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# Industry sustainability under technological evolution: A case study of the overshooting hypothesis in sports

Stuart Thomas\*, Jason Potts

*RMIT University, L10 445 Swanston Street, Melbourne 3000, Australia*

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## Abstract

This research investigates cycles in equipment-based sports in which a sport can experience a rapid rise in popularity when it is new but under technology-driven competition, equipment “overshoots” the capabilities and budget of users, collapsing the equipment market and the sport, with significant adverse consequences for the industry and allied sectors of the economy. We find clear support for the overshooting hypothesis in this case, with adverse consequences not only for the sport’s manufacturing, distribution and retail sectors but we also find indications of spillover effects in allied sectors. We suggest that industry self-regulation may be a way of avoiding this phenomenon and its adverse consequences.

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## 1. Introduction

High rates of technological innovation in an industry – where market-leading firms compete to create ‘lighter, stronger, faster, better, cheaper’ products to benefit consumers – is thought to be one of the graces of free-market competition. This competition can be tough, with losing firms risking bankruptcy, and all the private and social costs that entails. The process can be wasteful for firms and for consumers who make the ‘wrong’ choices. However, in the long-run, so the argument goes, the best and most innovative firms will capture the market and consumers will be the winners (because of faster, better, cheaper products). This technological ‘creative destruction’ that drives an industry forward is widely understood to be a net social good.

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\* Corresponding author. Tel.: +61-3-9925-5773; fax: +61-3-9925-5773.

E-mail address: [stuart.thomas@rmit.edu.au](mailto:stuart.thomas@rmit.edu.au)

We study a class of situations where this doesn't happen: where unbridled technological competition actually damages an industry, harming not only firms but also consumers. We call this phenomenon 'overshooting', the basic model originating with Minsky [16] on financial bubbles and business cycles and later, Christensen [6] on disruptive product innovation. Earl and Potts [9,10] have subsequently developed this model to examine technological overshooting in competitive 'Schumpeterian' innovation, finding it to be widespread in the creative industries (e.g. in music genres) and in many highly engineered consumer products (such as cars).

Equipment-based sports are further exemplars of this tendency [3,13,21]. We employ a mixed-mode approach to investigating this phenomenon, using the sport of windsurfing as a case study. We interrogate publicly-available sources of information and conduct in-depth interviews with industry representatives to 1) map the trajectory of the sport's development and eventual decline; 2) identify any significant technical innovations and structural changes in the industry that influenced the trajectory; 3) identify triggers to the eventual decline; and 4) consider whether there are ways to avoid or remedy this kind of overshooting and eventual failure.

## 2. Technological innovation in sports

Central to the technological innovation literature is the idea that innovation takes place in firms because this is where the competencies and capabilities required for innovation exist [17,20]. In the product life cycle view, technological innovations, often as spillovers, give rise to new industries: firms enter the emerging industry under conditions of technological and market uncertainty and they experiment with various product designs and features to attract and satisfy customers. The combined effort of these firms leads to subsequent market development [1,2,11]. The *innovating firm* in this view, as in the organisational fields and populations view, is the central actor in developing new technologies.

Against this, Shah [21], based on an examination of boardsports (skateboarding, windsurfing, among others), argues that models that rely solely on firms and research institutions to explain innovation fail to provide insight into the activities of 'user-innovators' and the commercial consequences of their activities [5,13,14]. Baldwin et al [3] examine the formation of firms by user innovators and the adoption of their ideas by manufacturers. Sometime after user innovation begins, the first user-purchasers appear – users who want to buy the goods that embody the lead user innovations rather than building them for themselves. Manufacturers emerge in response to this demand. The first manufacturers to enter the market are likely to be the user-innovators who exploit the flexible production technologies they use to build their own prototypes. The relatively high variable costs of these user-manufacturers tends to limit the size of the market initially but as information about product designs is disseminated, and as market volumes grow, existing user-manufacturers and established manufacturers from other fields (who may bring their own new ideas or refinements to generate manufacturing efficiencies) can justify investing in higher-volume production processes.

These processes bring lower variable costs and therefore average prices, thus expanding the market [4]. We observe that at some stage, competition among manufacturers leads to predominantly manufacturer-driven equipment innovation in sports is motivated by their desire to stay ahead of the pack by offering the faster, lighter, more specialised, and often more expensive equipment, usually catering to the demands of elite, professional athletes, which is promoted and endorsed by those same athletes. We also observe that in some sports this equipment design "arms race" can systematically exceed the technical capabilities and often the budgets of the majority of the sport's participants, most of whom are not elite athletes. Recreational participants and even the most aspirational enthusiasts find that these technological and financial demands placed on them begin to exceed their capabilities and budgets (both in money and time) inducing them to leave the sport. This leads to eventual collapse of the market for the equipment with spillover effects into other sectors of the economy that provide complementary goods and services such as clothing, hospitality and event tourism.

## 3. Data and method

The intent of the study was to understand the evolution of windsurfing as a case study sport, and since there is no academic literature or empirical data as yet readily available we chose qualitative data collection procedures. Qualitative approaches are preferred in areas that require theory-building because they 'make room for the discovery

of the unanticipated' [22]. Our approach is based upon primary data gathered through interviews (by ST) with Australian pioneers of the case-study sport and through analysis of international and domestic industry publications and grey literature. Working within the meaning-based tradition of research we adopted an interpretative approach to interviews [7].

Informants were asked a mix of 'grand tour questions' and 'floating prompts'. Informants were asked to provide some background on their history in the sport and their current role in the industry. Since they would approach this question with personal stories or experiences, further prompts were used to understand the significance of their role in the sport/industry or user experiences. Following a general discussion interview questions then focused on: (1) interviewee background, experience, and role in the industry (manufacturer/ importer/ distributor/ retailer/ athlete); (2) history and evolution of the sports as they saw it, including mechanisms and time-frames; (3) consequences of rise and decline for them directly and for associated industries and business, (4) broader regional economic implications; and (5) their views how to avoid repeating the same 'mistakes' the sport experienced due to overshooting and collapse.

The primary data were derived from semi-structured, in-depth interviews with informants selected on the basis of their long standing and experience in various roles within the sector, including as former elite participants, current participants, instructors, importers, retailers, distributors, manufacturers. Long interviews allowed access to informants' first-hand personal experiences and meanings associated with their engagement in the sport and associated industry. Although the interviews were broad and only semi-structured, informants were asked to elaborate on various statements they made. Interviews lasted on average an hour and resulted in 615 minutes of total interview time. Interviews were recorded and transcribed *verbatim*, resulting in 229 pages of text. They were continued until saturation on the key themes of the trajectory of windsurfing as an industry and as a sport [8]. Analysis began with the transcripts which were read in detail and meanings interpreted by the organisation, comparison and interpretation of various themes and meanings drawn from the transcripts [15]. Throughout this procedure preliminary findings were compared back and forward between the available trade, market and grey literature on the sport and includes both descriptive and interpretive explanations of the raw data [12].

#### **4. Case study – the rise and fall of windsurfing**

##### *4.1 Industry inception and the early years: 1970-1980*

The creation of the windsurfer as a user-innovation has been documented in Shah [21] and elsewhere [19,24, among others]. Briefly, several people have laid claim to inventing it but Californians Hoyle Schweitzer and Jim Drake claimed priority in patent filed in 1968 on the craft. U.S. Patent #3,487,800 for what they called a 'sailboard'. Schweitzer embarked on an ambitious licensing programme to encourage manufacturers to take up production. Windsurfing struggled initially to gain credibility in countries that had strong surfing and watersports traditions, but in places like Germany, France and Holland that had no strong surfing culture it very quickly became a 'cool' sport [19]. Boardsailing (as it was then known) became the world's fastest growing sport. In Europe by 1981 nearly one million boards had been sold and the sport was second only to skiing in the number of participants. According to Boardsailing U.S.A. figures of the day, 50,000 sailboards were sold in the United States in 1981 with projections for 50 to 75 percent annual sales growth for the following five years.

##### *4.2 The turning point: 1980-1985*

After the initial upsurge in worldwide board sales, two development paths emerged for the sport. BiC Sport among other European manufacturers continued to follow the populist route, with an emphasis on simple, low-cost equipment and primarily flat-water, sailing-based participation. In parallel, new developments in Hawaii would kick-start the 'performance windsurfing' movement [19,24]. Windsurfing in Hawaii was transformed into a technical, performance-based, athletic sport. Hawaii's consistent winds and big waves were encouraging a small group of designers and sailors to try new things. Elite users of the day, including Robbie Naish, Mike Walsh and Matt Schweitzer, among others, stretched the capabilities of the bulky, long boards of the day to perform fantastic

acrobatic stunts [19]. Boards became shorter and lighter to make them faster and more maneuverable but with this, the boards and sailing rigs required a higher level of skill to use. Alongside this performance-oriented progression of equipment came the advent of the “team rider” – an elite athlete sponsored by a manufacturer in return for using and promoting their equipment. Consumer demand emerged as aspirational participants saw or heard about the Hawaiians’ innovative equipment. With this new emphasis on high-performance and elite athletes, manufacturing technology shifted back to high variable cost methods that relied less on complex and expensive tooling (with long payback) and allowed rapid prototyping. The product was, therefore able to be adapted, prototyped and brought to production much more quickly to satisfy the competitive drive of the manufacturers’ elite ‘team’ riders and the appetites of aspirational consumers. At the same time, marketing and promotion of the sport focused almost solely on these elite and aspirational users and ignored entry-level, social and recreational participants (which were, simply, no longer ‘cool’).

#### *4.3 Decline and fall: 1985-2000*

Along with the change in emphasis towards performance, the ‘downstream’ industry began to change. In the early days of the sport the equipment was rudimentary and despite a high degree of enthusiasm there was still learning curve for most newcomers. Windsurfing schools were established wherever there was a suitable body of water and as their clients wanted equipment of their own, many of the windsurfing schools evolved into board resellers to capitalise on the business opportunity this presented. As the equipment became more sophisticated and expensive, there was more money to be made (with less effort) by selling equipment than teaching people how to use it. The retailers began to neglect their school operations and many schools closed down. The (unexpected) consequence of this was to close off the pipeline of new entrants into the sport. Along with the decline in take-up by new entrants, as the sport and the equipment became more technically demanding, early acolytes and even aspirational enthusiasts began to lose interest and leave the sport.

From 1985, as the performance market boomed, the recreational side of windsurfing crashed and several of the biggest mass producers went bankrupt in that year [19]. The decline in entry-level participation also had its effect on the distribution and retail sectors. In 1985, as the performance market boomed, the recreational side of windsurfing crashed and several of the biggest mass producers went bankrupt in that year [19]. The decline in entry-level participation also had its effect on the distribution and retail sectors. By way of example, on east coast of Australia the number of retail outlets for sailboards in the state of Victoria declined from approximately 120 in the 1980s to 12 by 2000. In 2015 there are three remaining. This same pattern repeated worldwide and as of writing, windsurfing is in long run decline as measured by almost any index - the overshooting is more or less complete.

## **5. Conclusions**

In consequence of entrepreneurial initiative and a suite of technological innovations the sport of windsurfing began, in the early 1970s, as a casual and fun leisure pursuit that was reasonably accessible to consumers, both financially and in terms of skills. Equipment in the early period was relatively inexpensive and unsophisticated, with many new brands and manufacturers entering the market and bringing cross-over manufacturing skills. The pastime eventually developed into a highly competitive sport with a range of specialised disciplines necessitating more specialised, sophisticated and expensive equipment. Driven partly by the demands of elite competitors and partly by relentless competition for market share, manufacturers refined their equipment and materials to the point where using it moved beyond the skills and budget of the average recreational user. Rapid developments in materials and manufacturing processes also left many of the early manufacturers behind. The sport and its associated industries then went into rapid decline, with severe economic consequences for those directly connected with the. A view emerged that further decline could be avoided by regulating or standardising equipment, at least for competition, but attempts to do this came too-little-too-late to arrest the decline.

This illustrates a curious but surprisingly widespread pathology of Schumpeterian innovation-driven industrial dynamics that Earl and Potts have dubbed ‘overshooting’ [9]. Evolutionary economists have long appreciated Schumpeter’s conception of disruptive innovation, or ‘creative destruction’, with the costs of innovation being born by those technologies and owners of capital and skills that are displaced by technological innovation. Overshooting

is a different phenomenon, in which the costs come back on those who benefited from the earlier phases of innovation by ‘overshooting’ the point at which they would have ideally liked the technological competition to stop. The reason it didn’t stop was the same evolutionary logic of competitive innovation that created the sport and its early phases of development in the first place. The overshooting was inevitable but no individual user or firm could do anything about it.

It is difficult to estimate the overall costs of the overshooting in windsurfing, but it is likely that they are significant not only in the loss of individual enjoyment of a once-thriving sport, along with the depreciation and accelerated obsolescence of sports equipment and manufacturing capabilities but also the broader losses that accrue to ancillary and service industries, from coaching, event tourism, clothing, media, and so on which may differentially affect some regions more than others. On the other hand, this process can indeed be viewed as creative destruction, in the sense of the overshooting as a form of evolutionary selection that frees up resources for new sports to emerge. At the time of writing the two fastest growing sports in wealthy waterfront locations with beach launching are kite-surfing and stand-up paddle-boarding. Where 30 years ago squadrons of windsurfers tacked back and forth across the bays, beaches and lakes, now flotillas of kite-surfers occupy the skies and stand-up paddle-boarders patrol the shoreline. Both sports emerged in the early 2000s, and according to the interview subjects in this study, both are already showing signs of overshooting as the equipment is rapidly escalating in specialization, complexity and price as driven by the demands of elite users.

We suggest viewing overshooting as a predictable phenomenon of evolutionary instability, in the sense that there will be winners and losers, rather than an outright pathology. Plainly, overshooting in sports technologies does harm those who have invested in that particular sport. So how might they seek to control this process? We observe that overshooting does not occur in all sports, but it tends to be confined to new sports, particularly those that lack effective industry-wide governance. Cycling and swimming, for example, have largely avoided overshooting by the expedient of regulating the core equipment. Other sports, such as yachting and motorsports, have coped with technological overshooting by the continual proliferation of new domains of competition (e.g. Formula 1, Formula 2, and so on, each with a well-defined set of ‘legal’ technological specifications). So in general overshooting is controlled by institutional regulation, but this is by definition a collective action problem that requires industry-spanning agreement in effective self-governance [18]. The extent to which a sport can achieve this creation of a regulated technological commons is inversely proportional to the likelihood of its eventual collapse from overshooting.

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