culture, influence our aesthetic experiences. Even if we like to believe that aesthetic experiences are purely based on the intrinsic values of the work of art, “we do not judge works of art in terms of their intrinsic qualities alone.” (p. 78).

According to Meyer (1983), those beliefs are so profound that they can affect our bodily reactions and how we feel when we look upon a work of art. The beliefs Meyer claims to be basic to our appreciation of art are (1) our belief in causation, (2) our belief in human freedom, and (3) our belief in the importance of the individual creator. One could say that all three beliefs circle around or stem from one concept, namely creation. Human creation is not something that just happens, there is intention behind it, i.e. it has a cause. Creation is possible because humans can choose among their discoveries, only restricted by the limits set by tradition. Choice also indicates risk, and risk-taking according to Meyer, is something that is admired, especially in the Western world, just as much as repetition has been shunned ever since the Renaissance.

The importance our culture attaches to originality is a corollary of our attitude toward repetition. In our culture – particularly since the Renaissance – repetition has been considered wasteful and unproductive. (p. 85)

The creative act thus seems to have a revered place in our culture and hence there is something special about the creative power of the great artist, which we want to be part of. If we have seen a beautiful painting, is it not so that one of the first things we will want to know is the name of the artist who created it? This also says something about our relationship to the artist and indicates the importance we assign the individual creator. One reason why we give such importance to the name of the creator of the painting according to Meyer, is because a work of art has its place in history and we partly understand it by understanding how it came to be. The original is also more valuable and more exciting, Meyer argues, “because our feeling of intimate

contact with the magic power of the creative artist heightens awareness, sensitivity, and the disposition to respond. Once a work is known to be a forgery, that magic is gone” (p. 87).

This Western idea of “*the creator and the created object*” (Moulin, 1978, translated and quoted by Becker, 1982, p. 353), where art and the artist represent something unique and irreplaceable thus originated during the Renaissance. Even if we are ever since culturally programmed to appreciate the lonely genius who changed the world single-handedly, that is of course not the whole picture. According to Bourdieu (1993), through this our “charismatic ideology”, which forms the basis of our belief in the value of the work, we direct attention to the “apparent producer”, i.e. the painter, but forget the whole apparatus of actors (such as art dealers, investors, etc) surrounding him, and in so doing we suppress “the question of what authorizes the author, what creates the authority with which authors authorize” (p.76). We could go on and on to illustrate the great sociological machinery in which it seems the artist is reduced to a mere cog. In our view, however, such exchange and market processes appear less uniquely associated with art and we leave them at this moment.

The invulnerability of great works of art

The value of a replica lies first of all in the master’s degree of involvement and signature and only secondly in the paintings similarity to the original. Successful replication would then mean that, in the eyes of the beholder of a replica, the mark of the master can be seen. Our admiration of creators, and thereby our demand for a sign of the master’s mark and involvement in the work, provides an effective shield against imitation. No matter how much you try from the outside, as long as you copy, and thereby lack originality, you will never create a great work of art, and thereby never become one of the great artists. By copying, paradoxically, you may even end up only having contributed even further to the greatness of the original artist. The copy disclosed as a forgery only confirms the artistic genius as in the case of the Vermeer forgeries.

Even though it was painted by van Meegeren in the twentieth century, it embodies and bears witness to the greatness of the seventeenth-century art of Vermeer (Lessing, 1983, p. 76).

The creative genius and achievements of the original artist, as recognized and placed in history, are embodied in the signature, which is a resource that display qualities of being both non-rivalrous in use and quite resistant to imitation.

Discussion

Replication in biology and art – a comparison

Genes have fabulous replication qualities. Through a self-copying and correcting process they are able to make non-inferior copies of themselves. In that sense they may be seen as

paradigmatic examples of a non-rivalrous resource. A high degree of stability/longevity, high speed and copying-fidelity are then among the most important features that a “good” replicator gene has to display. The reproduction skills and success of such a gene are then very much a matter of fast and exact “production”. By skillfully producing copies, it may out-compete its rivals in the battle for scarce resources. Having a fragile structure, moving slowly and producing copying errors most of the time, would thus prove to be fatal.

Nature is a tough place where only the fittest will survive. In such a world, “good” replicators have an advantage. However, genes do not often compete against other genes directly, but from the inside of “interactors”. This causes the outcome of also highly productive replication processes involving good replicators to be differential. Whether replicator genes or their specific interactors survive or not then depend also on contingencies in their particular environment. Sheer luck in choice of habitat or timing may then be important. Being a skilful producer in the sense of replication fecundity and fidelity however, should give better odds of a continued existence. Put differently, a superior growth rate appears to be the main available “shield” against competitors in a natural selection context.

Paradoxically, genes are also interesting because of their copying-errors. Such blind or “un-intentional” variation constitutes a necessary pre-condition for selection and evolution. Without variation, selection has nothing to choose between. While most errors may result in dead ends, in a long term perspective some “errors” will turn out to be valuable to the mutated gene, or its interactors. Natural selection may thus be seen as implying a “mode of learning”, made up by cycles of variation, selection, retention, which involve replicators and interactors in a complex and non-transparent interplay. In nature, we may notice and observe what interactors survive and do well, and while this provides us with a chance of finding some clues as to why some prosper and some fail, it still seems to be a task of formidable complexity to disentangle, in a particular case, the role of “good genes, mutations, and environmental circumstances.

The artist’s signature, too, has replication qualities. The signature here embodies the creative genius of the artist and his work, as being recognized and reputed for originality in the history of art. Signed copies, made by this artist, or under the supervision of this artist, will then retain much of the value of the original. This will be especially salient in comparison to a similarly looking picture done by someone else, such as in the case of a known forgery. In our view, the fact that the repeated use of the artist’s signature does preserve the value of copies, makes it a candidate for being a non-rivalrous resource. Interestingly, such re-use of signature, also extends beyond mere copies, to encompass other works of the artist that are less closely related, in style, choice of object, and the like, to her or his previous works.

Basically, this means that the artist's signature, the replicator, is signaling the authorship of a new "finding" or a discovery. The possibility to preserve value is thus related to the artist's role in the genesis of certain art works. As suggested above, our respect and admiration for such achievements may be seen as mirroring our Western culture psychological mindset. We like to celebrate those who are daring and make discoveries, whereas "more of the same" and all kinds of forgeries are shunned. Copies, representing merely more of the same are thus not highly prized, whereas copies made into "more of the same special", by the respected artist, are. Various actors in the art system, aiming for economic gains, are co-producers of these artists' reputations and market value. In our view, however, what is specific about the value-conserving capability of art, is rather to be sought in connection with the art works' *genesis* than in the exchange and promotion processes going on at galleries and the art market generally.

Returning to the issue of what makes a "good" replicator, we may first notice that a signature should signal that a "finding" or a discovery has been made. As a parallel to "productivity" in biology, we would thus suggest that "originality" is a major feature associated with good art replicators. As in biology, some degree of "stability" would no doubt also be a good characteristic associated with a signature. However, unlike what was the case in biology, there is far less need for an art replicator to be recognized as a fast copier, or one that copies exactly. In fact, if "originality" is there, this will have the effect of "covering-up" for both delays and copying errors.

Replication in business – a combined metaphor view

As a strategy, replication should ideally be a matter of growing spatially by creating copies of a successful business model without allowing for competitors to engage in successful imitation. More specifically stated, it is a problem of duplicating the non-rivalrous resources that inhere in such a model, while preserving their value-generating capacity. Generally, we may think of such resources as information- or knowledge-like, mirroring the discussion in Arrow (1973). Using a "knowledge" terminology we may then ask how the above views in biology and art could be used as metaphors for illuminating what goes on in firms that grow by practicing replication.

We return first to the biology-inspired view displayed in Winter and Szulanski (2001). In the light of the above comparison discussion, we may then underline its "productivity" features. In their two-stage theory they emphasize that replication is a matter of "reaching large markets quickly". Apparently, this fastness imperative is important in the first exploratory phase and certainly even more so in the subsequent full-scale exploitation phase. As it seems it is only the first phase that is mirroring the natural selection dynamics in biology. In the second phase, where copying exactly is advocated, it is rather "pure replication – no learning" that is the task.

What may happen in a third phase or later life stages is not discussed as it is beyond the analytical scope of their article.

Anyhow, the normative implication of their view would appear to be that a firm should try to beat their competitors by learning faster/cheaper and transferring knowledge faster/cheaper and more precise. Undertaking a replication strategy, thus entails not only identifying the recipe that proved to be successful, but also to do it fast, and rapidly apply it over and over again to expand before another company can identify and imitate it. In our view, such a conception implies a knowledge-related “dilemma” as the demand for speed is not easily reconciled with reliance on natural selection and transfer of “routinized” knowledge. First, stabilizing a template, seen as a matter of allowing for repeated cycles of variation-selection-retention, would appear to be a time-consuming affair. Second, the vital Arrow core features that eventually become “principled” enough, inhere in “routines”, incorporating much “tacit knowledge”. As is often pointed out, transferring tacit knowledge is a highly difficult and time-consuming endeavor. Considering the kind of processes involved in such transfer, there is also very little space for accelerating the speed. Indeed, tacit knowledge appears to travel at its “own” pace and also to affect the speed at which its complementary explicit dimension may travel.

Continuing on the theme of tacit knowledge, we may also consider that such knowledge may be both difficult and costly, but in principle not impossible, to transfer. So while being fast and exact in copying should contribute to keeping successful competitors behind, in the long run, imitators might be able to acquire the routine-embedded secrets underlying the business model. One, often applied strategy for this is to bid for key persons or teams that possess the experience needed. Having superior access to the template would certainly enable a firm to be among the fittest in the sense of learning quickly in the first phase, and by transferring how-to-do knowledge swiftly in the second. However, over time such a differential advantage may become a less and less effective shield.

In our view, art may be associated with quite different knowledge features. Instead of focusing on arduous work in relation to repeated learning cycles and knowledge transfer, art is concerned with “findings” and “discovery”. Apparently, we are here dealing with two different knowledge processes. One more craft-like variant, stressing the value of learning and building tacit how-to-do knowledge, and another artistic variant, stressing that new knowledge is what counts, however it came about, and that the recognized originator of this knowledge is respected.

The art view of replication, too, is suggesting a two-phase solution. First, there is a phase wherein the discovery has to be made and recognized. As with the former metaphor, we thus also have a kind of exploration phase. However, unlike the biology-inspired one, coming up

with a replicator proper is not seen as necessarily involving a learning process. Rather, it is here a matter of somebody's insight, which happens to be new to the world, whether this is the result of a genius' superior mind, luck, or serendipity. As to the second, more purely, exploitation oriented phase, the art metaphor suggests the presence of quite a different type of shield against imitation. Once a reputation for originality is established, the signature of the replicating firm is authoritative. Imitators will appear as mere copiers or forgers and receive public dissent as their regrettable nature is being disclosed. Indeed, the presence of a number of such mere imitators may actually serve only to strengthen the reputation of the original firm.

Having access to such a shield has important knowledge-replication ramifications. First, it means that knowledge transfer may be carried out at a pace that is compatible with the kind of knowledge that is involved. As a result, where much tacit knowledge is important, such a shield allows it to travel at its own pace. Second, such a shield also allows for more variation in setting up new outlets. It thus becomes less important that new outlets are copied exactly from the paradigmatic template. The signature will here "cover-up" and preserve value, although some intentional or unintentional "miscopying" is made. However, such deviations can turn out to have bad consequences, as in biology, but they may also be beneficial, as they will increase variation and selection options. Recognizing the firm as capable of "strategic intent", this would translate into an increased potential for engaging in goal-directed trial-and-error.

Conclusion

In conclusion, we believe that the combined use of replication ideas in biology and art as metaphors for replication processes in a business setting is a fruitful path to enter. By adding a complementary art metaphor, we point at a way in which the "fast copying-tacit knowledge" "dilemma" may be alleviated. As discussed above the presence of a signature shield may provide room for the kind of rather slow processes of transferring tacit knowledge, that are no doubt needed. Moreover, such a shield also makes it possible to copy less exactly, which may be beneficial from a learning point of view. Finally, this shield notion may also provide an explanation as to why a firm may keep imitators away in the longer run, although imitators may have actually been able to acquire much of the routine-based tacit knowledge that constitute the Arrow core.

We should emphasize finally, that we do not believe this second metaphor alone could make up a core replication theory for business firms. What we suggest is that the two metaphors used in combination, as complementary guides, could inspire the identification of a more comprehensive framework for understanding how firms that engage in a replication practice, may get along successfully, for short or long periods of time. In the next section (not included)

we illustrate our combined metaphor framework using data from a worldwide operating, fast-growing retail firm, which is doing really well and has done so for many years.

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