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**TECHNOLOGY REEMERGENCE:
CREATING NEW MARKETS FOR OLD TECHNOLOGIES,
SWISS MECHANICAL WATCHMAKING 1970–2008**

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ABSTRACT

In 1983, 14 years after the introduction of the battery-powered quartz watch, mechanical watches and the Swiss watchmakers who built them were predicted to be obsolete (Landes, 1983). Unexpectedly, however, by 2008 the Swiss mechanical watchmaking industry had rematerialized to become the world's leading exporter (in monetary value) of watches. This study reveals the process and mechanisms associated with technology reemergence, i.e., the resurgence of substantive and sustained demand for an old (legacy) technology following the introduction of a new dominant design. Drawing on the case of mechanical watchmaking, it reveals how technology reemergence is a decidedly cognitive process, unfolding in two phases: a first phase marked by a redefinition of the meanings and values associated with the legacy technology and facilitated by mechanisms of value recombining, temporal distancing, identity marking, and conceptual bridging; and a second phase marked by a redefinition of market boundaries and facilitated by mechanisms of competitive set reclaiming and enthusiast consumer mobilizing. For mechanical watchmakers, the process culminated in competitive and consumer differentiation that ushered in innovation reinvestment and a period of substantive and sustained demand growth for mechanical watches. This paper contributes to research on technology cycles, cognition, and incumbent responses to discontinuous change.

Keywords: technology reemergence, technology cycles, cognition, market redefinition, legacy technology trajectories.

1983: “Now we bid farewell to the master craftsmen who have brought us these wonders of the mechanical arts. Their time has come and probably gone” (Landes, 1983: 359).

2008: “I don’t know how it happened. I don’t think anybody really knows. But suddenly, these mechanical watches were back” (interview with the CEO of a Swiss watch company).

Is it possible for a legacy technology within a field or industry to *reemerge*? Schumpeter (1934) argued that the forces of creative destruction overturn existing market structures and force the dismantling of old technologies, as well as their applications in products, process, and practices. For decades, scholars have linked industry evolution to technology cycles in which a dominant technology is displaced by a new one that initiates a new regime (e.g., Klepper, 1996; Tushman and Rosenkopf, 1992; Utterback and Suárez, 1993). The prevailing theorization emphasizes technological displacement, assuming that old (i.e., legacy) technologies disappear when newer ones arrive. “The dying technology provides the compost, which allows its own seeds, its own variants, to grow and thrive” (Tushman and Anderson, 1997:12).

Yet displacement may not always be the inevitable outcome. Market demand for some legacy technologies may wane only to reemerge later. Products such as mechanical watches, sailing ships, vinyl records, fountain pens, and streetcars declined and then resurfaced to claim significant market interest. This study seeks to examine a possibility that has largely been overlooked in the literature: demand for some legacy technologies may not die away (Adner and Snow, 2010; Henderson, 1995), but persist in a generative form that permits sizeable market expansion. The aim of this paper is to induce the process associated with such a possibility, defined as *technology reemergence*. This paper asks: how does demand for a legacy technology rematerialize to achieve substantive and sustained market growth?

The research setting for this study is the Swiss watch industry from 1970 to 2008. For over 200 years, beginning in the mid-eighteenth century, the Swiss dominated the mechanical

watch industry (Donze, 2011); Swiss mechanical watches were universally considered a symbol of technological supremacy and innovation (Sobel, 1996). Their reign ended abruptly in the 1970s with the onset of the “Quartz Revolution” (or “Quartz Crisis”) and with the expectation that the battery-powered quartz movement would displace the mechanical. The Swiss dropped from holding over 50 percent of the world’s export market (in monetary value) to less than 30 percent a decade later.¹ By 1983, over half of watchmakers had gone bankrupt and two-thirds of all Swiss watch-industry jobs had disappeared (Perret, 2008). Industry experts predicted that mechanical watches and the communities of watchmakers who built them would disappear (Donze, 2011; Landes, 1983). Quite unexpectedly, however, demand for Swiss mechanical watches began to resurge. From 2000 to 2008, increased mechanical watch demand led to unprecedented growth, a proliferation of mechanical watch innovations, and an emergence of schools, trade shows, competitions, and government policies that propagated the field of mechanical watch production. By 2008, the Swiss, led by mechanical watch production, resurfaced as the leading exporter of watches and reclaimed 55 percent of the global watch industry’s export value.

An in-depth study of this anomalous process is necessary for several reasons. First, as the pace of technology change and technology cycles continues to rise (O’Reilly and Tushman, 2016), organizations must manage the trajectories of their legacy technologies far more frequently. Building on prior research that has theorized that contracted demand niches can develop for legacy technologies after a field settles on a new dominant design (e.g., Adner and Snow, 2010; Furr and Snow, 2014; Porter, 1980), this paper shows how a legacy technology, and

¹ The size of the watch industry is tracked by “export value,” referring to the value that companies assign to their watches when they file with the government for export. Approximately 95 percent of Swiss watches were sold outside Switzerland between 1970 and 2008. For the purpose of this study, export values serve as a primary indicator of demand shifts and market growth for the mechanical watch.

the organizations and community that support it, achieves *substantive* and sustained market growth following the introduction of a new dominant design. Second, this study identifies a novel process and temporal sequence related to technology reemergence that have not been accounted for in theories related to technology and industry evolution. Third, it offers a unique view of the role that cognition plays during periods of technological change by examining how the cognitive meanings, values, and market boundaries that actors attach to an existing technology can shift over time after its initial displacement. Whereas prior work in cognition and technology change has largely focused on the cognitive “traps” that inhibit incumbent firms from adapting to technological change (e.g., Danneels, 2011; Eggers and Kaplan, 2013; Gilbert, 2006; Vuori and Huy, 2016), this paper advances a process model, undergirded by several novel cognitive mechanisms, that enables adaptation and demand growth for a legacy technology. It answers calls (Helfat and Peteraf, 2015) to address the “very little overlap or even interchange between scholars studying technological advance and scholars in the field of cognitive science” (Nelson and Nelson, 2002: 265); and in turn, offers a multi-level analysis of the cognitive processes that unite often separate conversations about how “market pull and technology push have independent roles” (Kaplan and Tripsas, 2008: 802) within the context of technology change and industry evolution.

TECHNOLOGY CYCLES AND LEGACY TECHNOLOGY TRAJECTORIES

Technology cycles continuously reshape the trajectories of old and new technologies and the competitive landscape of incumbent firms (Dosi, 1982; Schumpeter, 1934; Tushman and Rosenkopf, 1992). Research on technology cycles has largely focused on the introduction of new technologies and how demand in a field initially fluctuates between variants during an era of ferment, but then settles on a new dominant design (Anderson and Tushman, 1990; Argyres, Bigelow, and Nickerson, 2015; Benner and Tripsas, 2012; Suárez and Utterback, 1995). Marked

by phases of variation, selection, and retention (Basalla, 1988), such cycles have been theorized as a “highly path-dependent process” (Kaplan and Tripsas, 2008: 790) in which legacy technologies are assumed to reach a natural limit and eventually fade away (Fleming, 2001).

For the legacy technology, technological discontinuities initially generate capricious market demand as consumer preferences vacillate between the old and new technological variants (Abernathy and Utterback, 1978; Mitchell, 1989; Tripsas, 1997). Prior to a new dominant design, incumbents often try to preserve market demand for the legacy technology by engaging in a *technological race*, extending the performance of the old technology to compete with new technological variants (e.g., Lerner, 1997). These races may also induce incumbents to incorporate features of a discontinuous variant into the legacy technology. For example, carburetor (Furr and Snow, 2014, 2015) and sailing ship (Rosenberg, 1976) producers experienced productivity gains by adopting intergenerational components from electronic fuel injectors and steam ships, respectively. Although these strategies may temporarily extend a technology’s life, such late-stage efficiency gains have been shown only to delay the eventual demise of the legacy technology (Tripsas, 1997). As a result, technology cycle research has focused primarily on the mechanisms that facilitate the rise of discontinuous technologies and the emergence of markets associated with them (e.g., Suárez, Grodal, and Gotsopoulos, 2015). This article, alternatively, focuses on an undertheorized aspect of the technology cycle that traces the possible trajectories of the legacy technology after the introduction of a dominant design (Figure 1).

[Insert Figure 1 About Here – Technology Cycles and Legacy Trajectories]

Legacy Technology Trajectories

Scholars have devoted little attention to legacy technologies (Furr and Snow, 2014). Potential explanations may be the dominance of the Schumpeterian (1934) paradigm or a

continued pro-innovation bias in organizational theory (Gopalakrishnan and Damanpour, 1997; Kimberly, 1981; Rogers, 1995). A review of this extant literature indicates that legacy technologies often follow one of two possible trajectories: *technology displacement* or *technology retrenchment* (Adner and Snow, 2010; Anderson and Tushman, 1990; Dosi, 1982). Here, I categorize the core assumptions associated with each (see Figure 1) and propose a trajectory that extends from the notion of retrenchment to account for another unique possibility: technology reemergence.

Technology Displacement (Retire). Technology displacement literature (e.g., Cooper and Schendel, 1976; Tushman and Anderson, 1986) has assumed that once demand for the old technology has been supplanted by the new dominant design, the field will reorient itself and incumbent firms will retire the legacy technology. The displaced technology is presumed to hold little or no utility, leaving incumbents with few options but to unwind production, reallocate or disband investments in manufacturing facilities, and cease R&D devoted to the old technology (Klepper, 1996). Technology displacement is most often associated with the fate of VHS tapes, audio cassettes, bias tires, and dial-up modems; in each case, the selection of a new dominant design (DVDs, compact discs, radial tires, and the Ethernet) shifted significant market demand away from the old technology (Cusumano, Mylonadis, and Rosenbloom, 1992; Sull, 1999). Technology displacement may occur rapidly or over a protracted period of time (Henderson, 1995), contingent on several factors. Existing consumers may face high switching costs (Hall and Khan, 2003) associated with maintaining pre-existing social ties or institutional norms associated with the legacy technology (Fuentelsaz, Garrido, and Maicas, 2015). Or the residual benefits of the old technology may initially outweigh the consumers' perceived benefit of adopting the new dominant design and thus delay the firm's need to retire the legacy technology (e.g., Ansari and Garud, 2009). Eventually, however, the prominent mechanism of technology

displacement is demand substitution; the displaced legacy technology is theorized to be “swept away” as consumer demand shifts toward the new dominant technology (Utterback, 1996: xix).

Technology Retrenchment (Retreat). An alternative trajectory has been identified by Adner and Snow (2010) as technology retrenchment, i.e., moving into a contracted niche in the technology’s home market or relocating the old technology into a new market application. They advance the notion of a “bold retreat” whereby a legacy technology exploits heterogeneity in its demand environment that permits limited alternative use (2010: 1655). As an important distinction to this present study, Adner and Snow (2010: 1657) specify limits to market growth associated with technology retrenchment, arguing, “The goal and expectation of technology retreats is not for growth and expansion, but rather for survival and contraction.” Thus, an assumption of technology retrenchment is that the market for the old technology will decline and only a small subset of firms will be able to survive by exploiting remaining pockets of latent demand (see also Porter, 1980).

There has been limited empirical work on technology retrenchment, but illustrative examples include the prolonged use of paging devices in the medical community after others adopted mobile technology, and the use of CRT monitors by a subset of video game enthusiasts after the introduction of flat screen technology (Adner and Snow, 2010). Alternatively, some technologies may find other uses that can sustain limited demand (i.e., latent demand heterogeneity). For instance, after silicon transistors replaced vacuum tubes in radios (Cartwright, 2012), a small cohort of firms continued to produce vacuum tubes in guitar amplifiers for musicians who preferred their tonal quality over solid state alternatives.

Notably, Adner and Snow (2010) highlighted mechanical watchmaking as an example of legacy demand heterogeneity revealing demand niches. The authors theorized that because quartz watches were far superior to mechanicals in their ability to keep time, a niche market for

mechanical watches emerged that decoupled elements associated with technological determinism (e.g., precision timekeeping) from other aspects (e.g., nostalgia). Retrenchment explicated a role for latent demand heterogeneity that created a contracted niche for the legacy technology. My study's findings confirmed an initial phase of retrenchment and contracted demand growth for the mechanical watch as predicted by Adner and Snow (2010), but also reveals a subsequent, unexpected process of demand growth – along with a novel set of mechanisms – that extends beyond prior assumptions associated with technology trajectories.

Technology Reemergence (Redefine). Technology reemergence constitutes a path whereby market demand for the legacy technology first retrenches and contracts into a limited demand niche but later achieves substantive and sustained demand growth. For example, demand for Swiss mechanical watches dissipated and contracted into a market niche following the mass production of quartz watches; but unexpectedly, beginning in the late 1980s, Swiss mechanical watchmakers experienced significant revenue expansion that exceeded even that of quartz manufacturing. After a period of mechanical R&D stagnation while they focused on quartz technology, new entrants and incumbents began to heavily reinvest in mechanical watchmaking. These efforts led to innovations that extended well beyond the field's prior technical achievements, and therefore, accounts for the possibility that an entire community (as opposed to a remaining few firms) may choose to reinvest in technical innovation and manufacturing assets associated with a legacy technology. This study offers a novel theoretical extension to the technology cycle by revealing the mechanisms associated with the sustained growth of market demand for a legacy technology. Because we know little about the notion of technology reemergence, nor about the mechanisms that enable it, this work focuses on explicating the process whereby a legacy technology and its market are redefined in a manner that leads to significant demand growth and innovation.

METHODS AND RESEARCH CONTEXT

Data Sources

This study draws on data from multiple sources, following what Creswell (2003) termed a concurrent triangulation strategy, whereby multiple methods, data sources, and units of analysis are used to evaluate a set of theorized relationships within a single study. See Table 1.

Interviews and observation. I conducted 136 interviews with senior executives, watchmakers, distributors, retailers, industry analysts, collectors, government officials, company historians, auction house representatives, and museum curators associated with the watch industry. The average interview lasted 91 minutes. Twenty-nine percent (n=39) of the individuals interviewed started their career in the watch industry prior to 1990, 24 percent (n=34) started between 1990 and 2000, and the remaining 47 percent (n=63) joined the industry in 2000 or later. The sample included interviews with executives from watch companies that cumulatively comprised roughly 85 percent of all watch sales in Switzerland between 1970 and 2008. I also led four focus groups with 42 watchmakers and collectors in both Switzerland and the U.S. I attended Baselworld, the industry's largest annual field-configuring event (Lampel and Meyer, 2008) to observe the interactions of over 100,000 participants, 1,800 exhibitors from 45 countries, and 3,300 journalists. Further observations included private tours of nine watch factories. Finally, to converse fluently with executives and watchmakers, I observed a watchmaking course taught by prominent horologists at the National Association of Watch and Clock Collectors' School of Horology.²

Advertisements. To better understand emerging trends in the field data, I developed a custom database of company advertisements from the three most prominent watch industry trade journals between 1970 and 2008. I searched horological archives located in Switzerland, the

² A horologist is a member of the profession of horology, the science of timekeeping.

United States, and France, compiled a set of all prior magazine issues, and scanned every advertisement in the first three issues of each even year between 1970 and 2008. This process led to an initial sample of 845 advertisements. I narrowed the sample to the 700 ads related to Swiss watch companies, which comprised my final sample. The main data source for the advertisements was the *Journal Suisse D'Horlogerie (JSH)*, published in Switzerland. From its inception in 1876, JSH was the foremost authority on industry trends, events, and innovations in the watchmaking industry. Field interviews confirmed that the journal's readership consisted of members of all facets of the watchmaking industry, including watchmakers, dealers, parts suppliers, consumers, and watch enthusiasts. I also used the journal to study industry announcements, trends, and innovations. The journal suspended publication in 2000. Because no single journal ran during the entire length of the study, I relied on two additional leading watch journals, *Chronos* and *International Watch (iW)*, for the remaining years of analysis. *Chronos* was first published in 1993, and *iW* in 1989. I chose these journals after asking numerous industry experts, historians, and company CEOs about which journals played a similar role in the watch industry as JSH. To ensure the composition of advertisements in my sample remained consistent across all three journals, I began my analysis of *Chronos* and *iW* in 1996 so that I could verify that no significant differences existed among the three journals during the four years their publication overlapped.

Archival documents and interviews. I collected data from several additional archival sources. These included the annual reports issued by the Federation of the Swiss Watch Industry, which provided information regarding sales and broad demographic trends for the entire watch industry. I also reviewed all historical employment data while visiting the *Convention Patronale de l'Industrie Horlogère Suisse*, the umbrella organization for employees of the Swiss watch industry. I collected press releases and Swiss Parliamentary testimony from the Swiss Federal

Institute of Intellectual Property, the federal agency in Switzerland that was responsible for the “Swissness Project,” an initiative that protected products from counterfeiting. Finally, I coded an additional 27 interviews published throughout the 1990s and 2000s with Swiss watch CEOs from TimeZone, a leading industry news source. I relied on these historical interviews to confirm that what I had learned in my field interviews was not subject to recollection bias.

[Insert Table 1 About Here – Data Sources]

Data Analysis

Data analysis evolved in three stages. First, I reconstructed the historical evolution of Swiss watchmaking (e.g., Delmestri and Greenwood, 2016), in order to delineate substantive market demand shifts for mechanical watches between 1970 and 2008. From this analysis, I charted the chronology of Swiss mechanical watchmaking through several distinct periods: a technological discontinuity marked by a technology race with quartz technology; a period of retrenchment and contracted market growth; and finally, a period of significant market growth and reemergence.

The second stage aimed to induce a process model associated with technology reemergence. This stage involved concurrent data gathering and analysis of interview data, archival documents, and advertisement data. I used NVivo 10 to initially code the interview transcripts and archival data for descriptive elements related to key events, individuals, organizations, and community activities associated with mechanical watchmaking. During this initial coding process, I induced and began to discern that the reemergence process was influenced by several mechanisms that appeared to sit at the intersection of cognition and technology change (c.f., Kaplan and Tripsas, 2008). Accordingly, I began to develop codes associated with the cognitive meanings and values (e.g., Schultz and Hernes, 2013) that organizational and community-level that I found actors had attached to mechanical watches, and

the mechanical watch market, over time. The Appendix provides a more detailed description of how these themes evolved and resulted in a preliminary codebook that informed my analysis of the advertisement data (see Table 2).

To analyze the advertisements, I initially collaborated with a management professor and a trained research assistant to conduct pilot coding sessions (e.g., Hsu and Grodal, 2015). We coded 100 ads not included in the final sample to assess the validity of the codes and reliability of my codebook. We independently assigned codes to approximately 30 ads at a time and then met to compare scores, resolve discrepancies, and reach consensus; we repeated this process twice until we achieved roughly 95 percent consistency, with the remaining 5 percent attributed to human error such as mistyping intended codes in the spreadsheet. I then coded the sample and had the research associate code 10 percent to verify continued consistency.

Next, I attempted to identify distinct time periods (Langley, 1999) between 1970 and 2008 that could be mapped to the shifts in the trajectory of the legacy mechanical watch technology. Using annual export data for both quartz and mechanical watches, I initially identified inflection-point years where the total Swiss export values for quartz or mechanical watches crossed and eclipsed each other (e.g., 1982, 2002). As I became more interested in delineating cognitive shifts in the Swiss watch community's primary espoused focus on quartz or mechanical watches, I coded each ad's explicit mention of the watch as "mechanical," "quartz," or "no mention." I used the ads coded as mechanical to conduct analyses related to the process and mechanisms of technology reemergence. I then identified even-year inflection-points where the majority of ads representing either technology shifted to the other (e.g., 1992). By overlaying the export data on the ad technology-mentions, four distinct inflection cross-over points delineated four specific time periods in the trajectory of the mechanical watch: *t0*: discontinuity (1970-1980); *t1*: retrenchment (1982-1990); and two distinct phases of

reemergence, *t2*: (1992-2000) and, *t3*: (2002-2008).³ Extensive field interviews provided additional qualitative support for these conceptual period distinctions (see Figure 2). Finally, I conducted analyses of variance (ANOVAs) for every code in the ads, comparing differences across each period and for all possible permutations (e.g., *t0* compared to *t1*; *t0* compared to *t2*).⁴ For models that reported significant results, I conducted Tukey's Honest Significant Difference (HSD) post hoc analyses to find posteriori differences among the sample means. Since it was possible to assign more than one code to an ad, I conducted a similar analysis for all co-occurring codes that appeared in the ads during reemergence (*t2* or *t3*) and compared these co-occurring codes to earlier periods (*t0* or *t1*).

The results helped to triangulate the advertisement data with the other data sources and to identify the mechanisms associated with an emerging process model. For example, company historians, whose role I discovered in interviews was to capture their company's traditions in watchmaking, noted the importance of bridging the past with the future. I then began to look for this theme in the advertisements. Doing so led me to induce the mechanism of temporal distancing, which I then coded for in the advertisements in a subsequent round of coding. A similar iterative process informed how I induced the other mechanisms.

In the third stage, I returned to the field. In focus group sessions and additional interviews, I asked individuals to comment on my nascent theoretical models and provide additional context. I also conducted checks with these informants to validate if my representation

³ Fig. 2 specifies each of these time periods. Each period begins with the closest even-year after export values or ad references for mechanical and quartz crossed the other. Hereafter, I include a period label (e.g., *t0*, *t1*, *t2*, *t3*) in parenthesis whenever reporting findings related to a specific period.

⁴ Because the Swiss had shifted their focus to toward selling quartz watches during the period of retrenchment (*t1*), only 17 mechanical watch ads appeared (less than 5% of ads) in my initial sample for *t1*. To ensure a large enough sample size to conduct analysis of variance across periods, I went back into the field and collected the mechanical ads featured in all the odd- and even-numbered journal issues during period *t1* (adjusted n=60). Sample size power analysis confirmed the larger sample was satisfactory for tests of proportional differences. This adjusted sample was used to compare shifts among periods reported in Fig. 3, but was not used in the analysis reported in Fig. 2 that shows the actual proportion of mechanical and quartz ads found in the journals.

of the phenomenon aligned with their experience. I continued to combine descriptive codes to form thematic and, eventually, theoretical codes (Glaser and Strauss, 1999). The entire process was iterative—alternating among data sources, analysis, extant theory, and returning to the field to collect more data to validate my findings—to induce a process model associated with technology reemergence.

[Insert Table 2 (Codebook) About Here]
[Insert Figure 2 (Export Values and Ad Mentions) About Here]

Research Timeframe. I chose 1970 as the starting point of this study because it marked the first full year after the first quartz timepiece was introduced to the market. 1970 also represented the height of Swiss mechanical watchmaking dominance of world markets. It allowed me to track more than a decade of performance data, events, and critical decisions that occurred immediately after the introduction of quartz technology as the field's new dominant design. 2008 served as the study's endpoint because it marked the onset of a global financial downturn that watch industry experts argued led to changes in industry performance that extended beyond the scope of this study.

Research Context

Switzerland's dominance in watch production arose in the 18th century, and by 1940, their exports comprised 80 percent of the global industry's total value and dominated industry sales until the introduction of quartz technology in the 1970s. I catalogued three distinct phases that followed.

Technological discontinuity (1970-1980). Ironically, a group of Swiss watch companies working together introduced the first prototype for a quartz battery-powered watch. Quartz technology included a circuit that allowed a precisely cut quartz crystal to turn vibrations into electric pulses that measured time. At first, quartz watches were extremely expensive to produce but were 20 times more accurate than their hand-wound mechanical counterparts. Most Swiss

watchmakers doubted that quartz technology would replace their centuries-old mechanical traditions and chose to race against quartz variants by investing resources into improving the mechanical watch's accuracy. However, because of early investments in electronics, Japanese firms such as Seiko and Casio entered and dominated the quartz market by reducing the price by a factor of 100. To compete with the Japanese, by 1974 Swiss mentions of quartz watches in ads surpassed their mentions of mechanical watches for the first time. But Japanese dominance had already taken hold. An executive I interviewed recalled of that time, "Everyone [in Switzerland] believed the future was in quartz." Most of the remaining Swiss watchmaking firms began to retool their manufacturing lines to accommodate quartz watch production (Donze, 2011). Experts predicted quartz technology would completely displace mechanical watches within a decade (Landes, 1983).

Technological retrenchment (1982-1990). By 1982, Swiss quartz watch sales surpassed their mechanical watch sales for the first time. That year, executives at the Swiss Corporation for Microelectronics and Watchmaking Industries Ltd. (SMH) introduced the Swatch watch that combined quartz technology with artistic design (Moon, 2004; Taylor, 1993). Within five years 50 million Swatches were sold, showing that the Swiss watchmaking community could compete in the quartz market. The Swiss' shift toward quartz technology, however, also ushered in a period of technology retrenchment for the mechanical watch. Latent demand benefited a subset of remaining mechanical watch firms that recognized a consumer niche that still valued mechanical watches for more than precise timekeeping (Adner and Snow, 2010). For example, an executive I interviewed said he successfully targeted a remaining customer niche by running advertisements that celebrated Swiss watchmaking traditions. Swiss executives were also surprised that watch collectors had begun to pay record prices for vintage mechanical watches at

auction (Reardon, 2008), especially since most companies were liquidating their assets associated with “outdated” mechanical production.

Technological Reemergence (1992-2008). By 1990, the broader Swiss watchmaking community had taken note that a market for mechanical watches was viable, and many more firms turned their attention back to mechanical production (Donze, 2011). This community-wide shift toward mechanical watchmaking is evidenced in 1992, marking the first even-year since the 1970s in which Swiss advertisements for mechanical watches appeared more frequently than quartz watch ads. Unlike the preceding period of retrenchment, where only a small subset of firms had been able to maintain a limited niche for mechanical sales, Swiss mechanical sales began to experience prolific growth, eventually surpassing quartz sales in 2002. By 2008, mechanical sales were no longer confined to a limited niche; hundreds of Swiss watch companies were selling mechanical watches and numerous mechanical watchmaking schools reopened to accommodate renewed demand. The Swiss Watch Federation (2009) noted, “The watch industry is today, as it was yesterday, one of the brightest stars in the Swiss economic firmament.” While these claims provide support that demand for the mechanical watch rematerialized to achieve significant growth, *how* this process unfolded serves as the impetus for this study’s findings.

FINDINGS: THE PROCESS OF TECHNOLOGY REEMERGENCE

Here, I illuminate and describe the process and mechanisms associated with technology reemergence. Figure 3 illustrates the process that led to the reemergence of market demand for mechanical watch technology. After the introduction of quartz technology (t_0 : 1970-1980), the model notes the period of latent demand that exposed a contracted demand niche for mechanical watches (t_1 : 1982-1990). The subsequent process of technology reemergence evolved in two distinct phases. During an initial phase of reemergence (t_2 : 1992-2000), Swiss mechanical watchmaking firms first focused on redefining the legacy technology via mechanisms of value

recombining, identity marking, temporal distancing, and conceptual bridging that shifted the cognitive meanings and values associated with mechanical watchmaking. During a second phase (*t3*: 2002-2008), associated with demand for mechanical watches superseding that of quartz, watchmakers shifted the reemergence process toward redefining the market for mechanical watches. This shift led the Swiss to reconstruct community and consumer market boundaries via mechanisms of competitive set reclaiming and enthusiast consumer mobilizing. Several intermediate outcomes followed. New firms began to enter the mechanical watchmaking field, creating additional competition and the need for mechanical watchmakers to further differentiate from each other; and, having established new meanings and boundaries to distinguish mechanical watchmaking from the quartz dominant design, competitive and consumer differentiation contributed to an increase in innovation within the mechanical watchmaking community. Together, these processes facilitated significant sustained demand growth and a reemergence of the legacy mechanical watch.

[Insert Figure 3 About Here – Technology Reemergence Process Model]

Figure 3 also illustrates the co-evolution of the reemergence processes and mechanisms as they relate to various levels of analysis. The figure is divided into three horizontal sections that distinguish how the (1) organizational-related mechanisms reported in the findings were influenced and affected by (2) community- and (3) consumer-related factors. Organizational factors are associated with the actions of individual watchmaking firms. Community-factors are defined as “the set of organizations that have a stake in the development of the product class” and that “participate in technological information exchange, decision-making or standards-setting” (Rosenkopf and Tushman, 1998: 315, 316). Akin to Scott’s (1994: 207-208) conceptualization of an organizational field, these community-level factors focus on how mechanical watchmakers maintained a common meaning system for those who were seen as

interacting “more frequently and fatefully with one another than with actors outside of the field.” Consumer-factors are defined as the supply-side elements that influence the consumer’s “willingness to pay for a product...[and their] preference structure” (Adner and Levinthal, 2001: 612). The findings that follow report the process and underlying mechanisms of technology reemergence.

First Phase of Technology Reemergence: Redefining the Legacy Technology

From 1992 to 2000 (*t2*), Swiss firms focused on redefining several aspects of mechanical watch technology. This initial cognitive shift occasioned the emergence and interplay of three mechanisms: value recombining, identity marking, and temporal distancing (see Figure 3).

Value Recombining. Informants attributed the early reemergence of the Swiss mechanical watch to a series of actions organizations took to cognitively redefine the values attached to the legacy mechanical technology. This process of value recombining, i.e., the act of interpreting multiple “qualities that we have not seen together before in quite this combination” (Weick, 1990: 170), permitted mechanical watchmakers to reactivate several latent value claims and conjoin them with novel values and new meaning.

First, during the early 1990s, watchmakers began to adopt and assert novel value claims related to craftsmanship. Firms began to explicitly tout the handmade process that went into producing mechanical watches. One CEO stated, “When we tell customers about our company, we start with innovation, independence, continuity, and craftsmanship. Craftsmanship is now assumed to be a must.” (Table 3 offers supporting data for quotes.) Another senior executive explained how an emphasis on craftsmanship evoked new value for mechanical technology:

Despite the fact you need machines for most modern technology, it is all men and women behind the machines. They're the machine. They're giving their best, for their little piece to be perfect as possible. At the end, all the pieces come together so the watchmaker can assemble them. You see people dedicated to their work, dedicated—some even scoff at the machinery.

Craftsmanship distinguished mechanical watchmaking from the mass manufacturing processes associated with quartz technology production. Mechanical watchmakers readily capitalized on this novel distinction; claims of craftsmanship aimed to shift the notion of the mechanical watch away from being merely a commodity good and toward “art.”

[Insert Table 3 About Here - Representative Supporting Data]

Second, firms continued to preserve pre-existing value claims related to the notion of precision (see codebook). One executive noted, “During the comeback, we continued to emphasize precision, accuracy, and function.” Most mechanical watchmakers, however, stopped using precision claims to compete directly with quartz timepieces. According to one industry spokesperson, “Precision is not sufficient. You have to give the customer more.” Thus, watchmakers began to incorporate notions of luxury to reshape the values attached to the mechanical watch. Although early watches were highly inaccurate (sixteenth-century kings and nobles commissioned them primarily as status symbols), by the late nineteenth century, the field had shifted its attention to creating more precise and affordable watches (Landes, 1983). During this initial reemergence phase (*t2*), executives began to reactivate these notions of luxury and status. An executive noted, “We now think of the [mechanical] watch as a status symbol. These are the intrinsic emotional values we have been trying to transmit related to the luxury lifestyle.”

In turn, during reemergence (*t2*), firms relied on the mechanism of value recombining to redefine prior notions of value to include aspects of both luxury and craftsmanship. Precision appeared to take on a new meaning, serving as a proxy for the level of mastery required to produce a mechanical watch and, like pieces of fine art and luxury handmade goods, began to justify higher prices. Combining these novel and latent value claims began to distinguish the mechanical watch from quartz. A watch historian discussed how the recombination of values helped to redefine mechanical watchmaking (personal interview, and in Trueb, 2005: 11):

[Mechanical watches] became something rare and very special: high-tech machinery, almost artistic skills and tremendous experience were required to make, assemble and service them. Damn the wonderfully accurate but mass-produced timepieces: intricate micromechanics are something exclusive and deeply emotional, and only limited quantities of such timepieces can be produced.

Patterns in the advertisement data validate how these reported shifts in value-claims evolved over time. The ads confirmed a majority of mechanical watch ads continued to focus primarily on precision timekeeping during the retrenchment period ($t1 = 85$ percent). During reemergence ($t2$), however, the recombination of precision and craft with luxury became prevalent. Rolex released an ad in the 2000s, stating, “Carved from the world’s most precious metal. ‘Made’ hardly seems appropriate. The Oyster Perpetual Day-Date in platinum. Nearly a year in the making, its 220 individual components demand such a process.” The ad touts the precision handmade manufacturing process, and also highlights the use of platinum, often found in luxury jewelry. Such processes of value recombining and reactivation repositioned mechanical watchmaking as a form of high-end functional art, as illustrated again in the following ad:

The beating heart of Piaget is its luxury watchmaking workshops. Crafted to very high technical specifications, a movement manufactured by Piaget is a thing of beauty, fascination and pride. World-famous as the specialist of extra-thin movements, Piaget harnesses its exclusive expertise to do justice to its signature creativity.

Analysis of variance tests showed significant differences in the value-claims that Swiss firms assigned to the mechanical watch during reemergence ($t2$) compared to earlier periods (see Table 4 and Figure 4). Compared to retrenchment ($t1$), significant increases occurred in mentions of both craftsmanship [$q(4, 410) = 7.22, p < 0.001$] and luxury [$q(4, 410) = 10.71, p < 0.001$].⁵ Where 7 percent of ads were coded as craftsmanship and 20 percent as luxury during retrenchment ($t1$), 38 percent were coded as craftsmanship, and 70 percent as luxury, during reemergence ($t2$). Interviews indicated no significant shifts in precision at any point during the

⁵ All findings reported are based on post-hoc Tukey pairwise comparisons using adjusted p-values where q is the studentized range distribution. Following Tukey’s method as described in Miller (1981), q values were used to report adjusted pairwise comparisons across all four time periods.

study's timeframe ($t0-t3$), suggesting that watchmakers never relinquished their focus on producing precision timepieces, but rather combined the notion of precision with other values. Several executives mentioned that precision and craftsmanship eventually became synonymous with each other, which likely explains why references to craft eventually tapered off (see Table 4); co-occurrences of precision and craft rose from an average of 3 percent during retrenchment ($t1$) to 32 percent during reemergence ($t2$) and then leveled off to 20 percent ($t3$). Finally, tests confirmed increases in all combinations of co-occurrences among the three value claims during reemergence ($t2$) compared to retrenchment ($t1$). Additional tests between the two periods showed a significant increase in the co-occurrence of all three value claims appearing in ads simultaneously [$q(4, 410) = 5.98, p < 0.001$].

[Insert Figure 4 About Here – Value Recombining]
[Insert Table 4 About Here – Analysis of variance of ad features]

Thus, the ability of Swiss watchmakers to reactivate latent values (e.g., precision, luxury) reinforced the salience of latent demand heterogeneity (e.g., Adner and Snow, 2010) as a demand function for a legacy technology. However, during reemergence, the mechanism of value recombining facilitated a distinct set of outcomes whereby latent and novel values formed new meanings and values attached to the mechanical watch. The ability to not only reactivate prior values, but to also generate *new* meanings and values associated with a legacy technology, appears to be a distinguishable characteristic of technology reemergence.

Identity Marking. Shifts in meaning attached to the legacy technology also stemmed from firms' attempts to redefine the mechanical watch as a self-expressive "identity marker" (e.g., Belk, 1987; Pratt and Rafaeli, 1997) for the consumer. Marketing research has associated identity marking with the ability of a product to "provide a vehicle by which a person can proclaim a particular self-image" (Aaker and Joachimsthaler, 2000: 49). Identity marking emerged as an important mechanism to help consumers personally identify with the mechanical

watch. In the wake of quartz technology, many Swiss watchmakers noted that they reframed the mechanical watch as an expressive tool to showcase aspects of the consumer's interests or personality. One executive stated, "When you buy a Swiss [mechanical] watch it's no longer for just having the time on your wrist. It's first of all to have an accessory that corresponds with your personality and the things you like." A CEO described how he communicated this shift to the consumer and his employees:

Your watch lives with you. You don't look to it for accuracy. You look for the soul, the beauty, the art. You look to the watch as a communicating instrument of your personality. Your watch is part of you. The watch belongs to you. The watch is you.

Using the advertisement data, I coded for explicit mentions and visual representations of the watch as a self-expressive identity marker (see codebook for examples). One such ad stated, "Discreet individualism is the mark of people who wear Girard-Perregaux watches – and of those who make them." Analysis of variance tests confirmed that identity marking more than quadrupled during reemergence ($t2= 53$ percent) compared to displacement ($t0 = 10$ percent) [$q(4, 410) = 9.19, p<0.001$]. During reemergence ($t2$), identity marking also began to co-occur more frequently with luxury value claims compared to retrenchment ($t1$) [$q(4, 410) = 7.27, p<0.001$] (Table 4). An industry veteran I interviewed noted that most firms began to combine these two elements: "Your mechanical Rolex or your Patek is a portable status symbol. It shows your status, your bank account, your power." During reemergence ($t2$), identity marker and luxury co-occurrences increased five-fold ($t2= 43$ percent) compared retrenchment ($t1 = 8$ percent). Such co-occurring patterns illustrated how identity marking and value recombining worked in tandem to shift the meanings attached to the legacy mechanical watch. Interestingly, identity marking initially became salient during retrenchment ($t1 = 40$ percent, compared to $t0 = 11$ percent) [$q(4, 410) = 5.03, p<0.002$]. Further analysis of these ads revealed that identity marking took a different form, showing the watch as an extension of individuals as they engaged

in recreational activities (e.g., sports, music, painting); these claims paralleled how Swiss quartz watches (e.g., the Swatch) were being positioned during retrenchment as accessories to compliment daily life ($t1$). Notably, co-occurrences of identity marking and luxury were sparse during retrenchment ($t1= 8$ percent).

Temporal Distancing. During reemergence ($t2$), mechanical watch firms began to distance themselves from the period of technological discontinuity ($t0$). This mechanism, which I label temporal distancing, enabled watchmakers to “selectively forget” (e.g., Anteby and Molnár, 2012) elements of the legacy technology’s recent turbulent past in order to reclaim earlier, more successful periods. As one company historian explained, “We take care to distance ourselves from the [quartz] crisis. We prefer to go back to the founding of our business when we mention mechanical watches.” Another noted, “In producing mechanical watches, companies cast themselves in the role of guarantors of a centuries-old regional tradition” (Pasquier, 2008: 314). When asked to share the history of their company, no senior executive explicitly mentioned the quartz crisis unless provoked. My field notes indicated that responses typically focused on the company’s early or most recent mechanical watchmaking achievements, how they had reinvested in R&D, or how they continued to advance a centuries-old tradition of watchmaking.

Analysis of interview transcripts revealed that temporal distancing emerged in two forms. First, mechanical watch firms began to use language that bridged the distant past with the future; i.e., explicitly overlooking recent history associated with the period of discontinuity ($t0$) and retrenchment ($t1$). When asked about the role of temporal distancing, an executive explained:

During the crisis, the consumer didn’t give a [expletive] about the history of the company. The consumer began taking watches totally for granted.... It didn’t matter how long the company had been around. A watch became a disposable item... replaceable when it went bad. All these issues became irrelevant. In an attempt to market their brands, watch companies decided to emphasize only some parts of their history. Many companies have rewritten their histories.

To understand how firms attempted to reframe their histories, I coded advertisements for statements that bridged references from the distant past with the future. One such ad showed a classic mechanical watch and stated, “The past inspiring the future.” During the quartz crisis (t_0 , t_1), ads coded as bridging the distant past and future fluctuated (e.g., 11 percent in 1972, 8 percent in 1982, and 29 percent in 1988). Executives noted that in the 1980s customer preferences began to shift to all things “electronic” or “futuristic.” Later, firms recommitted to using references that bridged the distant past and future more during reemergence (t_2) compared to retrenchment (t_1) [$q(4, 410) = 6.34, p < 0.001$] (see Figure 5). In fact, temporal distancing codes that bridged the distant past and future reached 55 percent in 1996.

Second, I found that temporal distancing also consisted of firms reclaiming historical roots related to their initial founding date. Executives noted that they began to tout their founding date to communicate the origins of the firm’s mechanical watchmaking lineage. To codify this distant past, many firms began to hire PhDs in history to write books on the company’s origin story. During the 1990s, a new formal role, “brand historian,” was institutionalized in the industry. By focusing on the company’s distant founding date, such actions aimed to reinforce and authenticate the practices and traditions tied to early mechanical watchmaking. An historian I interviewed stated:

Companies go great distances to tell about their historical background and historical achievements. This is a kind of capital behind the product. It's no longer just a very accurate product. When you buy a mechanical watch you buy something much more [too]; you buy history, you buy knowledge.

Advertisement analysis of variance tests confirmed significant increases in the use of company founding date during reemergence (t_2) as compared to retrenchment (t_1) [$q(4, 410) = 6.29, p < 0.001$]. Ads began to appear that made claims such as, “More than 250 years of uninterrupted history dedicated to perfection” and “Breguet. Since 1775. Known to history as the watchmaker’s watchmaker.” By comparison, from 1974 to 1980, not a single ad in the sample

mentioned company founding, suggesting that companies had little interest in making claims to historical heritage as quartz technology was on the rise. Founding claims averaged only 10 percent before 1992. However, during the first reemergence period ($t2$), such mentions averaged 41 percent and remained relevant during the second reemergence period ($t3 = 28$ percent). Founding date also appeared to reaffirm the firm's historical role in shaping the "craft" of Swiss watchmaking. During the reemergence period ($t2$), 23 percent of ads included both founding date and craftsmanship compared to only one such ad during retrenchment ($t1$) and discontinuity ($t0$) combined. In an archival interview, one CEO articulated how his firm combined the notions of founding date and craftsmanship to redefine mechanical watchmaking:

Ulysse Nardin is one of very few watch companies which has been continuously in production. [It] was first owned and managed by five generations of Nardins before I took over in 1983. One should of course differentiate between a manufacture (or in English a manufacturing) company and a marketing company. The longevity and history only have a meaning if it refers to a watch company which conducts its own research and development and manufactures watches (Paige, 1999).

In sum, temporal distancing allowed mechanical watchmakers to simultaneously reclaim past success while distancing themselves from more recent wounds suffered during the quartz crisis.

[Insert Figure 5 About Here – Temporal distancing]

Together, the above mechanisms of value recombining, identity claiming, and temporal distancing combined to redefine and shift the meanings associated with mechanical watchmaking during this period of reemergence. Swiss watchmaking became a form of "mechanical art," infused with craftsmanship, luxury, and history. Analysis of the advertisement data further confirmed a notable co-evolution of these combined mechanisms during the reemergence period ($t2$). The co-occurrence of every combination of these codes (precision, craftsmanship, luxury, identity marking, bridging the distant past and future, and company founding) increased during this first phase of reemergence ($t2$) relative to the period of retrenchment ($t1$) (see Table 4).

Conceptual Bridging. As watchmakers attempted to shift the values and meanings attached to mechanical watch technology, they adopted communication practices to help consumers and employees reconceptualize and interpret these meanings and values. Processes of “conceptual evolution” have been found to help consumers make sense of new discontinuous technologies, such as early automobiles (e.g., horseless carriages) (Clark, 1985) and electric lighting (Hargadon and Douglas, 2001). Watchmakers engaged in a similar process of conceptual bridging, i.e., the use of linguistic mechanisms to help actors develop “common ground in a step-by-step manner” (Cornelissen and Werner, 2014: 217) about a new technology (e.g., Ansari and Garud, 2009). Firms began to use the language of metaphors and analogies (Bingham and Kahl, 2013; Cameron, 1986; Powell and Colyvas, 2008) to communicate the new definitions and values attached to the legacy watch technology. As one executive asserted, “We don’t sell watches. We sell dreams.” Executives noted they relied on such language to disassociate the mechanical watch from negative perceptions formed during the quartz crisis (e.g., less accurate and inferior technology). In interviews, individuals frequently evoked metaphors and analogies to compare the mechanical watch with forms of art, culture, highly technical mechanical objects (e.g., cars, airplanes), and the human body. Multiple individuals likened the oscillating balance wheel of the mechanical watch to a “beating heart,” describing the watch’s gears as part of a “living organism” that needed to be “fed” with daily winding. A CEO stated, “A mechanical watch has a soul, it has a heart, it has life, it has something breathing inside of it.” Such descriptions evoked new meanings that consumers could assign to the legacy technology itself.

Analysis of the advertisement data showed a steady increase in the use of conceptual bridging (i.e., the use of metaphors and analogies; see codebook and Table 3) during the reemergence phase (*t2*) compared to retrenchment (*t1*) [$q(4, 410) = 3.82, p < 0.036$]. Such references grew from 14 percent of ads in 1992 to 58 percent in 2000 (see Figure 6). Further

analyses of the advertisement data revealed that conceptual bridging and aspects of value recombining began to appear more frequently together, as well as co-occurrences with both aspects of temporal distancing (bridging distant past with the future, founding date); more specifically, analysis of variance tests showed a significant increase in the co-occurrence of the conceptual bridging code alongside codes for luxury [$q(4, 410) = 7.65, p < 0.001$], craftsmanship [$q(4, 410) = 5.76, p < 0.001$], and temporal distancing (i.e., bridging distant past with the future) [$q(4, 410) = 5.08, p < 0.002$] between the periods of retrenchment ($t1$) and reemergence ($t2$). In addition, co-occurrences of conceptual bridging and identity marking averaged 35 percent of all ads during the reemergence period ($t2$); one such ad published during the reemergence period stated, “Just like Achilles. But without the heel. We all have our weaknesses. Except for this watch, of course.” Thus, conceptual bridging appeared to serve as a vital congealing mechanism for the other mechanisms salient during this period by helping watchmakers amalgamate a set of reconceptualized values and meanings attached to a revised definition of the legacy technology.

[Insert Figure 6 About Here – Conceptual bridging]

Related Community and Consumer Factors. Analysis of interview and archival data also pointed to several community- and consumer-related factors that influenced the organizational mechanisms induced above (see dotted horizontal lines in Figure 3). First, mechanical watchmakers benefited from and capitalized on market shifts that coincided with the mechanical watch’s initial reemergence. Between 1992 and 1998, discretionary household incomes for the top four countries that Swiss companies consistently exported watches to rose: by 26 percent in the US between 1992 and 1998, and by 7 percent on average in Japan, Italy, and Germany between 1994 and 1998. Watchmakers also benefited from increased global demand for luxury goods. During the 1990s, luxury consumption increased four times faster than other forms of household spending (Frank, 1999). Comparing the 1990s to early twentieth-century conspicuous

consumption, Frank (1999:15) noted, “We are in the midst of another luxury fever... The quest to move up is currently in swing.” Analysis of growth consumption patterns for luxury goods proved to be strongly correlated with the growth of mechanical Swiss watch exports from 1994 to 2008 ($r=0.95$, $p<0.001$).

Mechanical watchmaking was also influenced by, and likely contributed to, cultural shifts (c.f., Giorgi, Lockwood, and Glynn, 2015) related to craftsmanship. The late twentieth century marked a change in how consumers defined product quality, initiating a rise in demand for hand-made goods (Luckman, 2015) such that:

More and more factories around the world are basing their work on this new paradigm that enhances craftsmanship. As the entrepreneur Bonotto (2011) says: “Time is the new luxury”; more attention to detail is given to adding quality and value to the product.” (Cimatti and Campana, 2015:13-14)

New markets for high-end artisanal products began to emerge (e.g., Khaire and Wadhvani, 2010) in response to globalization and industrialization (Jones, 1989). Swiss watchmakers adopted, and influenced, many of the cultural trends related to slow manufacturing and craft (e.g., van Bommel and Spicer, 2011) in an attempt to reinforce their renewed definition of mechanical watchmaking.

To summarize the first phase of reemergence between 1992 and 2000 (*t2*), mechanical watch technology underwent a cognitive redefinition process facilitated by mechanisms of value recombining, identity marking, temporal distancing, and conceptual bridging. The interaction of these mechanisms helped Swiss watchmakers redefine the values associated with mechanical watchmaking, reframe their past history, and reconceptualize the mechanical watch as a self-expressive identity marker for the consumer. Conceptual bridging helped communicate these shifts in meaning to consumers and others in the field. In addition, the process was influenced by several cultural and economic factors that reinforced these cognitive shifts.

Second Phase of Technology Reemergence: Redefining the Market

Starting in 2002, Swiss mechanical watch exports eclipsed quartz exports, prompting a notable shift in focus within the watchmaking community that led to a reconstruction of market boundaries and significant reinvestments in mechanical watch technology. 2002 to 2008 marked a subsequent phase in the reemergence process (*t3*) whereby firms began to refocus their efforts on reconstructing the community and consumer boundaries associated with the market for mechanical watchmaking. Figure 3 illustrates how this redefinition process occurred via concurrent processes associated with mechanisms of competitive set reclaiming and enthusiast consumer mobilizing.

Competitive Set Reclaiming. As market demand for mechanical watches surged, data revealed that the Swiss watchmaking community began to reinterpret and reclaim the cognitive boundaries of their *competitive set*, i.e., “the causal beliefs that permit managers to define competitive boundaries and make sense of interactions within these boundaries” (Porac, Thomas, and Baden Fuller, 1989: 412). During the quartz crisis (*t0*), Swiss mechanical watchmakers defined Japanese quartz watchmakers as direct competitors and struggled to make sense of their new competitive landscape. A CEO noted, “I desperately tried to diversify [into quartz]. But it was difficult because there were now other channels that sold these products.” Reemergence (*t3*), however, marked a shift in focus that led the Swiss to reclaim membership boundaries to exclude firms that only produced quartz watches. For instance, during the 2000s, mechanical watchmakers reinforced these boundaries at the industry’s annual conference in Basel, Switzerland. Swiss industry insiders on the conference organizing committee awarded the most coveted booth locations to firms that demonstrated a commitment to mechanical watchmaking; floor maps made clear these distinctions. By contrast, an executive at a quartz manufacturer

complained that his company had been denied a booth in the “main hall” and had been assigned a space in a temporary tent outside:

We are now seen as outside the family of watchmakers. All the [mechanical] companies are associated with the same watch manufacturer associations. They visit each other’s booths, but they don’t visit ours. There is an exchange of knowledge and information. We only receive guests from [other quartz watch companies], and same goes for them.

In an attempt to capitalize on increasing demand for mechanical watches, some quartz manufacturers reintroduced mechanical watches back into their product portfolios during the 2000s. One executive explained how difficult it was to reclaim membership in the mechanical watchmaking community, noting, “Once the image is set about a brand as ‘digital plastic,’ it’s quite difficult to reset the mind and convince others in the industry that we offer more.”

Further, competitive set reclaiming established new boundaries inside the mechanical watchmaking community. Many executives I interviewed discussed a hierarchy that emerged, often noting, unprovoked, where they were located on an informal “industry pyramid” that sorted each brand by its ability to produce quality mechanical watches, and thus, by price. Such distinctions created sub-communities within the mechanical watchmaking community. Companies that produced more mechanical components in-house were higher on the pyramid and more prestigious than those that sourced their components from others in Switzerland. An industry historian explained this distinction:

After the quartz industry crisis, few watchmakers had maintained the [machinery] needed to produce all the steps of making a [mechanical] watch. Many watchmakers had to rely on others [to make watch components]. Starting in the early 2000s, brands that produced their own components began to call themselves a ‘*manufacture*’ in an attempt to distinguish themselves from others in the industry.

Competitive set reclaiming extended beyond established firms; of the new entrant Swiss watchmaking firms whose CEOs I interviewed, all claimed their company’s primary founding objective had been to compete primarily in the mechanical watch market.

A second dimension of competitive set reclaiming consisted of the reestablishment of Swiss geographic boundaries, i.e., the community of organizations “influenced by embeddedness in similar geographic environments” (Marquis and Battilana, 2009: 285). One executive stated, “The integrity, the diligence, the value system. That is what makes ‘Swiss’ Swiss. Swiss markers indicate the whole Swiss way of doing things. It plays a large role in the business and the industry.” Several community-level intermediary actors helped reconceptualize and reinforce these membership boundaries. To defend against counterfeiting, the Swiss government implemented “Swissness” legislation that protected local products and communicated Swiss values of quality, exclusiveness, and reliability. A government official noted that his office had commissioned studies from local experts on the impact of foreign counterfeiting. Swiss watch academies started to limit the number of non-Swiss applicants enrolled in their programs and, as a result, who could apply for jobs. A non-Swiss watchmaker said, “By the 2000s, [Swiss] schools were training mostly their own people again. It was much more difficult for a foreigner to get accepted and then get a job in Switzerland.”

Competitive set reclaiming also applied to the messages that mechanical watchmakers began to send to the consumer. I analyzed each of the advertisements for “Swissness” claims, i.e., references to the watch being Swiss, either in the text or by prominently displaying *Swiss Made* in the ad photo or graphic. One such ad showed a mechanical watch sitting where cheese is placed on a mousetrap, with the tagline: “100% Swiss. The world’s finest collection of Swiss watches.” Significant increases in references to Swissness occurred between the retrenchment and both reemergence periods [$q(4, 410) = 7.54, p < 0.001$] (see Figure 7). During retrenchment ($t1$), when the future of the Swiss mechanical watch industry was still uncertain, Swiss watchmakers appeared to have distanced themselves from making such claims ($t1 = 8$ percent). During the first phase of reemergence Swissness claims began to increase ($t2 = 46$ percent); in

interviews, several executives mentioned that during this phase mechanical watchmakers attempted to capitalize on the popularity of the Swiss-made Swatch quartz watch. An industry reporter recalled, “Swatch was a phenomenon that put the Swiss watch back on the map. I saw its impact in Switzerland. It was absolutely amazing.” After the Swatch craze began to subside, however, the use of Swissness took on new meaning; a common theme in interviews pointed to watchmakers’ invoking Swissness claims ($t_3 = 53$ percent) to establish new and distinct community boundaries that separated the field of Swiss mechanical watchmaking from quartz technology. This cognitive shift appears to have contributed to an additional significant increase in Swissness claims between the two phases of reemergence [$q(4, 410) = 1.56, p < 0.001$].

[Insert Figure 7 About Here – Competitive Set Reclaiming]

Enthusiast Consumer Mobilizing. A concurrent set of processes led Swiss mechanical watchmakers to redefine the cognitive boundaries associated with their consumer base during this phase (t_3). Some activities focused on existing customers, while others were targeted at attracting new customers, and still others appealed to both old and new customers. First, firms began to reconceptualize and mobilize consumers as “enthusiasts.” Enthusiasts were distinct from typical consumers in that they would seek out higher levels of information, serve as opinion leaders, and actively engage in activities to “maintain, conserve, or enhance a product” (Bloch, 1986: 54). Swiss watchmaking firms began to engage in several activities that mobilized both old and new mechanical enthusiasts to help them expand their customer base. Mechanical watchmakers began to refocus their attention on enthusiasts who had continued to ascribe value to the mechanical watch during the quartz crisis. A former CEO discussed how he and other CEOs began to connect with these mechanical watch aficionados and collectors by traveling globally to seek their input. Many hosted events aimed at cultivating collector communities and re-engaging mechanical watch enthusiasts. Another executive noted that her company

established a new norm of asking enthusiasts to participate in focus groups during the design of their new mechanical models, stating, “These individuals often know more about the brand and the technology than we do.” Enthusiasts took on new importance in the industry, not only because they bought watches, but because firms believed they could become third-party arbiters of value and authenticity for new consumers, much like art appraisers and wine connoisseurs (e.g., DiMaggio, 1987; Peterson, 2005).

Next, firms began to attract and cultivate new cohorts of enthusiasts. Many broke from a long-held industry tradition of remaining highly secretive about their manufacturing processes. According to one executive, her firm began to invite potential enthusiasts on factory tours to witness their hand-crafted production methods, noting, “If you see inside quality traditional watchmaking production, you have to appreciate it. Because it's human, it's real.” Once an unthinkable practice, factory tours became a way to educate and induce a wider range of consumers to become enthusiasts for brands and the community. On factory tours, I noted that guides encouraged participants to speak with watchmakers as they worked and to ask questions about the watchmaking process. Additionally, firms hosted regional parties at exclusive clubs or hotels and flew their master watchmakers to these events to demonstrate how watches were crafted. Other brands hosted in-house watchmaking classes that gave new enthusiasts the opportunity to work alongside a watchmaker. Such activities helped develop enthusiast communities, with the goal of cultivating a new generation of opinion leaders and informal “brand ambassadors.” Because consumer enthusiasts were more often “attracted, rather than repelled by product complexity” (Bloch, 1986: 54), many brands believed these individuals could serve as intermediaries to influence an even broader base of emerging watch consumers.

Enthusiast communities also helped Swiss watch firms identify emerging tastes and preferences of new consumers in previously untapped demographics. Mechanical watchmakers

attempted to attract enthusiast consumers in new geographic regions. As household disposable incomes increased in countries outside the industry's traditional U.S. and European markets, so too did the global appetite for luxury mechanical watches. The growth of worldwide watch sales offered increased stability to the mechanical watch industry in the early 2000s, especially as disposable incomes in the United States and Europe began to stagnate. For example, I interviewed a watch enthusiast in the Middle East who was approached by several Swiss brands in the mid-2000s to become a retailer in the region. He commented, "With this new wealth coming out, and more and more people having an interest in [mechanical] watchmaking, the mentality of people has changed. Nobody would have thought in the eighties that people would consider having three, four watches." Mechanical watchmakers also targeted Asian markets. In 2008, the Federation of Swiss Watchmakers reported, "The Asian continent absorbed more than 46 percent of Swiss watch exports. Europe consumed almost a third, with the Old World recording a more modest increase (+4.4 percent). America lost some market share, accounting for 19 percent of Swiss export sales." Several executives noted that their ability to cultivate enthusiasts in Asia, the Middle East, and Russia proved a critical driver of market growth during the 2000s.

Finally, firms relied on enthusiasts to help them better understand the tastes of younger consumers who had initially abandoned mechanicals for future-oriented quartz watches. One CEO stated that younger enthusiasts began to experience a shift in taste, stating, "We now believe the younger population likes mechanical watches more and more because we're working towards educating them. They are a highly technical customer, but they understand and appreciate the mechanical aspects." Another CEO recalled that cultivating a younger consumer base had been critical to the resurgence of demand for mechanical watches, noting, "Young people wanted to wear mechanical watches again." Consequently, enthusiast mobilizing helped

mechanical watchmakers expand their consumer base to a much wider and more diverse group of potential patrons.

Intermediate Outcomes of the Reemergence Process

Competitive differentiation. Several intermediate outcomes emerged from the phases of reemergence. First, the reconceptualization of community boundaries and membership had implications for competition. Executives reported that rising demand for mechanical watches, along with an influx of new entrants, generated a rise in internal competition among firms within the industry. Competitive differentiation took multiple forms. Some executives shared how they had purchased the naming rights to previously defunct brands that went bankrupt during the quartz crisis so they could sell mechanical watches under the legacy moniker again (e.g., Blancpain, Gallett). Additionally, luxury brands (e.g., Hermes, Mont Blanc) established watchmaking partnerships with Swiss manufacturers to produce “Swiss Made” mechanical watches. Many new brands entered the mechanical watchmaking community (e.g., Alpina, Frederique Constant). When asked how his firm differed from more established brands, one new mechanical watchmaker explained, “We're doing the mechanical watchmaking of the twenty-first century... Everybody else is claiming to be from the nineteenth century.” Another CEO described how it had become crucial to distinguish his watches from other mechanicals, noting: “We radically modernized the tradition of watches, placing [mechanical technology] in a very bold design, which was new because of the association with traditional mechanical movements.” Advertisement data offered evidence of mechanical watchmakers’ increased focus on competitive differentiation during reemergence. Compared to retrenchment (*t1*), the later phase of reemergence (*t3*) marked a four-fold increase in the percentage of mechanical firms that chose to advertise, a measure of competitive differentiation often cited in marketing research (see Boulding, Lee, and Staelin, 1994) and especially luxury marketing (Fionda and Moore, 2009).

Competitive differentiation appeared to serve as an intermediate outcome of the field having set new competitive boundaries and was an indication that competition within the newly established field had begun to ensue from within (e.g., Navis and Glynn, 2010).

Consumer differentiation. The expansion of consumer boundaries also led firms to begin differentiating customer preferences with far more granularity and within more specific price segments. During the 1990s, industry consolidation led to the formation of the watchmaking “group” model (a firm comprised of multiple brands under one owner). These brands often competed for the same customer (Breiding, 2013; Donze, 2011). Beginning in the 2000s, brands within the “group” model began to take great care to differentiate their consumers and vertically segment the market. According to a CEO in one group, the new strategy allowed each brand to target customers at a specific price point; for example, lower priced brands might have sat at the bottom of an industry price pyramid, but could still play an important role in attracting new customers. The brand CEO explained, “If you don’t have a base, you cannot have a top. A pyramid has a base. The larger its base, the higher you can build the top.” Another former CEO stated that his successor raised prices and quadrupled the company’s marketing budget to target consumers in a new price segment that didn’t compete with other brands in his group. The goal, he said, “was getting the company out of the mass market margins and into luxury market margins.” Alternatively, some brands that had traditionally focused on higher price segments were acquired and repositioned in the mid-tier “in the hopes of luring the middle class” (Glasmeier, 2000: 249). One CEO explained how his brand exploited this strategy in the 2000s, noting, “Clear product policy, clear marketing policy, clear distribution policy, and a very clear decision to stay in our price league. Every day I tell my people, stay in your [expletive] league.” Within each segment, brands began to employ unique strategies to attract a more specific type of core consumer. As demand for mechanical watches continued to increase during

this period of market reemergence (t_3), customer differentiation led firms to further refine the market for mechanicals to attract a more diverse base of consumers well beyond those who maintained the limited niche market for the legacy watch technology during the period of retrenchment (t_1).

Reinvestment in innovation related to the legacy technology. The above processes culminated in the reinvestment of innovation and manufacturing for mechanical technology across the field. The goal of these innovation efforts was to further distinguish each brand from others, and to target the tastes of specific consumer segments. Early in the reemergence process (t_2) only a few firms invested in mechanical innovation. While many Swiss firms remained focused on quartz innovation, one seller quipped that a small cohort began to shift its attention toward mechanical innovation: “We had high tech. Now we have ‘high mech’” (Passell, 1995: D9). During the second phase of reemergence (t_3), however, the majority of Swiss brands followed suit and began to reinvest heavily in mechanical watch “complications,” i.e., an innovation or function on the watch other than the display of time (e.g., stopwatches, moon phase indicators, tourbillons). To produce such complications, the CEO of a mechanical watch company established in the 2000s noted that his watchmaking methods were so novel that he applied for patents on the machinery needed to manufacture his designs. Innovation in material engineering also began to rise during the second phase of reemergence. Watchmakers utilized silicon, used in semiconductor chip manufacturing, to produce mechanical hairsprings that no longer required oil and offered improved accuracy. Others experimented in metallurgy. I embedded myself in one watch factory for a week to learn how the company had collaborated with a local university to develop a new alloy that fused 18-carat gold with ceramics. The process resulted in the world’s first non-corrosive and scratch-proof gold. Several executives acknowledged that their investments in mechanical watch innovation had fueled consumer

demand in the 2000s. At an industry press conference, a CEO commented on how the industry had shifted: “In 1992 nobody wanted these [mechanical watches], nobody wanted to invest. Now, everybody talks about the success of the Swiss watch industry.”

Analysis of the advertisements illustrated a significant increase in mentions of innovation and new “complications.” During the latter phase of reemergence (*t3*), watch complication mentions averaged 28 percent [$q(4, 410) = 3.68, p < 0.001$] compared to retrenchment (see Figure 8). Alternatively, between the period of displacement (*t0*) and retrenchment (*t1*), such mentions decreased from 21 percent to 11 percent; there was no significant difference between retrenchment (*t1*) and the initial phase of reemergence (*t2*). These patterns reinforce interviewees’ statements that mechanical innovation and R&D began to resurge more broadly in the later phase of reemergence (*t3*) when firms began to redefine their market, but only after they had first redefined the meanings and values of mechanical technology in an earlier phase (*t2*).

[Insert Figure 8 About Here – Innovation and R&D]

Technology Reemergence. Nearly 40 years after the introduction of quartz watch technology had nearly rendered Swiss mechanical watchmaking obsolete, 2008 marked 19 consecutive quarters of market growth for Swiss watch exports, 70 percent of which came from mechanical watches. The Swiss watchmaking community reported 67 percent growth over the previous five years and claimed record sales of 15.8 billion Swiss francs (its closest competitor, Hong Kong, reported 7.1 billion) (Federation of the Swiss Watch Industry, 2009). The number of Swiss watchmaking employees had risen 40 percent since 1992, and as noted by one trade school instructor, watchmaking schools were again “blooming.” The Swiss had ceded their dominance in unit production to Chinese quartz competitors, but according to multiple industry analysts interviewed, by redefining the technology and its market, Swiss mechanical watch production

was once again the “referent point” and “envy” of the industry in terms of demand growth, export value, innovation, design, and prestige.

Figure 3 summarizes the process of technology reemergence. After the introduction of quartz technology, mechanical watchmaking experienced a period of discontinuous technological change ($t0$) and of technological retrenchment ($t1$). During a first phase of reemergence ($t2$), Swiss mechanical watchmakers focused on redefining the cognitive meanings that they and consumers attached to the legacy technology via mechanisms of value recombining, identity marking, temporal distancing, and conceptual bridging. In a second phase ($t3$), watchmakers focused on redefining the cognitive boundaries associated with the market and consumer for mechanical watches. This phase was facilitated by mechanisms of competitive set reclaiming and enthusiast consumer mobilizing. The reemergence process culminated in several intermediate outcomes associated with competitive and consumer differentiation, along with a reinvestment in mechanical innovations that coincided with a period of substantive and sustained demand growth for mechanical watch technology.

DISCUSSION

This study contributes to literature at the intersection of technology cycles and cognition by explicating the process and mechanisms associated with the concept of technology reemergence, i.e., the resurgence of substantive and sustained market demand for a legacy technology following the introduction of a new dominant design. It extends prior work in the tradition of technology cycles and industry evolution (Abernathy and Utterback, 1978; Suárez, 2004) by exposing how a legacy technology, along with the firms and community that support it, are able to generate multiple consecutive years of substantive demand growth and innovation after the introduction of a new discontinuous technology. In addition, this work advances a cognitive view of technological change in explaining technology reemergence and responds to

recent calls from scholars to investigate how firms redefine meanings and markets (Eggers and Kaplan, 2013) associated with incumbents facing threats from discontinuous technologies. Taking a process approach to theory-building (Langley, 1999), this research offers a vantage into several novel aspects of technological evolution and market cognition, discussed below.

Expanding the Technology Cycle: Processes and Outcomes of Technology Reemergence

This paper extends theories related to technology life cycles and technology trajectories in multiple ways. First, it demonstrates that technology cycles may be more expansive than previously modeled, extending beyond birth (technology emergence) (e.g., Santos and Eisenhardt, 2009) and death or decline (technology displacement or retrenchment) (e.g., Adner and Snow, 2010; Sull, 1999; Tushman and Murmann, 2002) to include possible rebirth and reemergence. While technological shifts create waves of creative destruction, for some technologies, these may be better seen as provisional rather than permanent. Prior work of technology cycles (e.g., Argyres, Bigelow, and Nickerson, 2015; Suárez and Utterback, 1995; Tushman and Anderson, 1986; Utterback, 1974) has focused on the discontinuous technology's ascendance to a dominant design (see Furr and Snow, 2015; Henderson, 1995 for notable exceptions). Alternatively, this study's focus on the trajectory of the legacy technology extends the notion of the technology cycle beyond the traditional path of variation, selection, and retention. The mechanical watch's trajectory toward reemergence afforded the opportunity to reconsider several base assumptions about creative destruction (Schumpeter, 1934) and the path-dependent processes (Anderson and Tushman, 1990) that have consumed much of technology cycle research. Under certain conditions, demand for a legacy technology may rematerialize to generate significant market growth in ways that extend the traditional technology life cycle.

Second, this article contributes to the literature on technology trajectories by explicating the process that facilitates a legacy technology's path toward reemergence. A unique aspect of

this study's findings and model (Figure 3) is that it reveals the sequence and mechanisms associated with technology reemergence over time. Whereas prior research on technology cycles has theorized that technological (Utterback and Abernathy, 1975), market (Clark, 1985), and cognitive (Kaplan and Tripsas, 2008) factors typically converge in parallel during a technology's emergence, this study exposes how reemergence requires a convergence process that instead occurred in phases. For mechanical watchmakers, technology reemergence unfolded during an initial phase where firm and community actors redefined the cognitive meanings associated with the legacy technology, and in a second phase where actors focused on the reconstruction of membership and consumer boundaries that redefined the legacy technology market. These findings also revealed that an important cognitive shift in meanings and values attached to the legacy technology preceded a significant resurgence in consumer demand; Swiss export values for mechanical watches did not eclipse quartz until the community had shifted its focus to redefining the market boundaries for mechanical watchmaking. Thus, this work offers a novel theoretical perspective related to the sequencing and optimal timing (Suárez, Grodal, and Gotsopoulos, 2015) associated with the cognitive and market factors that influence technological change and evolution.

Relatedly, this study expands on Adner and Snow's (2010:1657) notable theoretical claim that pockets of demand for a legacy technology can enable periods of firm "survival and contraction" for a few remaining actors. This study confirmed that mechanical watches experienced a period of retrenchment followed by a period of reemergence with substantive demand growth. An important contribution of this paper, however, is that it sheds light on the process whereby heterogeneous latent demand may provide the initial kindling during – in an initial period of retrenchment – that later ignites a period of reemergence and significant, sustained demand growth for a legacy technology.

Third, this work has implications for research at the interplay of technology cycles and ambidexterity (Andriopoulos and Lewis, 2009; O'Reilly and Tushman, 2011). Scholars have theorized that innovation and growth are reliant on an organization's ability to adopt new capabilities and innovation streams that transgress existing technology cycles, while simultaneously relying on exploitation strategies to sustain current growth (Raisch et al., 2009). A dominant view exists that firms will engage in exploration early enough in the technology cycle to build a wellspring of possible competency-destroying innovations before their existing exploitation strategy runs dry (Gupta, Smith, and Shalley, 2006). Alternatively, this study's findings reveal a potentially unique form of ambidexterity. In response to the 1980s quartz crisis, some Swiss watchmaking firms shifted their attention toward exploration and began to adopt quartz watch technology, but many returned to mechanical watchmaking in the 1990s. Ironically, the shift back to the legacy technology became a primary source of growth and innovation, even as many of the same firms continued to produce quartz watches and benefit from learning and innovation across both innovation streams. The notion of technology reemergence may provide an additional means to unlock some of the complex strategic paradoxes (Smith, 2014; Smith, Binns, and Tushman, 2010) that emerge when firms shift the locus of their innovation attention toward developing new capabilities. An alternative approach to ambidexterity and market growth may lie in a strategy of vacillation (Boumgarden, Nickerson, and Zenger, 2012) back to the legacy technology.

The Critical Role of Cognition in Technology Change and Market Creation

Technology cycles have been shown to be impacted by several cognitive factors that influence how firms, consumers, and community actors (e.g., analysts, trade associations, government officials) ascribe meaning to discontinuous technologies (e.g., Benner, 2010; Kahl and Grodal, 2016; Kaplan and Tripsas, 2008). Importantly, this study sheds light on several

novel cognitive mechanisms that enable technology change and industry evolution. By examining how actors shift the meanings and market boundaries associated with a legacy technology's trajectory over time, it answers calls (Anthony, Nelson, and Tripsas, 2016; Eggers and Kaplan, 2009; 2013) for research at the intersection of technology change and cognition in the following important ways.

Managerial cognition and technological adaptation. Prior research has focused on the role of managerial cognition as an inhibitor of strategic and technological adaptation (e.g., Danneels, 2011; Gilbert, 2006; Nag, Corley, and Gioia, 2007; Tripsas, 2009) and has argued that cognition causes organizations to “fail to adapt when they cannot adequately match their capabilities to the opportunities or threats seen in the market” (Eggers and Kaplan, 2013: 316). Alternatively, this study reveals a series of cognitive mechanisms that enabled adaptation in response to a competency-destroying innovation. Specifically, it exposes a process whereby various cognitive mechanisms contributed to a redefinition of the meanings and values associated with mechanical watchmaking. The mechanism of value recombining led watchmakers to combine prior notions of precision with craftsmanship and luxury, and to expand the definition of the mechanical watch as a status symbol that consumers could view as high-end art rather than a commodity good. A condition of technology reemergence may be whether actors can reactivate some latent value-claim embedded in the technology (i.e., latent demand heterogeneity), but more so, that latent values can be attached to a set of new value claims that generate novel meaning and increased demand for the legacy technology. The importance of value recombining to the reemergence process is that it is not anchored to any one value but that it permits the fusion of latent *and* novel value-claims; in turn, the creation of new definitions of value can only be materialized from their combined use.

Likewise, the mechanism of temporal distancing helped recreate a historical narrative that consumers and internal actors could attach to the technology's meaning. Similar acts of selective forgetting have been shown to be effective in other theoretical domains, such as Anteby and Molnár's (2012) study on the French aeronautic firm that explicitly ignored elements of its rhetorical history and identity in order to reconcile contradictory elements of its past (see also Schultz and Hernes, 2013). For mechanical watchmakers, temporal distancing enabled firms to reimprint some of the community's initial values (e.g., Marquis, 2003; Marquis and Huang, 2010) and reassimilate them into the definition of mechanical watchmaking while simultaneously "polishing away" the tarnish and notions of inferiority built up because of technological determinism during the rise of a new technology. Temporal distancing also served as an enabling mechanism for agency, allowing leaders to reclaim past success and reinfuse confidence into their organizations. Per theories of embodied agency, temporal distancing appears to have created the "spacing and timing" (Shilling, 1997: 741) necessary to help leaders redefine existing social structures and reconcile their prior circumstances (e.g., Giddens, 1984).

However, a shift in temporality and value claims may not be enough to create new meanings that reactivate market demand for a legacy technology. The mechanism of identity marking helped conjoin these values with the consumer's emotional identification with the mechanical watch as an extension of his or her self-identity (e.g., Hogg and Terry, 2000; Mittal, 2006; Pratt and Rafaeli, 1997). As a condition of reemergence, a legacy technology likely needs to activate normative values associated with the consumer's identity that extend beyond the use-value of the technology itself.

Finally, the reemergence process required reintroduction of the technology to the consumer via the mechanism of conceptual bridging. Whereas prior studies have shown that new discontinuous technologies may need to be couched in terms associated with the legacy

technology (e.g., Clark, 1985; Hargadon and Douglas, 2001), conceptual bridging helped reintroduce the legacy technology to multiple audiences during reemergence. Metaphors and analogies have proven to be well-suited tools for this purpose (Bingham and Kahl, 2013; Cornelissen, 2006), and especially to help reduce technological ambiguity (Orlikowski and Gash, 1994; Weick, 1990). Here, the use of conceptual bridging reintroduced the values and meanings associated with the legacy technology to new audiences. An additional condition of technology reemergence appears to be whether firms are able to attach new meanings to a legacy technology and allow for a gradual conceptual evolution.

Conceptual bridging may also serve as a mechanism to mollify the “internally focused fear” (Vuori and Huy, 2016: 9) often ascribed to incumbent actors in the wake of a technological discontinuity. Although beyond the data reported in this study’s findings, conceptual bridging seemed to have been valuable for those organizational leaders who attempted to reinvigorate employees made redundant during the quartz crisis. One CEO discussed moving his headquarters into an old farmhouse to attract employees and signal a metaphorical connection to the peasant farmers who built the Swiss watch industry several centuries before. In addition to shaping a legacy technology’s meaning for consumers, such acts of conceptual bridging may be relevant for leaders tasked with instilling confidence back into communities that have suffered the psychological difficulties often associated with competency-destroying technological change (Huy, 2002; Kanter, 2006).

In sum, this study has advanced a novel process illustrating how mechanisms of value recombining, temporal distancing, identity marking, and conceptual bridging can facilitate new meanings for legacy technologies and products. For scholars interested in technology cycles, this work exposes how these various cognitive mechanisms can be bound together during a period of technological change to enable a unique form of strategic and technological renewal.

From market redefinition to reemergence. Cognitive research related to market and field redefinition has typically focused on the emergence of *new* market categories rather than existing ones (Kennedy, 2008; Navis and Glynn, 2010; Santos and Eisenhardt, 2009; Sine and Lee, 2009); a large swath of this research has taken the perspective of outside entrepreneurial actors engaged in social movements who create new markets (Rao, Monin, and Durand, 2003; Weber, Heinze, and DeSoucey, 2008; Weber, Thomas, and Rao, 2009). While such accounts provide evidence that market creation requires the convergence of the meanings and boundaries within a specific time period (Grodal, Gotsopoulos, and Suárez, 2015; Vergne and Wry, 2014), far less attention has been given to how meanings get attached to markets over an extended period and, additionally, how incumbents redefine mature categories and product classes. This study's findings offer insights to address these previously undertheorized aspects of market redefinition.

Research on cognitive categorization (Porac and Thomas, 1994) has focused on how firms define competitive boundaries based on their perceptions of the actors they believe share a common product or market category (e.g., Benner, 2010; Benner and Tripsas, 2012). Whereas Porac, Thomas, and Baden-Fuller (1989) illustrated how Scottish knitwear firms developed cognitive communities that led them to misinterpret the boundaries of their competitive environment, this study revealed how the reclamation of a legacy technology's competitive set helped incumbent firms socially construct new marketplace boundaries that enabled, rather than inhibited, adaptation and market growth. Following the quartz crisis, Swiss watchmakers demarcated a new competitive environment that differentiated mechanical watchmakers from firms that only produced quartz technology. After redefining their competitive set, legacy watchmaking firms then began to mobilize cohorts of consumer enthusiasts to expand their customer base beyond the traditional geographic and demographic segments. Thus, mechanisms of competitive set reclaiming and enthusiast mobilizing illustrate how cognitive communities can

facilitate, rather than impede, market growth following a technological change. Interestingly, for mechanical watchmakers, market redefinition meant constricting the cognitive boundaries of their competitive set while simultaneously expanding how they conceptualized the boundaries of their customer base.

This work also contributes to literature on the emergence of dominant market categories, i.e., “the conceptual schema that most stakeholders adhere to when referring to products that address similar needs and compete for the same market space” (Suárez, Grodal, and Gotsopoulos, 2015: 438). While these categories are theorized to be important during product class emergence, this study shows how firms can reconstruct a dominant market category during a product’s later evolution. Because mechanical technology remained relatively consistent throughout this study, shifting to a new dominant market category appeared to enable the regeneration of a prior dominant design. Suárez and colleagues (2015: 440) argued that dominant designs “arise through technological experimentation (Suárez and Utterback, 1995), path dependence (Anderson and Tushman, 1990), and investments in process R&D and economies of scale (Klepper, 1996).” Ironically, a similar set of conditions that led to the mechanical watch’s technological decline may have also contributed to the emergence of a new dominant market category; only after redefining the values, meanings, and market boundaries associated with the dominant market category could mechanical watchmakers experiment again with the technology, reinvest in R&D, and consolidate manufacturing capabilities. Thus, a criteria of technology reemergence appears to be whether a new and distinct dominant market category for the legacy technology can emerge and shift the cognitive competitive boundaries away from those previously assigned to the discontinuous technology.

Relating Technology Reemergence to Other Forms of Market Redefinition

It is worth noting how this study extends and differs from prior accounts of market redefinition in established fields. For instance, Delmestri and Greenwood (2016) described how status recategorization contributed to the redefinition of Italian grappa in the spirits market. While both grappa and mechanical watches moved up their respective status classification hierarchies, how and why they did so differ significantly. Whereas grappa had historically been classified as the “lowest level of a wider class of spirits” (Delmestri and Greenwood, 2016: 2), Swiss mechanical watches had served as a referent point for the watch industry for centuries. While grappa’s redefinition relied on a status recategorization within an existing category, the shift in mechanical watchmaking originated from a technological shock that led incumbent actors to respond to a threat of displacement. This shift was reactionary rather than proactive, requiring actors to overcome many of the challenges associated with incumbent inertia (Danneels, 2011; Sull, 1999), and to recommit to investing in defunct manufacturing lines, infusing confidence back into a community on the brink of collapse. This study illustrated how actors went about disentangling values and meanings that had made them highly successful from those that had led to their near collapse, establishing new meanings for the mechanical watch. Technology reemergence advances a novel process of market redefinition that accounts for a product or technology’s past dominance, near collapse, and eventual resurgence.

It is also important to clarify how technology reemergence is distinct from resource partitioning. In Carroll and Swaminathan’s (2000: 716) craft beer case, the authors posited that within concentrated industries a limited number of large producers will dominate and pockets will open up for small organizations to “specialize in their product offerings and target markets.” A key difference between mechanical watchmaking and craft beer is that watchmakers did not shift into an unoccupied segment of the market but rather one they had previously occupied (see also Delmestri and Greenwood’s [2016] thoughtful theoretical distinction). In fact, when the

Swiss initially introduced quartz watches into the market, quartz was considered far more specialized, and mechanical and quartz variants competed for many of the same customers during the 1970s. As the cost to produce quartz technology steadily declined in the 1980s, quartz began to occupy the low-, mid-, and high-tier segments. During the reemergence period, however, mechanical watchmakers were able to push quartz watches out of the high-end segment, while many brands continued to compete vigorously with quartz in the mid-range segment. The focus of this study has been to illustrate how legacy technologies reclaim substantial market space in segments they once occupied, thus distinguishing technology reemergence from resource partitioning theories that typically focus on how actors exploit unclaimed segments of highly concentrated markets.

Technology Reemergence and Future Research

Beyond watches. Anecdotal accounts of technology reemergence in other industries abound; legacy technologies appear to be thriving in an age of “disruptive innovation” (The Economist, 2014: 62). After the introduction of compact discs and on-demand music streaming, vinyl record sales nearly collapsed. By 2015, however, the vinyl record segment experienced a tenth straight year of revenue growth (McCarthy, 2016), leaving analysts to write, “Today, vinyl is as popular as it has been in years...with some stores reporting their best sales ever” (Hogan, 2014: 1). For centuries sailing ships dominated the maritime shipping industry, but faced a near collapse following the introduction of steam-powered vessels (Rosenberg, 1976). Yet, by 2000, revenues for sailing ship production in the U.S. rose to a high of \$750 billion compared to \$9 million in 1921 (in 2000 dollars) (Helme, 2016). Industry experts reported, “Today, sailing exists only in the realm of recreation and competition... Once the purview of the wealthy, recreational sailing can be enjoyed by nearly everyone interested in the sport” (Stone, 2017: 25-26).

Similarly, streetcars were a common fixture in many U.S. cities at the beginning of the twentieth

century, but by the 1960s most had been replaced by buses. Over the last decade, a “streetcar boom” (Shapiro, 2001) has led 33 U.S. cities to adopt or begin planning for streetcars as a new form of “green” public transportation (The Infrastructurist, 2009). And following the introduction of ballpoint pens, fountain pen sales dropped from \$48 million in 1960 to \$7 million in 1975; yet by 2007 sales had resurged to \$17 million worldwide (Conner, 2005; Modis, 2003). Other legacy technologies may also merit attention, including folio notebooks, letterpress printing, travel agencies, and independent booksellers. The diversity of these legacy technologies – from modes of public transportation and recreation to music and bookselling – offers preliminary evidence that technology reemergence may not only be associated with products like watches and fountain pens that have become luxury goods. Examining how the process and mechanisms explicated here apply to other markets offers significant opportunity for future research.

More broadly, this study addresses calls to further examine the trajectories of legacy technologies and how firms manage mature products and services (Adner and Snow, 2010; Rogers, 1995). As seen in the Swiss watch industry, faced with a technology discontinuity, some legacy technologies may possess value beyond functionality that can lead to significant growth in demand. While this qualitative study sheds light on the process of technology reemergence, developing a deeper understanding of the directionality between the supply and demand side factors in the model, especially using more robust quantitative methods across multiple industries, will be an important direction for future work. Finally, our appreciation for the process of technology reemergence would benefit from further research that examines whether legacy technologies must always experience a period of demand contraction and retrenchment before they are able to reemerge.

CONCLUSION

This paper challenges several long-held assumptions about the ill-fate of legacy technologies and their organizational environments following the introduction of a discontinuous technology (Schumpeter, 1934; Tushman and Anderson, 1986). The Swiss mechanical watch industry offers an alternative view that some legacy technologies, along with the community of organizations that support them, can achieve substantive and sustained demand growth and market expansion following the introduction of a new dominant design. As the rate of technology cycles continues to increase, incumbent organizations and communities face an onslaught of new technologies that threaten to capture existing market share at a faster rate than ever (Eggers, 2012); the prospect that organizations confront decisions about how to manage their legacy technologies is likely only to increase. During periods of discontinuous technological change, managers commonly anchor on the values that have defined their past success. As illustrated here, the Swiss' insistence on holding firm to the cognitive meanings and community boundaries associated with mechanical watchmaking during the 1970s likely contributed to their initial decline, and loosening their grasp on these dimensions earlier might have led to a more effective response. Thus, preparing an organization to overcome the cognitive barriers to technological change – such as embedded perceptions about the meanings and values attached to a technology and perceptions about field and competitive boundaries – may be just as important as preparing an organization to address future technological hurdles. Technology reemergence extends prior theorizations of technology change and industry evolution to accommodate a path whereby some legacy technologies reemerge to find new life.

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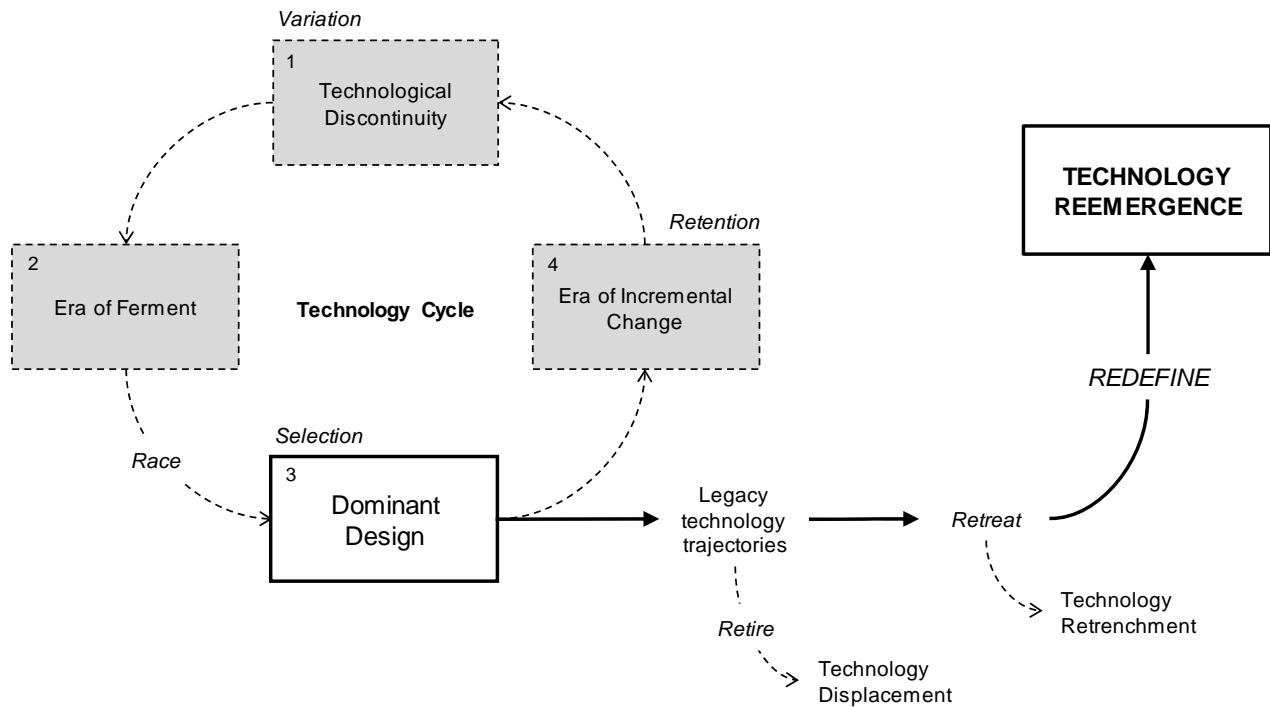
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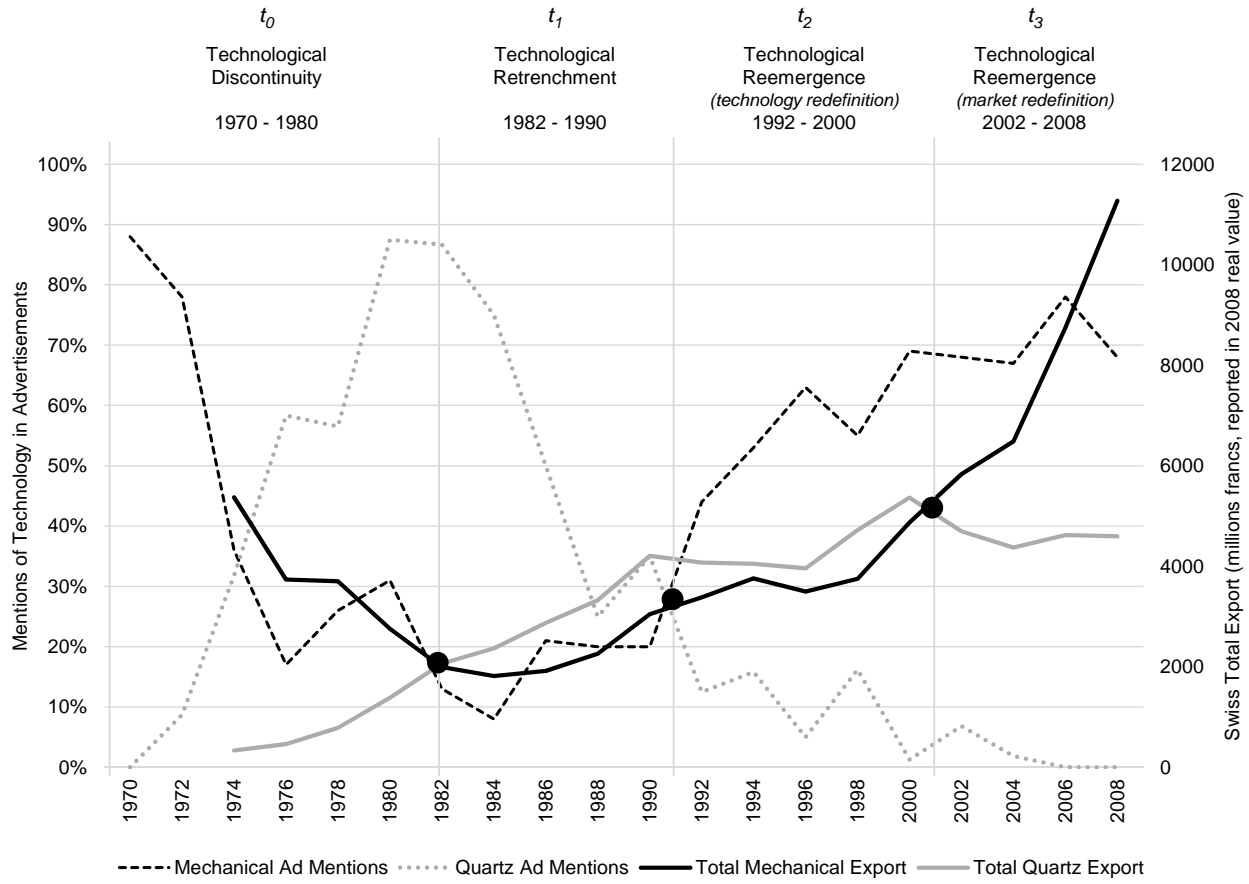
Figure 1: Technology Cycles and Legacy Technology Trajectories



Possible legacy technology trajectories following the selection of a new dominant design:

	Technology DISPLACEMENT	Technology RETRENCHMENT	Technology REEMERGENCE
Outcomes	Retire	Retreat	Redefine
Examples	telegraphs, dial-up modems, audio cassettes, VHS tapes bias tires	vacuum tubes, medical use pagers, CTR monitors	mechanical watches
Theorized responses			
<i>Industry revenue growth</i>	no industry growth	decreased and marginalized industry growth	increased industry-wide growth after an initial period of decline
<i>Firm entrants</i>	no new entrants	only a limited group of firms remain, typically in small niche	new entrants emerge from in and outside preexisting field
<i>Customer base</i>	prior customers switch to dominant design	maintenance of a limited and/or shrinking customer base	expansion of old and new customer segments
<i>Innovation and R&D investment in the legacy technology</i>	no further innovation, cease R&D	very limited incremental innovation and R&D	significant innovation and R&D efforts
<i>Production facilities investment</i>	cease use of facilities	attempt to maintain some existing facilities	reinvestment in old and new facilities
<i>Theorized demand function(s) for the legacy technology</i>	Demand Substitution: switching cost tradeoffs; liquidation of remaining supply	Latent Demand Heterogeneity: small pockets of remaining demand; niche specialization	Demand Creation and Growth: substantive & sustained market expansion; underlying mechanisms unknown
Representative Sources	Tushman & Rosenkopf, 1992; Utterback, 1994; Sull, 1999	Adner & Snow, 2010; Furr & Snow, 2014, 2015; Porter, 1980, 1996	----

Figure 2: Trajectory of the Swiss mechanical watch



Swiss export value sources: Federation of the Swiss Watch Industry; World Economic Outlook data, IMF; analysis by author. Reliable export data not available prior to 1973.

Figure 3: Process and Mechanisms of Technology Reemergence

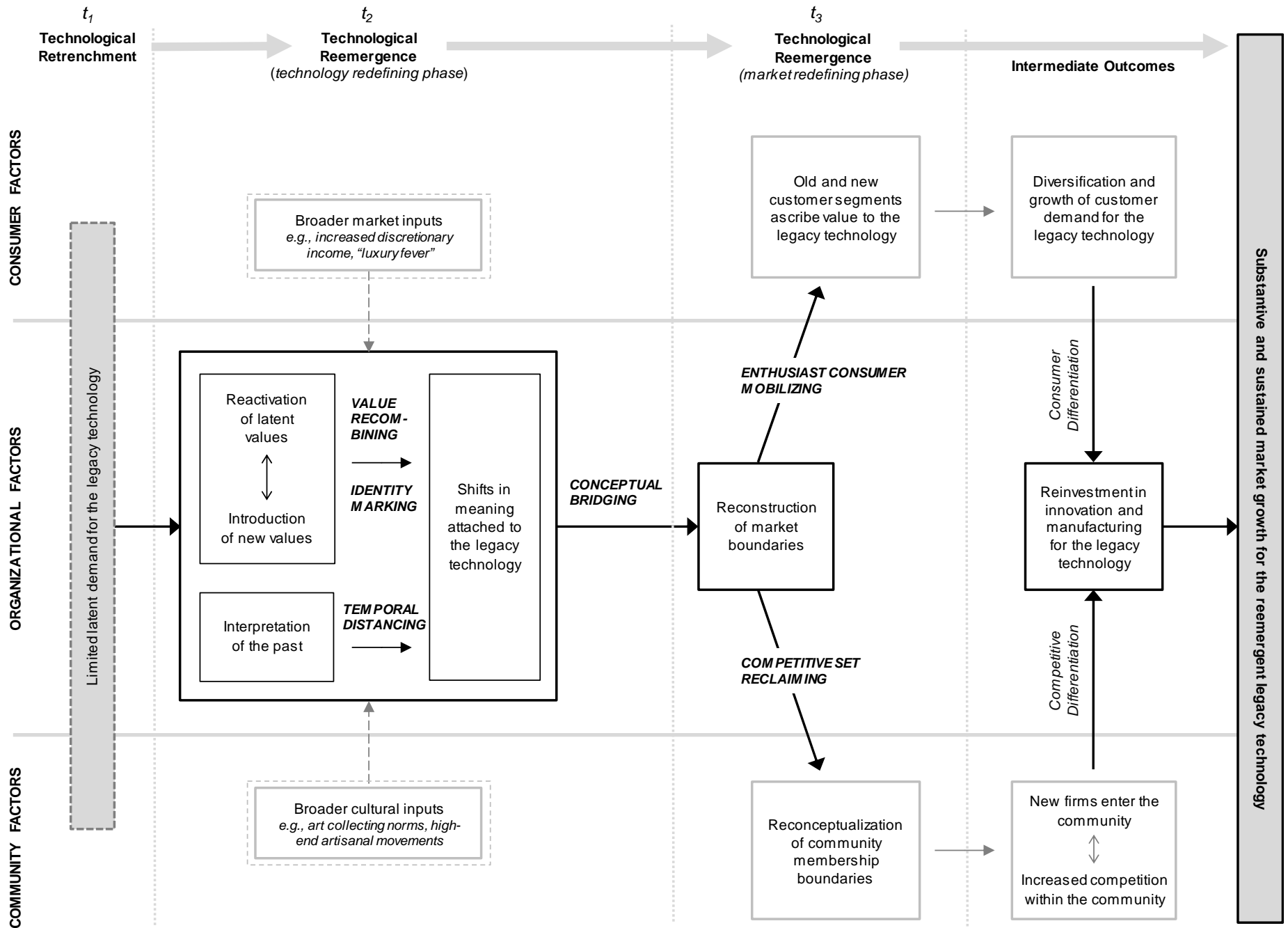


Figure 4: Value Recombining

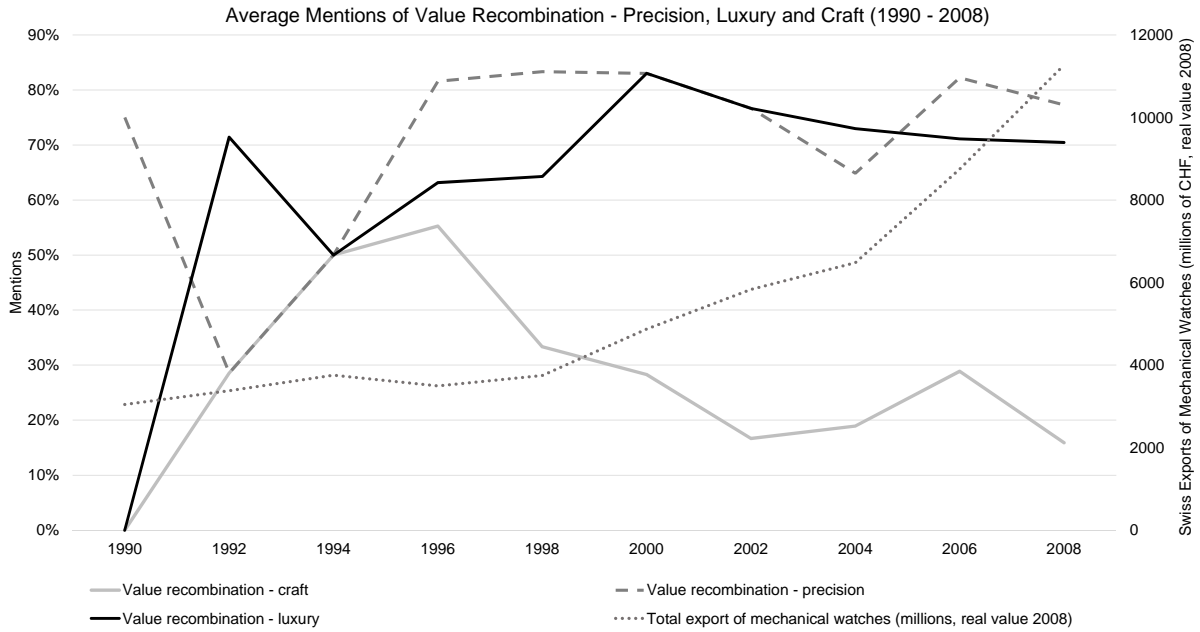


Figure 5: Temporal distancing

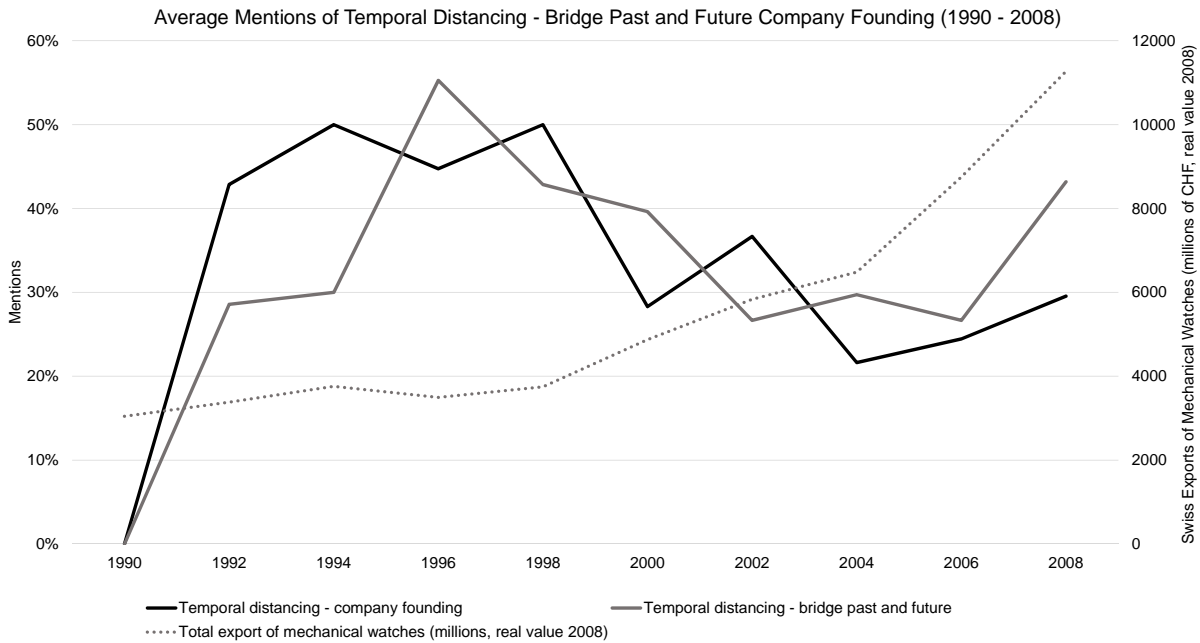


Figure 6: Conceptual Bridging

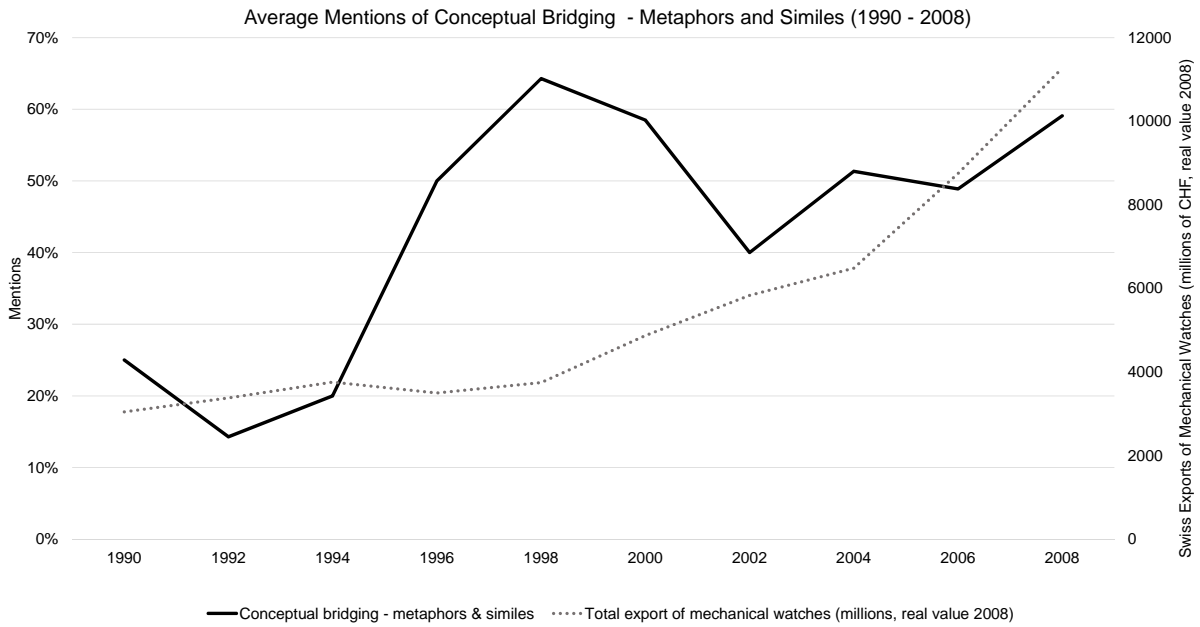


Figure 7: Competitive Set Reclaiming

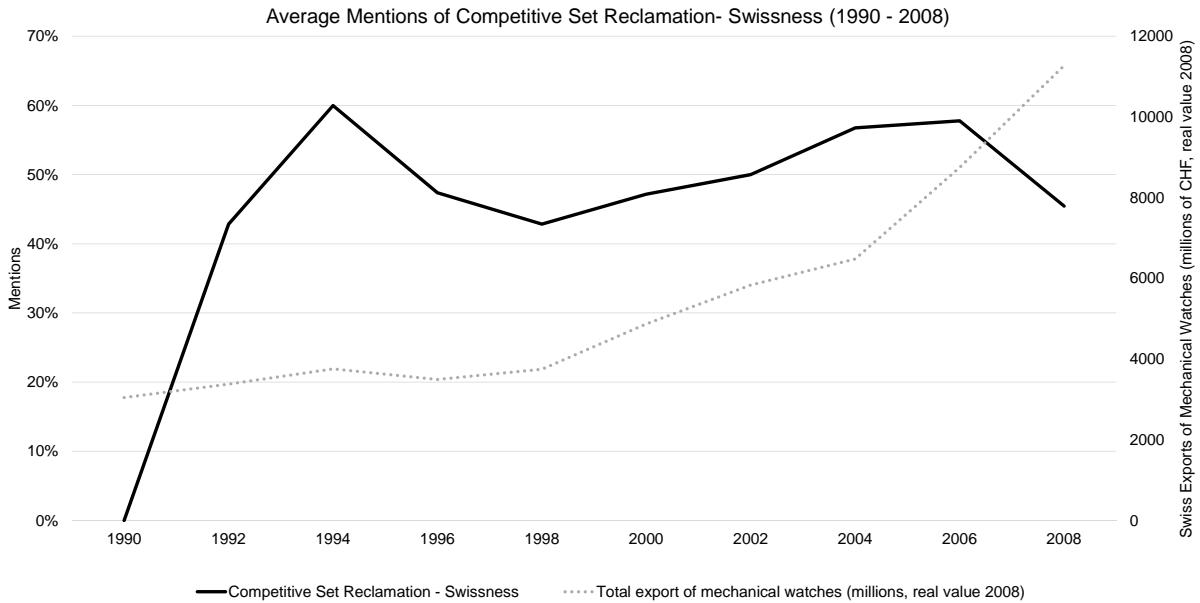


Figure 8: Innovation and R&D – Mechanical Watch Complications

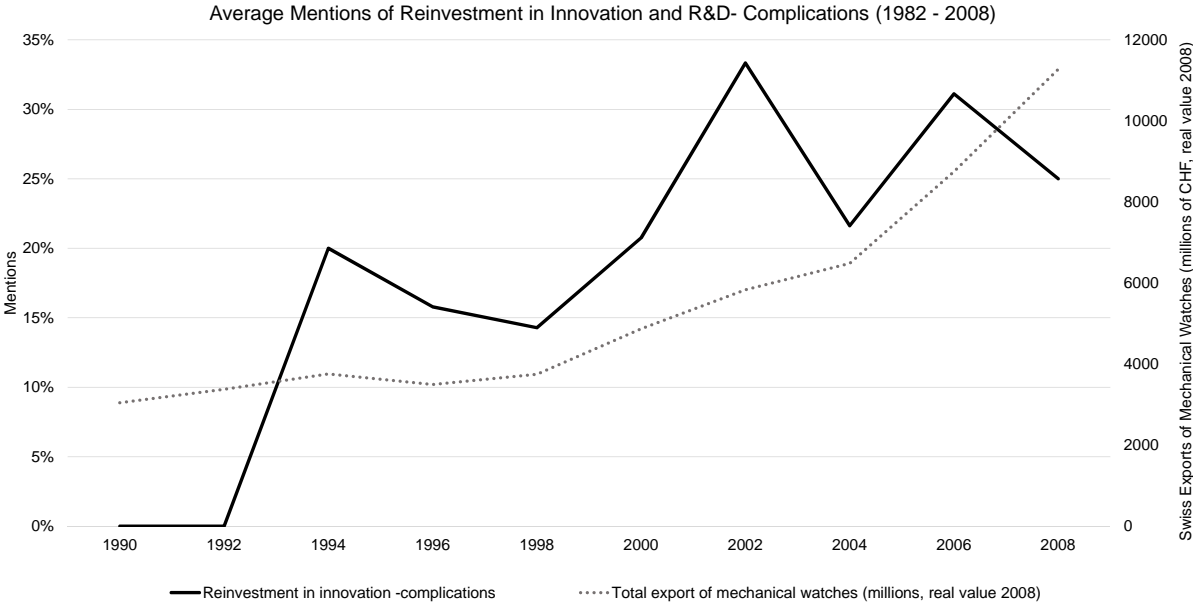


Table 1: Data Sources

Description of Data	
Semi-Structured Interviews	
- CEOs, senior executives, watchmakers, retailers, government officials, trade association representatives, horological academy administrators, horological societies presidents, company historians, academics, collectors, auction house executives, journalists.	<i>n</i> = 136 individuals Average interview: 91 minutes
Focus Groups	
- La Chaux-de-Fonds Swiss Watch Design Academy - NAWCC School of Horology, Columbia, Pennsylvania. - American Watchmakers Clockmakers Institute - Vintage watch collector associations	<i>n</i> = 4 focus groups with 42 individuals
Participant Observation	
- Attended BaselWorld, annual premier event with 104,000 visitors, 1,815 exhibitors, 3,300 journalists - Private tours of watchmaking factories in Switzerland and United States - Attended watch and clock making classes at NAWCC School of Horology	8 days during 1 conference, 10-12 hours/day 9 private tours 1 day
Industry Museums and Horological Archives	
- Toured national watch museums in Geneva, Le Locle, and La Chaux-de-Fonds, Switzerland - Toured Swiss National History Museum, Zurich, Switzerland - Toured National Watch & Clock Collectors Museum, Columbia, Pennsylvania. - Conducted research in leading horological archives throughout Switzerland and the United States	5 museums 3 horological archives
Print Advertisements	
- <i>Journal of Swiss Horology</i> (1970-2000, final issue) - <i>Chronos</i> (1996-2008) - <i>International Watch</i> (1996-2008)	<i>n</i> = 845 advertisements (700 Swiss), hand-scanned from archives in the United States, France, and Switzerland.
Archival Interviews	
- <i>TimeZone</i> (leading industry news website) interviews with CEOs and senior executives about industry trends and company happenings. Published between 1998 and 2012.	<i>n</i> = 27 CEO interviews
Swiss Watch Production, Companies, and Employees	
- Number of Swiss watches produced (mechanical, electric), every 5 years (source: <i>Federation of the Swiss Watch Industry</i>) - Number of Swiss employees, management in Switzerland; number of watch companies	All years, 1949-2011
Global Trade and Competition Data	
- Export value of Swiss watches overall, by country - Non-Swiss watch production, pieces, export values (mechanical, electric)	All years, 1970-2011
“Swiss Made” Government Regulations	
- Government press releases and “Swissness” legislation documents	All government-issued documents for 1971, 1995, 2007 (key years of legislation)
Macroeconomic Indicators	
- Consumer Price Index, currency exchange rates, interest rates, GDP (actual, per capita, growth rate, index), consumption (all, household, government), gross capital formation, exports of goods and services, imports of goods and services - Main exports of Switzerland, by product, (1840-1999), geographical distribution of Swiss trade (1990-1999)	Annual (1970-2008) for Switzerland and all major watch export countries
Archival Documents (company specific)	
- Company specific historical books written by company historians - Company specific historical books written by collector groups and watch enthusiasts - Archival documents, press releases, and annual reports found in company archives collected in Switzerland, Germany, France, and US.	67 books

Table 2: Codebook

ARTICLE Identifier	CODE ID	TEXTUAL CODING Common words/phrases	Example of Coding of Text	VISUAL CODING Visual cues	Example of Coding of Visual Cue	
Mentions of Technology	mechanical	<ul style="list-style-type: none"> “mechanical” “mechanical movement” “self-winding” “hand-winding” “winding stem” “automatic” “balance spring” “mainspring” “escapement” “rotor” 		<p>“The watch is water resistant, has a sapphire crystal and an automatic Ulysse Nardin movement. The San Marco is a rare masterpiece, assembled entirely by hand and destined for both enthusiasts and collectors of fine mechanical watches.”</p> <p><i>Other example:</i> “Kelek automatic mechanical diving watch intended for professionals.”</p>	<p>Ads that expose the internal mechanism of the watch (i.e. balance wheel, gear train, mainspring, etc.)</p> <p>Ads that show side-by-side displays of the watch – one showing the face of the watch and the other exposing the internal mechanisms of the watch</p>	<p>This ad shows both the face of the watch and the internal mechanisms.</p>
	quartz	<ul style="list-style-type: none"> “quartz” “quartz movement” “electronic” “electronic timekeeping” “battery operated” “integrated circuit” “stepping motor” “digital” “digital display” 		<p>“Longines, leaders in electronic timekeeping”</p> <p><i>Other example:</i> “The spell of a new concept Hublot, the perfection of Swiss technology with an exclusive natural rubber strap. Quartz movement, waterproof 5 ATM.”</p>	<p>Ads that show a quartz digital time display, or internal mechanisms of a quartz watch, like the integrated circuit or the quartz crystal</p>	<p>This ad shows the quartz digital time display.</p>
Value Recombining	precision	<ul style="list-style-type: none"> “precise instrument” “made/manufactured to the highest level of precision” “love of precision detail” “accurate” “never loses a second” “never loses a beat” “never fails” “durability under duress” “keeps perfect time underwater” “on time” “chronometer” 		<p>“High precision attested by official rating-certificates...”</p> <p><i>Other example:</i> Ernst Benz: Precision instruments for timekeeping.”</p>	<p>Ads that show watchmakers or individuals testing the watch’s ability to keep time</p> <p>Ads that show close-ups of the movement of the watch’s timing function, sometimes under duress because of weather, atmospheric pressure, water, or heavy use</p>	<p>This ad explains the watch is accurate enough to serve as a timekeeper for Olympic athletes.</p>

Table 2: Codebook

ARTICLE Identifier	CODE ID	TEXTUAL CODING Common words/phrases	Example of Coding of Text	VISUAL CODING Visual cues	Example of Coding of Visual Cue
Value Recombining (cont.)	Luxury	<p>“exclusive”</p> <p>“only the best”</p> <p>“exceptional”</p> <p>“living well”</p> <p>“living the high life”</p> <p>“life of luxury”</p> <p>“rich”</p> <p>“finest watch”</p> <p>“precious”</p> <p>“lucrative”</p> <p>“high-class”</p> <p>“classy”</p> <p>“limited”</p> <p>“good taste”</p>	 <p>“The finest watch in the world will only be worn by exceptional people.”</p> <p><i>Other example:</i> “Eterna. Simply a statement of taste. Taste for the better things in life. Living each moment to the fullest. Rising to every challenge, making no concessions.”</p>	<p>Ads that show pictures of the watch being used or positioned alongside other luxury items or in elite social settings (e.g. jewels; chandeliers; tuxedos; fancy gowns; yachts; premium cars)</p>	 <p>This ad portrays an aspirational lifestyle (e.g. a couple in fancy attire being chauffeured in a luxury car).</p>
	craftsmanship	<p>“craftsmen”</p> <p>“skills of the watchmaker...”</p> <p>“by hand”</p> <p>“hand-crafted”</p> <p>“hand-assembled”</p> <p>“hand-made”</p> <p>“hand-finished”</p> <p>“artistry”</p> <p>“art of watchmaking”</p> <p>“touch”</p> <p>“made by individuals...”</p> <p>“from the manufacturer’s workshop”</p> <p>“engraved by hand”</p>	 <p>“For the past 100 years, KELEK has continued its course to produce the finest hand-made mechanical timepieces in the world. We not only uphold the tradition of Swiss craftsmanship, we help set the standard.”</p> <p><i>Other example:</i> “The master craftsmen at Corum have chosen the transparency of sapphire. The delicate lace-like structures of its movement are fashioned and engraved by hand.”</p>	<p>Ads that show pictures of the watchmaking manufacturing or production process (e.g. close-ups of hands using watchmaking tools; a group of watchmakers gathered around a watch-in-the-making)</p>	 <p>This ad shows a group of Swiss watchmakers in the process of crafting watches.</p>
Identity Marking	Identity markers	<p>“reflection of self”</p> <p>“personal preference”</p> <p>“personal style”</p> <p>“personified”</p> <p>“identify”</p> <p>“identity”</p> <p>“expression of self”</p> <p>“self-expressive”</p> <p>“individuality”</p> <p>“who you are”</p>	 <p>“Identify yourself”</p> <p><i>Other example:</i> “Presenting the ultimate hood ornament for your wrist, the Jean Marcel Targa, edition 911. It speaks volumes as to who you are.”</p>	<p>Ads that communicate who a person is while wearing or using the watch (e.g. a musician; artist; athlete)</p> <p>Ads that show symbols of one’s personality (e.g. a conductor waving a baton while wearing a watch; a tennis player swing his/her racquet while wearing a watch; an artist painting while finding inspiration from a watch)</p>	 <p>This ad shows a conductor demonstrating how he boldly waves his hands at musicians with personal passion while wearing the watch.</p>

Table 2: Codebook






ARTICLE Identifier	CODE ID	TEXTUAL CODING Common words/phrases	Example of Coding of Text	VISUAL CODING Visual cues	Example of Coding of Visual Cue		
Temporal Distancing	bridge past and future	<p>“continuing the tradition/legacy/legend”</p> <p>“debuting a new generation of [watch name]”</p> <p>“generation to generation”</p> <p>“reinventing the past”</p> <p>“history for tomorrow”</p> <p>“timeless”</p> <p>“a modern classic”</p> <p>“renaissance”</p> <p>“handing down”</p> <p>“rebirth”</p>		<p>“Eterna: Rebirth of a Classic”</p> <p><i>Other example:</i> “The Retro watch...at the crossroads of yesterday and today.”</p>	<p>Ads that show multiple pictures of the same model of watch displayed over three decades</p> <p>Ads that show family members of the old and the young gathered around a watch, watchmaking or watch collecting</p> <p>Ads that show the passing down of a watch over multiple generations</p>		This ad shows a father and son gathered around the tradition of watch-making.
	company founding	<p>“since...”</p> <p>“beginning in...”</p> <p>“founded”</p> <p>“established in...”</p> <p><i>specific mentions of the year or time period the company was founded</i></p>	<p>“since...”</p> <p>“beginning in...”</p> <p>“founded”</p> <p>“established in...”</p>		<p>“The oldest watch manufacturer in the world. Geneva, since 1755.”</p> <p><i>Other example:</i> Chopard, since 1860: The automatic movement presented by Chopard is called L.U.C – short for Louis-Ulysse Chopard – in tribute to the company founder.</p>	N/A (only coded for textual mentions of company founding year)	
Conceptual Bridging	metaphors and analogies	<p>“just like...”</p> <p>“example of...”</p> <p>“seen as...”</p> <p>“similar to...”</p> <p>“in the mode of...”</p> <p>“likened after...”</p> <p>“compared to...”</p> <p>“fashioned after...”</p> <p>“reflective of...”</p> <p>“modeled after...”</p> <p>“inspired by...”</p> <p><i>linguistic comparisons to describe the watch, including the use of metaphors and analogies</i></p>		<p>“Just like Achilles. But without the heel.”</p> <p><i>Metaphor:</i> “The “Timemaster” is a piece as beautiful and seductive as a genuine antique car.”</p> <p><i>Analogy:</i> Like the Concorde, the world’s first supersonic airliner, but surely not the last, Breitling’s Chronomat draws time and space ever closer – with both aesthetic excellence and outstanding technical performance.</p>	<p>Ads that show the watch representing another object (e.g. the watch as a globe because of its ability to show time from multiple cities around the world; the watch as a lightbulb because of its long-lasting power)</p> <p>Ads that show the watch compared to other objects (e.g. the watch being compared to horses to illustrate that the brand is “another breed” above others brands; its classic style and speed; the watch being compared to a snake hunter for being durable and fearless)</p>		This ad shows the Chronoswiss watch being compared to a ship's navigation instruments.

Table 2: Codebook

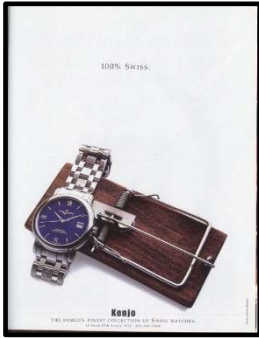

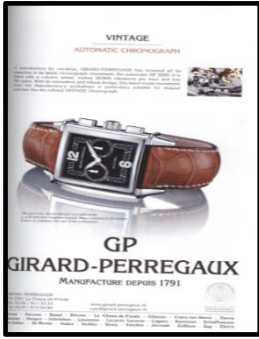

ARTICLE Identifier	CODE ID	TEXTUAL CODING Common words/phrases	Example of Coding of Text	VISUAL CODING Visual cues	Example of Coding of Visual Cue	
Competitive Set Reclaiming	“Swissness” <i>makes explicit reference to the Swiss brand, either in the text or by prominently displaying “Swiss made” in the ad photo or graphic. References the Swiss watchmaking community</i>	<p>“Swiss made” “made in Switzerland” “embodies Switzerland” “from the heart of Switzerland” “the spirit of Switzerland” “Swiss certified”</p>		<p>“100% Swiss. Kenjo”</p> <p><i>Other example: “Elegant masterpieces of contemporary art. Designed and hand-crafted to perfection by traditional Swiss goldsmiths and expert Swiss watchmakers.”</i></p>	<p>Ads that show any display of the Swiss flag, Swiss coat of arms, Swiss symbols like the Alps, Swiss cross, combinations of red and white that convey the Swiss national colors</p>	 <p>This ad shows the Swiss Alps in the background and combinations of red and white in the form of the Swiss cross and the national colors.</p>
Reinvestment in R&D	complications <i>makes explicit references to complications or innovations added to the watch</i>	<p>“innovation” “new technology” “invest/re-invest” “complications” “tourbillon” “minute-repeater” “chronograph” “moonphase” “calendar” “power-reserve” “silicon” “jump hour” “perpetual/annual calendar” “flyback chronograph” “rattrapante split-second chronograph”</p>		<p>“A manufacture by vocation, Girard-Perregaux has invested all its expertise in its latest chronograph movement, the automatic GP 3080. It is fit with a column wheel, makes 28’800 vibrations per hour, and has 38 rubies. With its innovative and robust design...”</p> <p><i>Other example: “Fitted with a double complication that is unique and exclusive to the brand, the dual time zone chronograph.”</i></p>	<p>Ads that show a close-up of a watch complication that is novel or new, such as a silicon hairspring, a tourbillon, a moon phase dial, or non-scratch gold</p>	 <p>This ad shows a tourbillon carriage separately and inside of the watch.</p>

Table 3: Representative Supporting Data of Technology Reemergence Process and Mechanisms

REPRESENTATIVE DATA	
Value Recombining	
<i>Precision</i>	<p>“Precision is a fact [of Swiss mechanical watches], but we certify that every watch is precise. It's not one of ten, or two of ten, it is 100 percent. (interview)</p> <p>“At a time when instruments routinely monitor flight data at Mach 1 miles above the earth, why continue improving mechanical chronographs? Just ask Breitling, the world's leading maker of time instruments for aviation professionals. Its intricately beautiful movements and lovingly hand-polished watchcases put technological progress in a broader, more rewarding perspective.” (advertisement, 1996)</p>
<i>Luxury</i>	<p>“I perceive luxury as that which brings quality to people's lives. And luxury is – luxury. We all have different things. We drive different cars. Most of what we have, we don't need to have. We could eat the simplest food, we can all drive the same car, we can live in the same building, but we all choose different things because emotionally they bring us a certain amount of pleasure. And watchmaking is the same thing.” (interview)</p> <p>“Longines: Elegance is an attitude.” (advertisement, 2000)</p>
<i>Craftsmanship</i>	<p>“Clean, classic lines enhanced by the craftsman's matchless touch create fascinating masterpieces, made to endure.” (advertisement, 1992)</p> <p>“For the past 100 years, KELEK has continued on its course to produce the finest hand-made mechanical timepieces in the world. We not only uphold the tradition of Swiss craftsmanship, we help set the standard.” (advertisement, 1996)</p>
Identity marking	
<i>Identity markers</i>	<p>“When you buy a Swiss watch it's no longer for just having the time on your wrist. It's first of all to have an accessory, a nice accessory which corresponds to your personality and the things you like.” (interview)</p> <p>“It's not only a watch. It's the branded emotion of the product and one's personality. That's why we've spent [expletive] millions on this message.” (interview)</p> <p>“What is a piece of jewelry a man could wear and would be respected or renowned as a piece where he could show and make a liaison with what he was wearing? He couldn't put a car around his wrist. He has to leave it in front of the restaurant. But the watch gives away a little bit of [information] about his intellect and his stature. (interview)</p> <p>“It defines who you are.” (advertisement, 2008)</p>
Temporal Distancing	
<i>Bridge past & future</i>	<p>“We've benefited from the emphasis on vintage timepieces, especially an inseparable correlation between the vintage and the new [models] on so many different levels: the nature of the new watches relative to their history, the values of vintage timepieces based on what's going on with the industry with the new models that are being released, perceived value of different branded watches.” (interview)</p> <p>Switzerland National Museum: “‘The future needs a past.’ – Odo Marquard”</p>
<i>Company founding</i>	<p>“Ever since its foundation in 1755, Vacheron Constantin has designed its watches to the expectations of the world's most demanding men and women.” (advertisement, 1998)</p> <p>“The company tries to create legitimacy. We know to say, okay, we're Swiss but not since last year, but from decade or centuries. It's a matter of the Swiss watch industry being based on tradition. We have knowledge going back to Swiss factory. These are our rules. It's so important to explain that to the customers.” (interview)</p> <p>“We are family-owned business for four generations. The philosophy of the founders of the company was that wanted it to make the best watches in the world. And we just try to make our best to continue what they wanted to do.” (interview)</p>

Table 3: Representative Supporting Data of Technology Reemergence Process and Mechanisms

REPRESENTATIVE DATA	
Conceptual Bridging	
<i>Metaphors and Analogies</i>	<p>"Nothing sparks my passion more than putting the top down and turning the key of an antique roadster. It is my love of watchmaking and classic cars that inspired my timepiece. The "Timemaster" is a precious wristwatch fashioned after the classic cars of the past." (advertisement, 2004)</p> <p>"People only look only at the outside of the watch. But they don't open the watch and aren't able to touch the movement. It's tiny and you need special knowledge to be able to see what makes up the value of a movement because you won't see it with your bare eyes. It's like when you buy a car today, people don't open and look into the motor because they do not understand anything about the motor. The design of the car, the color, you say "oh I like that!" (interview)</p> <p>"Built like a rock, the LM-6 Ocean7 extraordinary watch ensures that you'll never lose your sense of time – or being." (advertisement, 2008)</p>
Competitive Set Reclaiming	
<i>Swissness</i>	<p>"This country [Switzerland] is seen as the originator. It is important that you can prove this origin." (interview)</p> <p>"At a time when globalization and relocation were common, commercial logic dictated that the tradition be anchored in the [Swiss] Neuchatel territory." (archival document) (Pasquier, 2008: 314)</p>
<i>Reclamation of Competitive Boundaries</i>	<p>The manufacturers in Japan are a bunch of engineers and these engineers have no clue about marketing. They make great products. When the Swiss started to feel that the mechanical had something, they put all the marketing forces to it. Now, the Japanese, I know, have started to build mechanical movements, quite good ones. But they are still running after. They're not setting trends. (interview)</p>
Competitive Differentiation	
<i>Competitive Differentiation</i>	<p>"You had two separate entries into the market; first you have the originals. If you take my company, we've been doing business since the 1800s. You can add the big brother's, like Patek. We all represent the originals. Being an 'original' means you have been in this business since the beginning, the origins." (interview)</p> <p>The contemporary watchmaker is popular. It started as a phase when everybody copied it, but we started with something bigger. If you look for the technology of the movement, there are only two companies that will give something with the technology was new: It's [mechanical watch company name X] and [mechanical watch company name Y]. (interview)</p> <p>Every year, we organize a creativity competition within the company with a very high reward for the project. Since a lot of our people have crazy ideas, other watchmakers come and see us present the projects. So there's a big inflow of good ideas. And then he [the founder] just organizes production capacity and the technical know-how to be able to transform the idea into reality. And everything is geared up for small series and prototyping. It means we can go faster and better than anybody else in the [mechanical watch] industry for this sense. (interview)</p>
Enthusiast Consumer Mobilizing	
<i>Activating existing enthusiasts</i>	<p>"The philosophy that the brand has is the power that we show. And we need that velocity in order to deliver to our customer their desire to be a watch collector. So today we don't have customers. They're all watch collectors. That's how we speak to them. They're very knowledgeable. We build the product around that knowledge. We do not take the consumers knowledge for granted." (interview)</p> <p>"The consumer plays a much bigger role today. They help the brands to think." (interview)</p>

Table 3: Representative Supporting Data of Technology Reemergence Process and Mechanisms

REPRESENTATIVE DATA	
<i>Attracting new enthusiasts</i>	<p>"[The CEO] took me on a tour of the factories so he could share his passion for the art of watchmaking with me." (interview)</p> <p>"Every day, people really feel like a part of a larger community of collectors. And today, you walk into any business and the guys, they're kind of checking out what other people are wearing on their wrist. And it is a conversation starter. Watches are so much part of our culture around the world now." (interview)</p>
<i>Consumer expansion</i>	<p>"The other good point is that the market itself is growing, developing, and essentially it feels great having to think about Asia. The number of people entering the so called "middle class" in China, we're talking about millions of people classified by the increase of their purchasing power, so it's phenomenal. The potential and demand for Swiss quality product is just enormous. You can talk about the same in India, Russia, Indonesia, and so on, and so on." (interview)</p> <p>"As always we try to satisfy the consumer worldwide and I know that our Chinese friends love mechanical movements. They love innovative mechanical movements. They have nobody that can offer them now." (interview)</p> <p>"The younger generation, that is the right fit for us because that's how we've defined ourselves. We are the fusion, the fusion of tradition, of high technology, of design. The beauty of our brand is to have the ability to actually seduce people that either didn't have the potential to buy watches. Guys in their 30s or their 40s, they're not waiting until their 50s to buy a high-end watch, whereas before, people would be waiting a little bit longer in life before they would make their first purchase. This is why also some of our clients have several of our watches." (interview)</p> <p>"Today, we are restructuring [company name], and I'm trying to connect the brand to younger generation. And what do I do to try to understand? I go with kids who are 15 years old, in Tokyo, I go shopping. They show me what is big in fashion. I go with the young kids and I listen to the music of the young kids. The more I learn [from them], the more I can direct [company name] to this generation." (interview)</p>
Consumer Differentiation	
<i>Consumer differentiation</i>	<p>"We are able to produce new or to introduce new products depending on the demand of the market, we are capable of managing that. For America and Europe, the demand will be there. Now we just have to have the right product to satisfy that demand. In China, if you take an example, don't even try to sell a 10 hand complication watch to a middle-class man in China, no, he just needs a three-hand watch. That's what he wants." (interview)</p> <p>"Companies are putting a lot of means, not only financially, but new resources in educating the customers because there are certain people in, for example, China who come to Switzerland to spend \$1,000 for just one expensive watch without knowing what it means. Companies are doing a lot of efforts to explain, 'Do you know why they made such a great brand for the watch? Do you know what is behind the history we were just talking about?'" (interview)</p>
Reinvestment in Innovation for the Legacy Technology	
<i>Reinvestment in mechanical watch innovations and R&D</i>	<p>"You're already seeing new technology with some of these other companies who are making mechanical watches in a different manner. It's not the old fashion way. It's different." (interview)</p> <p>"Since 2000, the industry has discovered a new material. It's silicon. Silicon doesn't need oil and you can have easy higher frequencies with silicon. Yes, you will have companies like Patek Philippe, and they are doing mechanical. But they are using new technologies." (interview)</p> <p>"Our watchmakers never stop. They never stop increasing the quality and increasing the complexity, not for the sake of complexity, but asking 'What happens if I do that and that? Is there a function which allows me to do that?' They do something on one day, and the next day they say 'Well, that's not good enough, so let's continue.'" (archival document, 2005)</p> <p>"Franck Muller: Master of Complications." (advertisement, 2000)</p>

Table 4: Results of analysis of variance of advertisement features

CONSTRUCT		TIME PERIOD				All Time Periods n = 700	TUKEY T-TESTS		
		t0: Technological Discontinuity (1970 - 1980) n = 133	t1: Technological Retrenchment (1982 - 1990) n = 103	t2: Technological Reemergence: (tech. redefinition) (1992 - 2000) n = 246	t3: Technological Reemergence: (market redefinition) (2002 - 2008) n = 218		T0 vs. T1	T1 vs. T2	T1 vs. T3
Mentions of Technology:		<i>(% of advertisements depicting feature)</i>							
Mechanical	Mean	0.47	0.17	.61	0.70	0.55	-5.04***	8.04***	9.62***
	SD	0.50	0.37	.48	0.46	0.50			
Quartz	Mean	0.32	0.53	0.07	0.01	0.17	4.91***	-12.01***	-13.31***
	SD	0.47	0.50	0.26	0.11	0.38			
Mechanical Ads Only	Adjusted Sample	n = 62	n = 60	n = 150	n = 156	n = 428			
Value Recombining:									
Precision	Mean	0.79	0.85	0.78	0.76	0.78	0.80	-1.11	-1.49
	SD	0.41	0.36	0.42	0.43	0.41			
Luxury	Mean	0.13	0.20	0.70	0.72	0.56	0.91	7.57***	7.99***
	SD	0.34	0.40	0.46	0.45	0.50			
Craftsmanship	Mean	0.06	0.07	0.38	0.21	0.23	0.03	5.11***	2.27†
	SD	0.25	0.25	0.49	0.41	0.42			
Identity Marking:									
Identity markers	Mean	0.10	0.40	0.53	0.62	0.48	3.56**	1.76	3.10**
	SD	0.30	0.49	0.50	0.49	0.50			
Temporal Distancing:									
Bridge Past and Future	Mean	0.06	0.13	0.43	0.32	0.30	0.87	4.48***	2.81*
	SD	0.25	0.34	0.50	0.47	0.46			
Company Founding	Mean	0.06	0.12	0.41	0.28	0.27	0.67	4.45***	2.45†
	SD	0.25	0.32	0.49	0.45	0.44			
Conceptual Bridging:									
Metaphors and Analogies	Mean	0.21	0.33	0.53	0.51	0.45	1.41	2.70*	2.35†
	SD	0.41	0.48	0.50	0.50	0.50			
Competitive Set Reclaiming:									
Swissness	Mean	0.31	0.08	0.47	0.53	0.41	-2.62*	5.33***	6.18***
	SD	0.46	0.28	0.50	0.50	0.49			
Reinvestment in Innovation and R&D:									
Complications	Mean	0.21	0.12	0.17	0.28	0.21	-1.28	0.81	2.60*
	SD	0.41	0.32	0.37	0.45	0.40			

†p<.1; *p < .05; **p < .01; ***p < .001. Tukey HSD post hoc t-tests reported; q-values and adjusted p-values available from the author upon request.

Table 4: Results of analysis of variance of advertisement features

CONSTRUCT		TIME PERIOD				TUKEY T-TESTS			
		t0: Technological Discontinuity (1970 - 1980)	t1: Technological Retrenchment (1982 - 1990)	t2: Technological Reemergence: (tech. redefinition) (1992 - 2000)	t3: Technological Reemergence: (market redefinition) (2002 - 2008)	All Time Periods	T0 vs. T1	T1 vs. T2	T1 vs. T3
Mechanical Ads Only		n = 62	n = 60	n = 150	n = 156	n = 428			
Value Recombining:									
Luxury and Precision	Mean SD	0.10 0.30	0.12 0.32	0.52 0.50	0.52 0.50	0.40 0.49	0.24	5.80***	5.82***
Luxury and Craft	Mean SD	0.03 0.18	0.03 0.18	0.29 0.46	0.16 0.37	0.17 0.38	0.02	4.69***	2.30†
Craft and Precision	Mean SD	0.05 0.22	0.03 0.18	0.32 0.47	0.20 0.40	0.20 0.40	-0.22	4.90***	2.84*
Luxury and Craft and Precision	Mean SD	0.03 0.18	0.02 0.13	0.24 0.43	0.15 0.36	0.15 0.35	-0.25	4.23***	2.61*
Identity Marking and Value Recombining:									
Identity and Luxury	Mean SD	0.02 0.13	0.08 0.28	0.43 0.50	0.53 0.50	0.36 0.48	0.85	5.14***	6.75***
Identity and Precision	Mean SD	0.03 0.18	0.32 0.47	0.39 0.49	0.42 0.49	0.34 0.47	3.44**	1.00	1.44
Identity and Craft	Mean SD	0.00 0.00	0.00 0.00	0.19 0.40	0.13 0.34	0.11 0.32	0.00	4.08***	2.72*
Temporal Distancing and Value Recombining:									
Bridge Past/Future and Luxury	Mean SD	0.03 0.18	0.05 0.22	0.33 0.47	0.24 0.43	0.21 0.41	0.25	4.59***	3.12**
Bridge Past/Future and Precision	Mean SD	0.06 0.25	0.10 0.30	0.36 0.48	0.28 0.45	0.25 0.43	0.46	4.04***	2.84*
Bridge Past/Future and Craft	Mean SD	0.02 0.13	0.02 0.13	0.21 0.41	0.10 0.30	0.11 0.32	0.01	4.16***	1.69

†p < .1; *p < .05; **p < .01; ***p < .001. Tukey HSD post hoc t-tests reported for all significant co-occurrences; q-values and adjusted p-values available from the author upon request.

Table 4: Results of analysis of variance of advertisement features

CONSTRUCT		TIME PERIOD				TUKEY T-TESTS			
		t0: Technological Discontinuity (1970 - 1980)	t1: Technological Retrenchment (1982 - 1990)	t2: Technological Reemergence: (tech. redefinition) (1992 - 2000)	t3: Technological Reemergence: (market redefinition) (2002 - 2008)	All Time Periods	T0 vs. T1	T1 vs. T2	T1 vs. T3
Mechanical Ads Only		n = 62	n = 60	n = 150	n = 156	n = 428			
Value Recombining:									
Co. Founding and Luxury	Mean	0.02	0.03	0.27	0.20	0.18	0.26	4.26***	2.96*
	SD	0.13	0.18	0.45	0.40	0.38			
Co. Founding and Precision	Mean	0.06	0.07	0.32	0.22	0.21	0.03	4.16***	2.61*
	SD	0.25	0.25	0.47	0.42	0.41			
Co. Founding and Craft	Mean	0.00	0.02	0.23	0.07	0.11	0.31	4.62***	1.19
	SD	0.00	0.13	0.42	0.26	0.31			
Temporal Distancing and Identity Marking:									
Bridge Past/Future and Identity	Mean	0.02	0.07	0.28	0.24	0.20	0.72	3.62**	2.91*
	SD	0.13	0.25	0.45	0.43	0.40			
Co. Founding and Identity	Mean	0.00	0.05	0.19	0.17	0.13	0.83	2.68*	2.30†
	SD	0.00	0.22	0.39	0.37	0.34			
Conceptual Bridging:									
Metaphors and Luxury	Mean	0.05	0.07	0.43	0.39	0.31	0.23	5.41***	4.90***
	SD	0.22	0.25	0.50	0.49	0.46			
Metaphors and Craft	Mean	0.00	0.00	0.19	0.10	0.10	0.00	4.08***	2.72*
	SD	0.00	0.00	0.39	0.30	0.30			
Metaphors and Identity marker	Mean	0.05	0.18	0.35	0.38	0.30	1.68	2.51*	2.99**
	SD	0.22	0.39	0.48	0.49	0.46			
Metaphors and Bridge Past/Future	Mean	0.02	0.08	0.30	0.25	0.21	0.94	3.59**	2.77*
	SD	0.13	0.28	0.46	0.43	0.41			
Metaphors and Co. Founding	Mean	0.00	0.03	0.16	0.13	0.11	0.60	2.69*	2.16†
	SD	0.00	0.18	0.37	0.34	0.31			

†p<.1; *p < .05; **p < .01; ***p < .001. Tukey HSD post hoc t-tests reported for significant co-occurrences; q-values and adjusted p-values available from the author upon request.

APPENDIX:

Watch Advertisement Coding and Analysis Process

Assigning codes to each advertisement involved three phases of analysis:

In the first phase, coding focused on identifying the descriptive aspects of the watch, including references to the type of the watch technology being advertised (e.g., mechanical, quartz). Coding also noted the historical period or geographic location, as well as references to when or where the watch technology was invented or produced, and/or when or where the company of the watch technology was founded. In addition, coding identified activities that the watch was associated with, including ads that referenced extreme and/or professional sports (e.g. Formula 1 racing), recreational hobbies (e.g. sailing), creative or artistic activities (e.g. painting), and occupational activities (e.g. business cocktail parties).

In the second phase, coding focused on the person wearing the watch. This process identified both descriptive and abstract cues associated with the owner or beholder of the watch. Coders analyzed what the person was wearing, what the person was doing, and if the person was a distinguished member of

their field (e.g. a professional athlete, model, artist, celebrity). Coders also analyzed the identity of the person, i.e., who the person aspired to be, or if the watch technology was meant to a reflection of its beholder. For example, a conductor wearing a watch portrayed the individual's bold style while waving a baton in front of his orchestra.

In the third phase, coding focused on extrapolating more abstract concepts associated with the values and meanings associated with the watch. Coding focused on why the watch was useful or important to the owner, e.g., text and/or visual cues alluding to the watch as a status symbol, or having a technical aspect that increased its utility. Coding also focused on identifying metaphors and analogies that the advertisements used to associate meaning to the watch. For example, ads might compare the watch to another sophisticated and durable technology, like a car, plane, or ship. Finally, coding identified temporal or historical aspects associated with the watch, i.e., whether the ad was situated in some period of past, the future, or both.

The above process evolved over multiple rounds of pilot coding and culminated in the creation of a codebook (Table 2) that included both textual and visual cues for each code.