

## **The meaning of "Leapfrogging" for the Innovation Policy of Companies**

Customers are often faced with the decision between buying the currently available version of e.g. Windows and waiting for a new "release".

The expectations about product improvements, which the company integrates into a new software generation. play an important role.

Martin Riedi, Tobias Schlager

***Martin Riedi***

is Director of Market Insights at Sonova AG in Stäfa (Switzerland).  
[www.sonova.com](http://www.sonova.com)

***Dr. Tobias Schlager***

is project manager at the Research Center for Customer Insight (FCI-HSG) of the University of St. Gallen (HSG), Switzerland.

Martin Riedi  
Sonova AG, Stäfa, Switzerland  
Email: [martin.riedi@sonova.com](mailto:martin.riedi@sonova.com)

Tobias Schlager  
St. Gallen University, St. Gallen, Switzerland  
Email: [tobias.schlager@unisg.ch](mailto:tobias.schlager@unisg.ch)

There are also assumptions about how long it will take before the new "release" is available on the market, as well as expectations regarding the price for the new product generation (Gordon 2009). Based on these and other considerations, such as the urgency of need or the cost of product change, customers decide whether or not to wait for a new product generation and skip the one currently available on the market. This phenomenon of the deliberate skipping of a product generation is now observable in many markets. For example, hearing aid buyers always skip a specific generation, in favour of buying the next-generation device. The manufacturers of mobile phones and consumer electronics also report the hesitancy of customers to adopt new products.

There is a discussion of this phenomenon which is termed "leapfrogging" in the literature (Mody / Sherman 1990). This refers to a person's decision to postpone a planned product purchase because he/she expects a modified or improved generation to arrive on the market in the foreseeable future. For a company, leapfrogging means shifting sales and profits from the current period to a future one. Through this, the future generation of products which are expected by the customers cannibalises the products currently available on the market (Bayus / Gupta 1992).

Despite these significant economic consequences, leapfrogging is rarely considered in the discussion about the shortening of product life cycles (Druehl / Schmidt / Souza 2009). Managers in the automotive industry mainly make their decisions about the introduction of new product generations based on development and production conditions. Customer considerations, for example, play only a subordinate role in determining the time intervals in which product generations come onto the market. Also, all questions about the extent of the changes from one generation to the next are mainly answered from a technical perspective.

### **Conceptualization of “Leapfrogging”**

The viewpoint of describing leapfrogging as a phenomenon occurring in the adoption of a product (or technology) by a customer (or a company) dominates in the literature. Here, the individual decides to postpone the purchase of a product currently available on the market in favour of an anticipated (improved) next generation product (Weiber / Pohl 1996b). The focus is on three products: the legacy product (P0, the product currently used by the customer), the new product (P1, the latest current generation available on the market), and the future product (P2, the expected, but not yet available, future generation of this product) (Padmanabhan / Rajiv / Srinivasan 1997). The future product can be a completely new product based on a fundamentally different technology, as compared to its predecessor. Often, however, it is just a variant, a simple evolution or a "relaunch" of the existing product.

The decision made by a customer for or against a new product depends on a variety of influencing factors (Gierl 1997). One product-specific determinant is the urgency with which the old product has to be replaced due to wear and tear. Added to this is the quality advantage of the new product experienced by the customer, as compared to the old product, and the assumed quality advantage of the future over the new product. The focus is not solely on technical or economic product dimensions; rather, all product attributes (including the symbolic-emotional) are considered.

If the innovation is to be adopted, it must meet the customer's preferences and provide the necessary technical conditions (Cripps / Meyer 1994). A decisive hurdle to the adoption of the innovation arises if the application has to be learned. If the supremacy of the new product is easily and quickly identifiable, you can expect to see a considerable propensity to its adoption. The expectations of the customer, with regard to the timing of the introduction of the future product, are also relevant. These expectations are responsible for whether a customer decides to adopt the new product or to refrain from acquiring the future product. Such expectations arise

through the customer's knowledge and experience of the manufacturer, as well as from company announcements or information from third parties etc.

## **Summary**

This article discusses customers' leapfrogging behaviour, or the practice of skipping a currently available version of a product to wait for a new generation of the same product. Three factors that determine leapfrogging behaviour are identified. The perceived quality advantage of the future product as compared to the new product, the costs of switching, and company announcements about the market launch of a future product determine whether a customer waits for a future product or buys a new product.

## **Empirical studies**

Many manufacturers communicate information about their products so that they intentionally or unintentionally influence the leapfrogging propensity (Bayus 1988). Three studies have been carried out to investigate the effect of different information provided by the company on the quality of products, the costs of switching and the time taken to introduce the future car on the leapfrogging slope. Before doing so, however, a preliminary study should be carried out to clarify the qualitative differences between P0, P1 and P2, in order to determine the necessary terms for the main studies.

## **Preliminary study**

In a preliminary study, brochures, leaflets and documents from automotive companies as well as publications in the auto press were reviewed, in which the quality of vehicles from different generations are compared. The aim was to determine the terminology used for the comparison in order to capture the language repertoire that prevails in the automotive market. After reviewing the relevant documents, nine terms that could be used to compare the quality of different vehicle generations were identified. The quality of a vehicle as compared to its predecessor can be described as having "stayed the same (1)", "slightly improved (2)", "partially improved (3)", "noticeably improved (4)", "significantly improved (5)", "greatly improved (6)", "been fundamentally improved (7)", "radically improved (8)" and "made a quantum leap (9)". The ascending order of terms follows the increasing intensity of quality improvement. These nine terms were presented to 43 people

with the task of ranking them on a nine-point scale. For each subject, the scale values for the individual terms were recorded. A comparison of the averages shows that the rank order of the terms derived from the documents of the automobile companies and the motor press was confirmed by the subjects ( $M(1) = 1.67$ ;  $M(2) = 2.09$ ;  $M(3) = 2.95$ ;  $M(4) = 3.72$ ,  $M(5) = 5.35$ ,  $M(6) = 5.98$ ,  $M(7) = 7.00$ ,  $M(8) = 8.00$ ,  $M(9) = 8.33$ ). Paired samples tests for two consecutive terms show that their mean values are significantly different ( $p(1,2) = .060$ ;  $p(2,3) < .001$ ;  $p(3,4) = .004$ ;  $p(4,5) < .001$ ;  $p(5,6) = .007$ ;  $p(6,7) < .001$ ;  $p(7,8) < .001$ ;  $p(8,9) = .080$ ).

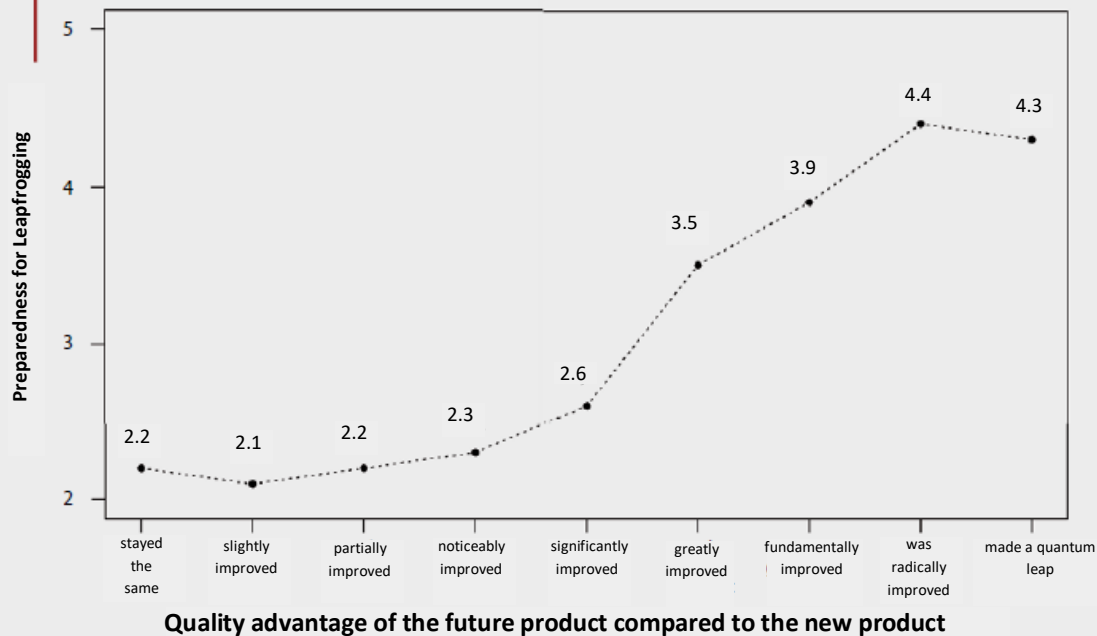
Following that, another 35 people were recruited and asked to place the nine terms on an eight-centimetre-long continuum. For each individual, starting from the zero point, the placement of the individual terms on the continuum was measured. A comparison of the averages shows that the ranking of the concepts derived from the documents of the automobile companies and the motor press could also be confirmed in this experiment ( $M(1) = .621$ ;  $M(2) = 1.28$ ;  $M(3) = 2.08$ ;  $M(4) = 2.53$ ,  $M(5) = 3.62$ ,  $M(6) = 4.61$ ,  $M(7) = 5.07$ ,  $M(8) = 6.41$ ,  $M(9) = 7.55$ ). Again, paired samples tests for two consecutive terms can be used to show that their mean values are significantly different ( $p(1,2) < .001$ ,  $p(2,3) < .001$ ,  $p(3,4) = .064$ ;  $p(4,5) < .001$ ;  $p(5,6) < .001$ ;  $p(6,7) = .081$ ;  $p(7,8) < .001$ ;  $p(8,9) < .001$ ).

## Study 1

To investigate the effect of varying quality differences between P2 and P1 on the tendency to leapfrogging, with a constant difference between P1 and P0, an initial design was developed. These quality differences were described using the terms identified in the preliminary study, resulting in nine experimental conditions.

483 persons of an automobile panel were contacted and evenly distributed across the nine conditions (315 men,  $M_{age} = 39$ ). After an introduction, the subjects had to put themselves in a scenario in which they were portrayed as the owner of a used vehicle. It was explained that the new vehicle is already on the market and in the foreseeable, but indefinite, period, a future vehicle is expected to hit the market. Depending on the condition, the quality difference between P1 and P2 was described using one of the nine terms (see preliminary study). In addition, participants were informed that, according to an empirical study, a very large majority of customers rated the quality difference between P1 and P0 as being "obvious". This was followed by the questions used in the literature to record "leapfrogging" ("readiness to wait until the future product is available" and "willingness to wait, provided that information about the future product already exists", Cronbach's  $\alpha = 0.88$ ).

**Fig. 1 Results from study 1**



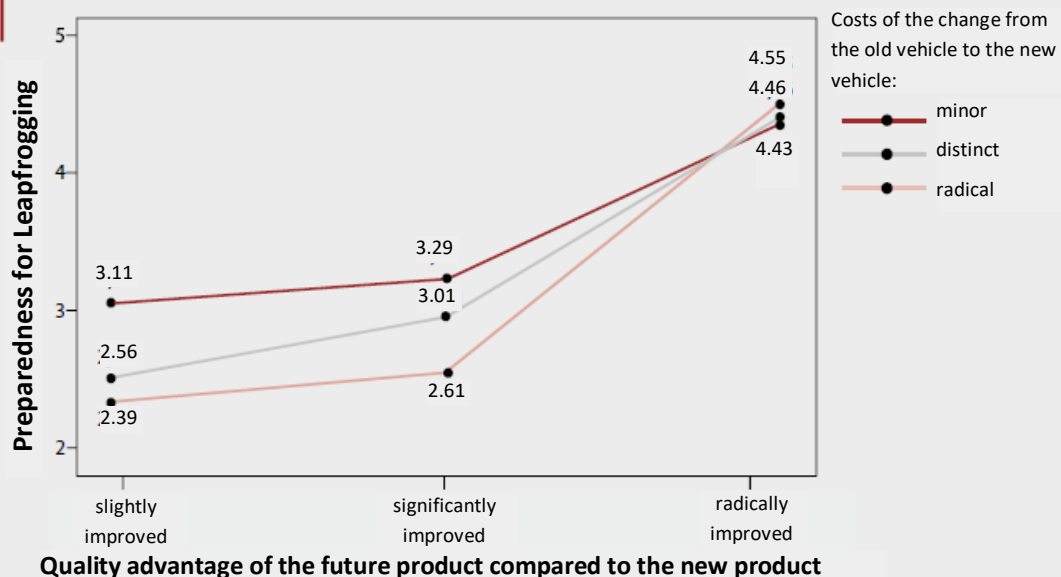
Source: own representation

**Figure 1** shows that the leapfrogging tendency varies significantly over the different quality differences. In addition, an asymptotic curve progression can be seen at the two ends of the scale. The relationship is best modelled by an LN-regression function. Here, the following function course could be determined: If the perceived quality difference between P1 and P2 is smaller than that between P0 and P1, there is hardly any "leapfrogging". The tendency towards "leapfrogging" only starts when the difference between P2 and P1 is at least as great as that between P1 and P0. If the difference between P2 and P1 is increased (with the difference between P1 and P0 remaining the same), the inclination can initially be increased. However, this increase levels off as the difference between P2 and P1 increases, so that the tendency towards "leapfrogging" cannot be arbitrarily increased. Apparently, given a quality difference between P1 and P0, there is a narrow corridor in which changes in the quality difference between P2 and P1 affect the tendency to leapfrogging.

## Study 2

Another experimental design was developed to investigate the combined effect of the difference in quality between P1 and P2 (with a constant difference between P1 and P0) and the cost of changing from P0 to P2 on the tendency towards leapfrogging. Three levels were chosen for both the quality and the exchange cost difference, resulting in nine experimental conditions. The quality difference between P1 and P2 has been described as "slightly improved", "significantly improved" and "radically improved". Similarly, the cost of switching from P1 to P2 has been termed "minor," "distinct," and "radical."

**Fig. 2 Results from study 2**



Source: own representation

567 people, again from an automobile panel, participated in the study. They were distributed evenly across the nine conditions (314 men, Mage = 41). The participants were welcomed and taken through the scenario described in Study 1. Once again, they were informed that a very large majority of customers rated the quality difference between P1 and P0 as "obvious". Added to this was the information that the cost of switching from P0 to P1 was deemed "significant" by a significant majority of customers. This was followed by the questions on the leapfrogging tendency explained in Study 1 (Cronbach's alpha = 0.81).

An analysis of variance shows that the quality difference between P1 and P2 ( $F(2,558) = 109.887$ ;  $p < .001$ ), and also the exchange cost difference between P0 and P2 ( $F(2,558) = 5.728$ ;  $p = .003$ ) each have a significant effect on the tendency towards leapfrogging. Both a decreasing difference in quality and a decreasing difference in switching costs increase the willingness of customers to leapfrog.

In addition, there is an interaction effect between the two independent variables ( $F(4,558) = 2.454$ ;  $p = .045$ ). **Figure 2** shows that, with a radical leap in quality from new to future vehicle, customers tend to leapfrog, regardless of switching costs. Obviously, a manufacturer with an outstanding future product can move their customers towards leapfrogging even if the switching costs are radical. On the other hand, if the difference in quality between P1 and P2 is only slight or obvious, customers tend to only leapfrog at small switching costs. On the other hand, if the cost of switching from P0 to P2 is significant or radical, customers tend to switch from old to new and to not wait for the future vehicle to be launched on the market.

### Study 3

A third experiment serves to investigate the effect of the quality difference between P1 and P2 (with a constant difference between P1 and P0) and varying times to market for P2 on the tendency to leapfrog. 15 different conditions were designed from the three levels for the quality difference between P1 and P2 and the five levels for the time to market of P2. As in Study 2, the levels of quality difference were described as "slightly improved," "significantly improved," and "radically improved." The time to market P2 was one, two, three, four or five years.

585 persons were recruited from an automobile panel, which in turn were evenly distributed among the 15 conditions (347 men, mean age = 41). Similar to the other studies, the participants were welcomed and introduced to the scenario. They also received the information that the difference in quality between P1 and P0 was considered "obvious" by many customers. Depending on the condition, subjects were told that it will take another one, two, etc. years, until the future vehicle comes on the market. This was followed by questions on "leapfrogging" propensity (see Study 1, Cronbach's alpha = 0.86).

An analysis of variance shows that the quality difference ( $F(2,570) = 84,692$ ;  $p < .001$ ) and also the time to market for the introduction of P2 ( $F(4,570) = 55,984$ ;  $p < .001$ ) each had a significant effect on the inclination of the customers to leapfrog. Both a decreasing quality difference and an increasing time to market for P2 are conducive to readiness for leapfrogging.

In addition, there is an interaction effect between the two independent variables ( $F(8,570) = 4.140, p = .023$ ). From **Figure 3**, one can see that customers tend to leapfrog with a future vehicle radically improved compared to the new vehicle, regardless of the length of time until P2 enters the market. Even if the future car does not come onto the market for another five years, with a radical improvement in quality compared to P1, the tendency to leapfrog is considerable. If, on the other hand, the quality difference between P1 and P2 is low, the tendency towards "leapfrogging" depends on the time until the market launch of the future vehicle. If it only takes another year, the preparedness to wait for P2 is very high. If, on the other hand, it will take four or five years, this willingness is significantly reduced. Apparently, customers tend to leapfrog if they either deem the length of time to market P2 to be very short, or they assume a radical leap in quality from P1 to P2.

### **Implications for innovation policy**

In many markets, companies determine the lifespan of their products, especially from a technical point of view. Due to a reduction in development cycles, product life cycles have also been reduced in recent years. Hence, the challenge arises of how to stimulate a sense of need for the new models which are presented at ever shorter intervals. This requires an extended perspective of the competitive situation, in that a product not only competes with the products of the other suppliers, but also competes with the future generations expected by the consumers.

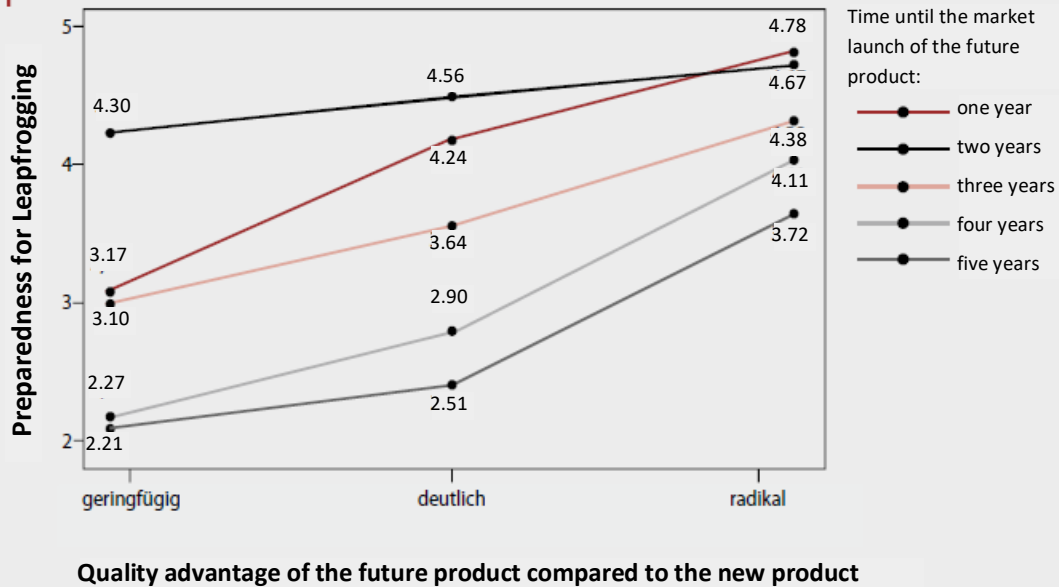
Study 1 shows that the intention to skip a product generation depends on the perceived quality advantage that the new product has over the old product, or the future product has compared to the new product. If the new product appears to be significantly improved relative to the old one, many customers will not wait for the future product, but instead trade the old model for the latest available model. By contrast, "leapfrogging" is to be expected, provided that the expected product differences between the latest model and the future model are considerable. In this case, customers do not want to run the risk of having an old model again in the foreseeable future. If, on the other hand, only minor improvements or just design changes (facelifting) are expected for the future model, the relative quality advantage is small, which reduces the tendency of customers to leapfrog.

Study 2 shows that "leapfrogging" is also influenced by the expected switching costs, primarily from the old to the new product, but also from the old to the future product. The switching costs result from the prices for P1 and P2, as well as from the loss of value of the old product at the time of purchase of P1 or P2. Price policy measures must therefore start with the price of P1 and P2 and the price of the used product. With regard to product prices, a distinction must be made between the list

price and the price which is ultimately to be paid. Since the manufacturer's price recommendations are non-binding, each dealer can independently determine their list price and thus pursue their own pricing policy. However, the price ultimately to be paid by the customer can differ significantly from the list price due to the granting of monetary and non-monetary discounts. For this, the entire spectrum of price policy options is available, such as list price discounts, financing on favourable terms, instalment payments, leasing or special price promotions for discontinued models.

In order to influence the "leapfrogging" of customers, the communication policy is also considered (Lilly / Walters, 1997). Study 3 provides the insight that the company's announcements about the time to market of the future product affect leapfrogging. The information about a new product can be provided during development up until the product becomes available. However, since the announcements are directed to the future, i.e. the manufacturer is not obliged to actually realize it, he must be careful to give credible signals in order to influence customer reactions (Eliashberg / Robertson, 1988). Fairs, exhibitions, reviews and reviews in trade journals, announcements in customer magazines, etc. are ideal for this. For radical innovations, complete secrecy can also make sense. Apple, Google, etc. regularly surprise with innovations that are deliberately concealed in the run-up to the launch. This serves to extend pioneer advantages and to increase customer interest in the product portfolio. The latter is apparent from the large number of Internet forums and magazine articles speculating about possible innovations.

**Fig. 3 Results from study 3**



Source: own representation

## Recommendations

Alongside actual competitors, companies should also consider their own products as competition for future generations.

Price policy measures must start with the used product to set the price of the new product and the future product.

Companies must consider the impact on products already on the market, both when determining the timing of new product announcements and when communicating the products' properties.

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