Adoption and diffusion of green innovations

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Paul H. Driessen & Bas Hillebrand

Abstract

This chapter gives a short overview of the factors influencing the success of green innovations from an adoption and diffusion perspective. It shows that adoption and diffusion theory offers a useful framework for studying the success of green innovations from the perspective of the customer.

Introduction

In the Netherlands, waste separation programmes for recycled glass have been quite successful (Bartels, 1994). Used glass is now deposited in waste separation containers placed at various locations in local communities throughout the country. Similar programmes in other countries, however, have found much less success or have been outright failures. In the same country, however, other environmentally friendly behaviours, such as car-pooling, have never reached high levels of acceptance. Why has waste separation for glass become successful in the Netherlands but not in other countries? Why did the Dutch embrace glass waste separation programmes, but not car-pooling? Why are some 'green' innovations accepted by consumers, but others are rejected? This chapter presents a framework of determinants of acceptance of green innovations. The framework is based on adoption and diffusion theory (Rogers, 1995; Gatignon & Robertson, 1991; Van Everdingen et al., 1998). Adoption and diffusion theory will help to better understand why marketing strategies and public policy interventions have varying impacts on green innovation success. The adoption and diffusion perspective has been a minor component in consumer energy research (McDougall et al., 1981), and has been almost totally ignored in research into other green innovations. This chapter shows that the adoption and diffusion framework is very well suited to understanding the acceptance of green innovations.

Innovations

Adoption and diffusion theory deals with innovations. An *innovation* is defined as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 1995). Two aspects of this definition deserve elaboration: the form of the innovation and the newness of it.

First, the definition shows that an innovation can take various forms or appearances. It may be a tangible product, like a energy-saving compact fluorescent lightbulb, but may also be intangible: a service or a behavioural pattern. Waste separation or car-pooling can be seen as innovations. Many forms of environmentally friendly behaviours can be viewed as innovations, and, therefore, lend themselves to study from an adoption and diffusion perspective (Darley & Beniger, 1981). Furthermore, there is a difference between *product* innovation and *process* innovation. Process innovation relates to innovation in company processes, which does not necessarily have to yield a changed outcome of the process; the

product. Most green innovations in the 1970s and 1980s can be characterized as process innovations (Lanjouw & Mody, 1996). This chapter is limited to product innovations, because these are most interesting from a marketing perspective. The term "product" however, is used to denote tangible and intangible products. Environmentally oriented product innovation is a relatively new phenomenon. For 'green innovation' we apply a rather pragmatic definition in this chapter. A green innovation does not have to be developed with the goal of reducing the environmental burden. The Bay Gen rewindable radio that operates without a battery or network currents was developed to provide radio news and entertainment to developing countries. It does however, yield significant environmental benefits. Therefore, such an innovation is called a green innovation here.

Second, a product is only an innovation if it is perceived as new. This constraint creates place and time dependence. In the Netherlands, waste separation using dedicated waste separation containers in local communities has become so commonplace that it can no longer be viewed as an innovation. In many other countries, it could be perceived as an innovation. Most authors in adoption and diffusion literature have chosen to use the term innovation only if a certain 'radicalness' or 'discontinuity' is present. An innovation is only new if there is a departure from current technologies and/or behaviour patterns. This view has led to a dichotomy of continuous and discontinuous innovations (Robertson, 1971)

This dichotomy is particularly salient with green innovations. Environmental management in large corporations has generally focused mainly on processes. This focus has led to a lack of attention being paid to environmentally oriented product innovation. To the extent that companies were paying any attention to green product innovation, attempts were largely limited to applying marginal product adaptations to decrease the environmental burden. Examples include non-bleached coffee filters, or laser printers containing anti-ozone filters. A more discontinuous green innovation was the fluorescent compact lightbulb, which contains technologies that are different to those in traditional incandescent lights, and which has slightly different applications for users. Even more radical are entirely new products such as electric vehicles, which use new technology and need an entirely new infrastructure of points for charging the vehicle. At a certain point in time, waste separation programmes were also radical, in the sense that they entailed entirely new behavioural patterns. For discontinuous innovations, it is far more difficult to initiate adoption than for continuous innovation, and it is therefore more interesting to study the factors that determine adoption. Moreover, the potential environmental benefit is much greater with discontinuous innovations, because only discontinuous innovations entail a departure with the past and offer opportunities to achieve structural and significant changes in consuming and behavioural patterns.

Adoption and diffusion

Adoption is the individual decision to use an innovation (Rogers, 1995). This means that simply purchasing an innovation is not adopting it. This distinction is all the more important for green innovations, because in many cases it is not so much the purchase but the use of the innovation that has an environmental impact. In marketing literature, however, purchase is very often the focus of attention rather than use, because purchase is easier to measure than use. Adoption and diffusion theory assumes varying speeds at which buyers adopt an innovation, and uses a typology to differentiate (potential) adopters. Some people, so-called *innovators*, take to adoption very rapidly, while others, known as *laggards*, are considerably slower to adopt new things. Adoption and diffusion theory attempts to explain this difference in speed.

Diffusion is the dissemination of an innovation within a social system. Diffusion theory focuses on how quickly and to what degree a social system accepts an innovation. Although adoption and diffusion are two different processes, they are highly interrelated. The major difference between adoption and diffusion is the aggregation level at which the processes are studied: adoption theory is concerned with adoption decisions of individual units (at a disaggregate level), whereas diffusion theory is concerned with dissemination on an aggregate level. Diffusion theory is, especially in the marketing literature, characterized by a quantitative modelling approach. The level of diffusion of an innovation is mostly dependent on two separate effects: an innovation effect and an imitation effect (Bass, 1969). The innovation effect indicates how quickly the relatively small segment of innovators accepts an innovation. The imitation effect indicates how quickly all other categories of adopters copy the behaviour of the innovators. Diffusion is the result of all the adoption decisions of the two categories. Therefore, an understanding of adoption processes is paramount to gain more insight into diffusion processes. Adoption decisions drive every diffusion process. Therefore, this chapter concentrates on individual adoption decisions, before turning to diffusion processes.

The origins of adoption research can be traced back to the beginning of the twentieth century, but became more important after the 1940s. In the second half of the twentieth century, researchers have looked for factors that explain the adoption of innovation. The factors they found can be separated into two categories: factors relating to the (potential) buyer, and factors relating to the supplier of the innovation. The next sections will discuss these two categories.

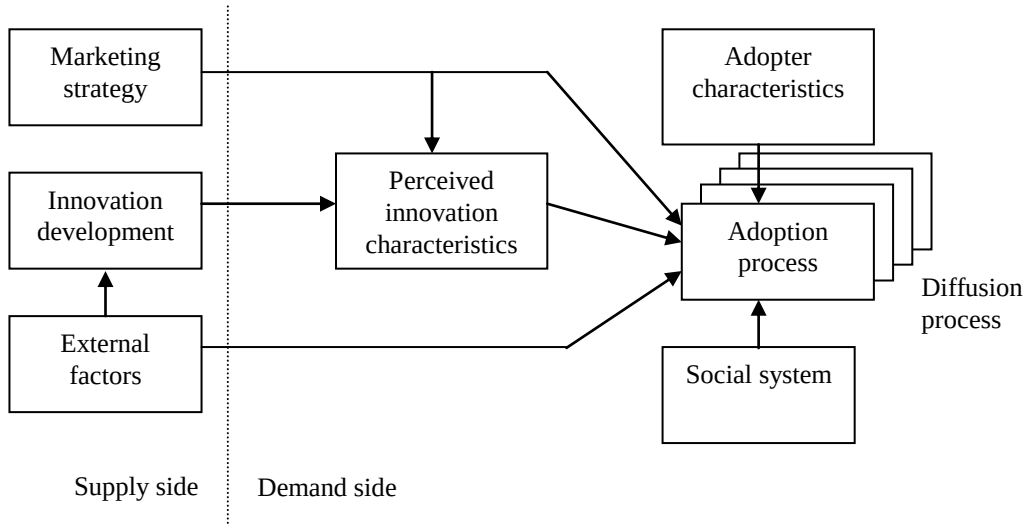

Figure 1: Adoption and diffusion model

Demand-side factors

Figure 1 shows a model in which factors influencing adoption process are identified (Gatignon & Robertson, 1991; Van Everdingen et al., 1998). This model is the starting point for describing the factors that affect adoption and diffusion of green innovations. On the right-hand side of the model, we find the demand-side factors. An important role is played by the *innovation characteristics* as they are perceived by potential buyers. Specific buyer

characteristics are assumed to affect the speed at which potential adopters decide to adopt. Furthermore, individual adoption decisions take place in a social system that affects potential adopters.

Adoption proces

The adoption process is an information-processing process that will eventually lead to either the rejection or acceptance of an innovation. Rogers (1995) views the adoption process as a hierarchy of effects. Adopters are thought to go through five phases: knowledge, persuasion, decision, implementation and confirmation (see Figure 2).

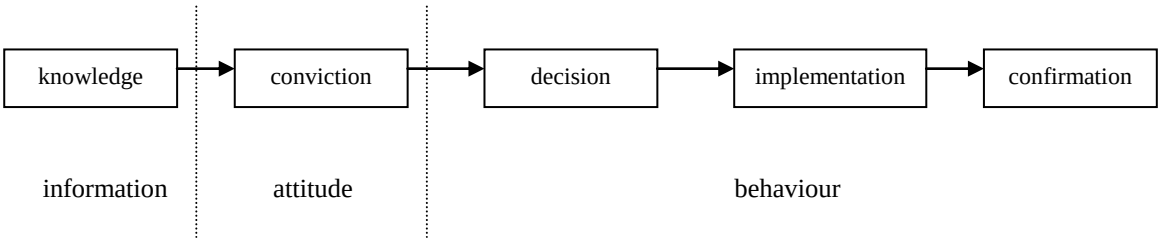

Figure 2: Adoption process

Almost all descriptions of the adoption process follow the information-attitude-behavior hierarchy of the Rogers model (Robertson, 1971). In reality, the adoption process is not so hierarchical. Especially when dealing with innovations where consumer involvement is low (low involvement goods), hierarchical processing of information is the exception rather than the rule. Nevertheless, information processing has many similarities between products.

An important factor in information processing are the sources of information of the potential adopter. One of the major research findings about the impact of information sources on adoption is that in the first phases of the process, non-personal information sources are important, but that later in the process personal information sources gain importance (Gatignon & Robertson, 1991). Right after the green innovation is introduced, when most potential buyers are in the early phases of the adoption process, possibilities arise for public policy intervention to stimulate adoption by using non-personal information sources. Moreover, diffusion theory assumes that right after introduction, where the innovation effect is strong, innovators decide (without being influenced by other individuals) whether or not to adopt. Innovators are better able, because of their high level of expertise, to interpret information that is delivered through non-personal sources like mass media. Therefore, it stands to reason that governments and suppliers of innovations should make their voice heard especially at the start of the lifecycle of an innovation.

The credibility of the information source plays a large role in green innovations (Driessen & Verhallen, 1995). Because of a host of unbelievable environmental claims in the past, claims about the environmental advantages of green innovations are met with some scepticism. A high degree of trust in the information sources can contribute to transforming a positive attitude regarding a green innovation into behaviour (Osterhus, 1997).

Adoption research has always studied innovativeness, the degree to which an individual has adopted early. Based on this construct, adopters can be categorized as innovators, early

adopter, early majority, late majority, and laggards. These categories are not static over different innovations. For each innovation, the composition of each category will be different.

The question of whether purchase is the right variable to study, when researching adoption can now be asked. In reality, various levels of adoption can be distinguished. We could study whether the purchase has been made to try the innovation or to use it, or the number of applications that adopters have for an innovation, or the frequency with which the innovation is used, or to plan delays in the acceptance of an innovation. All of these aspects are part of the adoption decision. Especially with green innovations, these 'soft' aspects of adoption are important. With green innovations, an important part of the adoption process takes place after purchase, in the use and disposal of a product (Jacoby et al., 1977). If an energy-efficient car is used mainly as a replacement for a bike, it is preferable to distinguish this from an energy-efficient car that acts a replacement for a gas-guzzler. In both cases, a purchase takes place, but from an environmental point of view it makes sense to separate the cases. In the one case, an environmental degradation takes place, where in the other case an environmental improvement is achieved. Usage determines the environmental load of a product. Electrical appliances are good examples of this phenomenon.

Perceived innovation characteristics

When studying adoption of innovations, it makes sense to investigate the characteristics of the innovation itself. Products vary greatly. Adoption and diffusion literature identifies several innovation characteristics that influence the adoption decision: relative advantage, compatibility, complexity, triability, observability and uncertainty (Van Everdingen et al., 1998; Rogers, 1995). All these characteristics are subject to the perception of potential adopters.

Relative advantage. The customer will only adopt an innovation if he/she perceives it to have a relative advantage over alternatives. This is the reason why relative advantage is one of the most important determinants of adoption. It refers to the degree to which an innovation is superior to the product it supersedes or with which it will compete (Robertson, 1971). The advantage can be of any nature: it can be price, quality, ease of use, life span, but also attributes that are far less concrete such as the status an innovation is likely to give to the user. The degree to which a product is perceived as green can be a form of relative advantage, especially with energy-saving innovations. With these, the perceived savings over an energy-inefficient alternative are important in determining the decision to innovate (Darley & Beniger, 1981; Labay & Kinnear, 1981). In general, however, research has not given a lot of insight in the role that is played by "greenness" in perceived relative advantage. It seems straightforward to assume that the higher the environmental benefits of an innovation, and thus the "greener" the innovation is perceived, the higher the perceived relative advantage. The importance that consumers attach to environmental aspects differs greatly over product categories. Research in the Netherlands has shown that environmental aspects were hardly perceived with clothing and shoes, but strongly associated to motorized vehicles (Driessen, 1993). In many consumer markets, traditional sources of relative advantage, such as good functionality, are far more important than environmental aspects. It is likely that in some markets greenness can only fulfil a role of dissatisfier: if a product is perceived as environmentally friendly it is not a reason to buy it, but if, however, a product is perceived as environmentally harmful it could be a reason *not* to buy it. For consumers, environmental effects are often so complex that they are hard to understand and virtually impossible to see the net result (Mohr et al., 2001). An example from the Netherlands is the

case of plastic coffee cups versus coffee mugs, which has stirred a debate in the past over which of the two alternatives is environmentally better. The complexity of this debate does not stimulate consumers to adopt environmentally sound behaviour patterns, whichever of the two that might be.

Compatibility. Compatibility refers to the degree in which an innovation is compatible to existing values, experiences and needs. If an innovation is not compatible, there are higher barriers to adoption. Green innovations that are highly discontinuous require a change in behaviour, which is often a change in habitual behaviour that is deeply rooted in everyday routine. Since the 1970s, a segment of consumers has emerged that has adopted a simple and environmental friendly life-style (Leonard-Barton, 1981). Some green innovations have such a close fit with these patterns of values and behaviours that this leads to adoption, even if the performance on other innovation characteristics, such as relative advantage, is not good (Darley & Beniger, 1981). For this reason, some consumers use an environmentally friendly cleaning liquid, even if it does not clean as well as the product they used before. In Rogers' classification scheme, the degree to which an innovation is seen to be green seems to be an aspect of compatibility with values. Compatibility can also be of a technical nature. For example, the first generation of energy-saving lightbulbs was not suitable to use in all types of lamps and, for that reason, had a limited adoption.

Complexity. Complexity is the extent to which the innovation appears difficult to use and understand. Customers who perceive an innovation as hard to use and understand will not adopt it rapidly. Source separation of glass by bringing it to designated glass containers is not a complex task, but source separation of chemical hazardous materials is much more complicated for many people. Many do not know which products fall into the hazardous chemical products category. Complexity might be a good explanation of the difference in adoption of these two environmentally innovative behaviours in the Netherlands. Research found that adopters of solar energy systems find this innovation easier to understand than do non-adopters (Labay & Kinnear, 1981). Some green innovations, like unbleached coffee filters, are very simple, and do not require any knowledge to use them. Solar panels, on the other hand, require do-it-yourself knowledge and skills or the assistance of an expert. In the case of solar panels, perceived complexity is a strong determinant of adoption (Darley & Beniger, 1981).

Triability. Triability is the degree to which the innovation can be tried and tested on a limited scale. Innovations that can be tried beforehand are much more likely to be adopted than innovations that cannot. This holds true particularly for innovations that have a high visibility and high uncertainty. For example, the positive effects of all kinds of energy-saving measures, like a clock thermostat, cannot be easily a priori determined. Only after sustained use of the innovation, users can see the advantage of the innovation (Darley & Beniger, 1981).

Observability. Observability is the degree to which the results of an innovation are visible to others. High visibility will in general lead to fast adoption. If everybody can clearly see the effects of adopting an innovation, customers will be more inclined to adopt it, if its observed effects are desirable. Green innovations often have a low visibility. Particularly with green product innovations that consist of small changes that limit the environmental impact of the product, there is often no perceivable difference with an older, less environmentally friendly, alternative. A car with a fuel-efficient engine looks the same as a car with an older, fuel-inefficient, engine.

Uncertainty. When an innovation is surrounded by uncertainty, people will be less likely to adopt it. Three different forms of uncertainty can be identified (Gerwin, 1988): technological uncertainty, financial uncertainty and social uncertainty. In a study, adopters of solar energy systems in the United States were found to perceive less financial and social uncertainty than the general audience (Labay & Kinnear, 1981). With companies, financial uncertainty has sometimes proven to be an effective obstacle to successful diffusion of green innovations (Cramer & Schot, 1990).

Adopter characteristics

Some people and organizations are quicker to adopt a certain innovation than others. Based on the degree to which people or organizations are early to adopt an innovation, they can be classified in the before mentioned adopters categories. A lot of research has been devoted to the characteristics of these categories. In other words, much research has been directed at finding the characteristics that explain the differences between people or organizations that are early to adopt an innovation (so-called early adopters) and people or organizations that are late to adopt (late adopters) or even do not adopt at all (non-adopters).

This research has led to the following overall characterization of early adopters (Gatignon & Robertson, 1985). Socio-economically, they tend to be younger, with a higher income, education, and social status. Also, their social mobility tends to be greater, i.e. they tend to move more to higher social classes during their lives than later adopters. People adopting innovations earlier also differ from others with respect to personal characteristics: they are more empathic, more open to new ideas, more intelligent and better able to handle abstract ideas, enabling them to better estimate the attractiveness of an innovation. Also, they tend to be less risk-averse and have a less fatalistic outlook. The latter might be especially important in the case of green innovations: people who are more convinced they can influence their own and the environmental situation might be more willing to consider adopting a green innovation than people who believe that their actions will not change anything. Earlier adopters also differ in their communication behaviour: their communication network is larger, i.e. they have more social contacts and have more contacts with people outside their immediate social circle.

Much research has been devoted to identifying the "green" consumer, but results have been mixed. Demographic variables have been found to be of little use (Roberts, 1996). Attitudinal factors seem to be more useful. First, and not surprisingly, people more involved with the environment tend to adopt green innovations earlier than people who are less involved (Bartels, 1994). People who are highly involved with the environment are more frequently seen as opinion leaders, are more open to new products, tend to put more thought into their shopping, and are information seekers (Shrum et al., 1995). Therefore they tend to have more knowledge on green innovations. Expertise influences the adoption process highly (Gatignon & Robertson, 1991) and refers to the ability to fulfil product-related tasks (Alba & Hutchinson, 1987). In the case of green innovations one might, for instance, think of the ability to estimate the environmental consequences of using a product and the ability to use a green innovation properly. However, the most important characteristic of "green" consumers seems to be the perceived consumer effectiveness, i.e. the degree to which the consumer believes individuals can make a difference (Roberts, 1996). This implies that the common approach of stressing the importance of environmentally friendly behaviour and the severity of the problem may reduce, not increase, environmentally friendly behaviour, because it may

result in the belief that the problem is too big to handle by an individual. Instead, one might consider focusing on the significance of individual actions and include information about the specific actions that would help solve the problem (Roberts, 1996).

Like consumers, organizations have been the subjects of research in order to find characteristics of organizations that might predict early adoption. The most important predictor of early adoption turned out to be organization size. Large organizations are more inclined to adopt an innovation than small organizations (Kimberly & Evanisko, 1981; Kennedy, 1983). This goes especially for costly and/or risky innovations. The reasons for this is that larger companies tend to have more money to spend on expensive innovations, and are less vulnerable, which means they can more easily afford to take the risks involved. The effect of size on adoption is also larger when there are economies of scale in the use of the innovation (Kimberly & Evanisko, 1981; Brown, 1981). Also, the size of the organization might require the adoption of certain innovations.

Apart from size, structure also influences adoption processes within organizations. However, the effect of structure on adoption processes is not straightforward: its influence at the start of the adoption process is different than at the end of the adoption process (Rogers, 1995). Organizations with a lot of specialized expertise are quick to decide to adopt a certain innovation, but are relatively slow to implement the innovation within the organization. In general, the former effect tends to be stronger. For instance, Groen (1994) found that printers employing relatively many highly educated people adopt green innovations more than printers with a lower degree of specialization. The effect of the degree of formalization and centralization within an organization on the adoption process is the opposite: formal and centralized organizations tend to be relatively slow to decide whether or not to adopt an innovation, but once the decision has been made these organization are quick to implement the innovation. The structure and climate of the decision-making unit may also influence adoption: a less formal structure and a climate that stimulates cooperation were found to have a positive influence on the adoption of green innovations (Suraphol Apaiwongse, 1991)
Within an organization, one person is of particular importance: the *product champion*. A product champion is a strong supporter of a certain innovation, and actively promotes the innovation within his or her organization. Research shows that the presence of a product champion within an organization has a major positive influence on adoption (Maidique, 1980). Drumwright (1994) found that the presence of promotors of green products has a positive effect on the organizational policy to buy green products.

Unfortunately, in general the effects of the above mentioned adopter characteristics on adoption are not very strong. The characteristics of early adopters turn out to vary with the innovation; that is, early adopters of one innovation are likely to have different characteristics than early adopters of another innovation. This goes for innovations in general (Gatignon & Robertson, 1985) and for green innovations (Kassarjian, 1971; Roberts, 1996). It thus seems advisable to study consumer behaviour towards particular issues instead of "green" consumer behaviour in general. Early adopters of a specific innovation also tend to be early adopters of innovations within the same product category (Gatignon & Robertson, 1985).

Social system

The social system of the potential adopter, especially the communication patterns between people within a social system, highly influences the adoption decision of the potential adopter. This also goes for green innovations (Darley & Beniger, 1981; Leonard-Barton, 1981). People

tend to communicate most with people similar to themselves in terms of norms and values, educational background, social status et cetera. This might be explained by the fact that communication between 'equals' is easier, because they have the same frame of reference and speak the same language. This implies that diffusion goes faster within social groups, where people are similar, than between social groups.

Although communication between equals is easier, it is not likely to render much information on innovations because equals tend to have the same information. Contacts with other social groups are therefore, although more difficult, very important for learning about new ideas and innovations. Granovetter (1973) labeled this "the strength of weak ties": occasionally communicating with people you do not often talk to (the so-called weak ties) tends to give you relatively more new information because these kind of contacts links you to other social groups that have other information (also see Chapter 31 by Mieneke Weenig).

Within a social system the opinions of certain people are more important then the opinions of others. The so-called opinion leaders are especially important. Opinion leaders are people capable of informally influencing the opinions of other people within their social group. They represent and articulate the norms and values within a social system. Therefore, when introducing an innovation into a social system, it is essential to convince the opinion leaders of the benefits of the innovation. Although the above is described in terms of people, the same goes for organizations: like people, organizations are influenced by the contacts they have with other parties. For instance, Groen (1994) found that printers adopting green innovations tended to have more contacts, especially with local governmental organizations, colleagues and (to a lesser extent) with trade organizations and suppliers.

The social system influences the adoption of innovations in yet another way. Some innovations are affected by so-called direct network externalities, i.e. adoption of such an innovation depends on the degree to which others within the social system have adopted the innovation. For example, adopting e-mail only makes sense if others you want to communicate with have adopted e-mail as well. Some green innovations are also affected by direct network externalities: some people believe their decision to adopt a green innovation would only have an impact on the environment if others would do likewise.

The role of the social system tends to increase when the innovation is more diffused within the social system (Darley & Beniger, 1981). For instance, in the Netherlands recycling glass has been greatly influenced by the social system. However, driving electrically-powered cars has not been influenced by the social system, simply because few people within the social system have any experience with this type of cars.

Supply-side factors

The left-hand side of the model in Figure 1 shows the supply-side factors that influence adoption. In the literature, it has been recognized relatively recently that the supplier of an innovation may influence the adoption of the innovation (Robertson & Gatignon, 1986). The marketing strategy of a supplier not only influences the potential adopters' perceptions of the innovation; it also influences the way they are able to adopt the innovation. The way a supplier segments the market and approaches its target markets is highly important (Sultan et al., 1990). This is not to say that the adopter side and the supply side of the adoption model are independent from each other: in fact, at the supply side it all comes down to anticipating and taking advantage of the adopter side factors. This implies that a supplier should start

investigating the adopter side during the development of the innovation. Also, external factors may influence the adoption process. External factors include the degree to which the environment is an issue within a certain market, the degree of competition, and the role of governmental organizations. This section discusses these three supply side factors in more detail.

Innovation development

Innovation development may have a major impact on the innovation characteristics. The innovation management literature frequently points out the importance of developing innovations proactively (Urban & Hauser, 1993), i.e. prioritizing research and development activities and trying to be first to market with a new product. If the innovation is radically new, the organization may be able to gain a competitive advantage as long as no other supplier comes up with a similar innovation. Within the environmental management literature, one particular stream of thought argues that a proactive innovation strategy may be best for the environment as well as for the organization (Porter & Van der Linde, 1995). The idea is that it is better to be ahead of governmental regulations and customer demands than to be constantly overtaken by events. However, within companies many obstacles may hinder the development of green innovations (Dermody & Hanmer-Lloyd, 1995, Cramer & Schot, 1990): lack of expertise and knowhow, limited willingness and capacity to innovate, and a lack of demand from society for green products and manufacturing processes.

Marketing strategy

The adoption process will only result in adoption if three requirements are met, which may all be influenced by marketing strategy (Gatignon & Robertson, 1991). First, the potential adopter should be aware of the existence of the innovation. Here, obviously, the marketing instrument *communication* comes into play. We have already pointed out that marketing communication is most effective at the beginning of the diffusion process, when the innovation effect is larger than the imitation effect. Marketing communication does not necessarily have to consist of advertising, but may also include promotional activities intended to stimulate trial adoption. This kind of communication (i.e. aimed at influencing behavior) is especially effective at the start of the diffusion process (Driessen & Verhallen, 1995).

Second, the innovation should be available to the potential adopter, which may be influenced by the marketing instrument *distribution.* Consumers tend to be unwilling to search for green products and go to other retail outlets (Bhate & Lawler, 1997). Therefore, one of the most important decisions a supplier has to make regarding distribution is the intensity of distribution. In most countries, green food products are distributed through a limited number of outlets, the so-called eco-dealers such as natural food shops (Driessen & Verhallen, 1995). These eco-dealers attract people who are already very involved with the environment. However, diffusion of the innovation within the rest of the society requires a higher distribution intensity.

Third, the potential adopter should be willing to pay the price for the innovation. The supplier may influence this in two ways: he may change the price itself (using the marketing instrument *price*), or he may try to change the potential adopter's perception of the innovation characteristics (using the marketing instrument *communication*). Ceteris paribus, only a small segment of consumers are willing to pay much more for green products. The majority of consumers will usually require additional benefits of green products in order to adopt them.

For instance, many consumers are willing to pay more for energy-conserving innovations only if they are convinced of these savings and if they perceive these savings as sufficiently high (Darley & Beniger, 1981). In general, willingness to pay extra for a green product largely depends on the perceived relative advantage of the product. The relative advantage leads the potential adopter to believe the green product to be more valuable, mostly in terms of perceived functionality. Especially in the case of discontinuous innovations, it is very important to first persuade the potential adopter of the functionality of the innovation, and only then position it as a 'green' innovation. It even remains a question whether it is advisable to emphasize the greenness of the innovation at all. Many suppliers refrain from positioning their innovation as 'green', because it may be counter-effective if the consumer does not believe that the product is 'green' (Ottman 1992; Osterhus, 1997). Obviously, the credibility of the information source is highly important for the claim to be believed by the consumers.

The impact of marketing strategy is largest at the start of the diffusion process. Later on, imitation effects become more important and diffusion mainly depends on the social system.

External factors

Two external factors may influence the adoption process: the competitive environment and the government. In highly competitive markets, an effective and efficient innovation development process is paramount. Frequently, the competitive environment determines the key success factors. In many markets, organizations are not (yet) forced by competition to present themselves as environmentally friendly. On the contrary, in some markets there seems to be a unspoken rule not to compete on environmental issues. In general, when it comes to developing green innovations, the role of the government seems to be more important.

In some cases, the government is the sole or major supplier of a green innovation, e.g. in the case of stimulating certain environmentally-friendly behaviour. However, commercial enterprises are frequently responsible for the development and marketing of green innovations. In these cases the government can only try to influence the adoption and diffusion process indirectly. It may do this in two different ways: by using economic instruments or by trying to influence norms (Osterhus, 1997).

Economic instruments try to influence the costs and revenues of certain behaviour. These costs and revenues may be financial, but may also be behavioural (Verhallen & Van Raaij, 1986; Osterhus, 1997). Behavioural costs include the time and the mental and physical effort it takes to behave in a certain way. By rewarding or punishing certain behaviour people receive feedback on the way they are supposed to behave. For instance, lowering VAT on green products may signal that the government believes these products should be preferred. Also, the government can try to influence behaviour by changing the situations in which the behaviour takes place, i.e. by making sure that the requirements for environmentally friendly behaviour are met. Some products are subject to indirect network externalities, referring to the fact that these kind of products are only useful in combination with another product. For example, the adoption of glass recycling requires the adoption of glass recycling depots, and the adoption of cars with catalytic converters requires the adoption of unleaded petrol. The government may stimulate the adoption of these products by increasing the availability of accompanying products, e.g. by placing a sufficient number of glass recycling depots and stimulating petrol stations to supply unleaded petrol.

Governments may also try to influence attitudes. However, changing attitudes does not necessarily mean changing behaviour, which in the case of green innovations is a major problem at the moment (Roberts, 1996). An environmentally friendly attitude does not necessarily lead to environmentally friendly behaviour because either the consumer is not aware of the consequences of his own behaviour, or he does not feel responsible for the problem, or he does not find the information source promoting environmentally-friendly behaviour credible (Osterhus, 1997). The government may try to overcome these three obstacles to environmentally friendly behaviour. Awareness of the consequences of one's own behaviour may be stimulated by supplying information on the environmental consequences of doing certain things (or refraining from doing certain things), e.g. by telling how much energy is saved by using energy-saving lightbulbs instead of normal lightbulbs. One may also try to make consumers feel more responsible by showing that others take responsibility as well, thus stating that the environment is the responsibility of everyone. The credibility of the information source is increased by building and using a well-known, objective and acknowledged eco-label.

A policy integrating economic instruments and influencing norms and attitudes using all marketing instruments seems to be most useful. A policy using only the price mechanism is bound to disappoint if the green innovation is not available on a large scale. Policies directed at only changing attitudes are likely to be ineffective without feedback on desirable behaviour using rewards and punishments. And a policy solely aimed at stimulating the development of green innovations does not contribute to the adoption of these innovations.

Conclusions

In this chapter we have attempted to give a short overview of the factors influencing the success of green innovations from an adoption and diffusion perspective. It has been our intention to show that the adoption and diffusion theory offers a useful framework for studying the success of green innovations from the perspective of the customer.

Although the adoption and diffusion theory has a long tradition in the social sciences, relatively little research has been done on the adoption and diffusion of green innovations. Most adoption research on green innovations was executed in the mid-1970s and early 1980s. We now call for a renewed interest in adoption research on green innovations for two reasons. First, in the meantime the adoption model has been extended by adding supply side factors, which has improved the adoption model as a whole (e.g. Frambach et al., 1998). Second, almost all adoption research focused on energy-conserving innovations. The reason for this is simple: when adoption and diffusion research was at its height in the mid-1970s, research on green innovations was mainly aimed at energy-conserving innovations (Zimmer et al., 1994). Now the term 'green innovation' has a much broader meaning and suggests that renewed attention for research on green innovations from an adoption and diffusion perspective would be beneficial.

The adoption and diffusion literature shows that suppliers may play an important role in the adoption and diffusion of green innovations. Especially the role of the government might be greater in the case of green innovations (even more so early in the diffusion process) than in the case of other innovations. Nevertheless, the standard adoption model does not pay specific attention to the role of the government; it is just one of the external factors which might influence the adoption process. Therefore, an adoption model specifically designed for green innovations, with a more prominent role for governments, is required.

References

Alba, J.W. & Hutchinson, J.W. (1987). Dimensions of consumer expertise. *Journal of Consumer Research, 13*, March, pp.411-454.

Bartels, G.C. (1994). *Saillante resultaten uit het milieucommunicatie-onderzoek*. The Hague: Ministerie van VROM.

Bass, F.M. (1969). A new product growth model for consumer durables. *Management Science, 15*, 215-227.

Bhate, S. & Lawler, K. (1997). Environmentally friendly products: factors that influence their adoption. *Technovation, 17*, 8, 457-465.

Brown, L. A. (1981). *Innovation diffusion*. London/New York: Methuen & Co.

Cramer, J. & Schot, J. (1990). *Problemen rond innovatie en diffusie van milieutechnologie. Een onderzoeksprogrammeringsstudie verricht vanuit een technologie-dynamica perspectief*. Rijswijk: Raad voor het Milieu- en Natuuronderzoek.

Darley, J. M. & Beniger, J.R. (1981). Diffusion of energy-conserving innovations. *Journal of Social Issues, 37* (2), 150-171.

Dermody, J. & Hanmer-Lloyd, S. (1995). Developing environmentally responsible new products: the challenge for the 1990s. In M. Bruce & W.G. Biemans, *Product development: meeting the challenge of the design-marketing interface.* Chichester: John Wiley & Sons.

Driessen, P.H. (1993). *Productinformatie milieu-aspecten* (thesis), Tilburg: Katholieke Universiteit Brabant.

Driessen, P.H. & Verhallen, T.M.M. (1995). Marketing, consument en milieu. *Maandblad voor Accountancy en Bedrijfseconomie, 69*, 189-197.

Drumwright, M. E. (1994). Socially responsible organizational buying: environmental concern as a non-economic buying criterion. *Journal of Marketing, 58*, July, 1-19.

Everdingen, Y. M. van, Frambach, R.T. & Hillebrand, B. (1998). *Marketing van nieuwe producten; het adoptiemodel in de praktijk*. Utrecht: Lemma.

Frambach, R.T., Barkema, H.G., Nooteboom, B. & Wedel, M. (1998). Adoption of a service innovation in the business market: an empirical test of supply-side variables. *Journal of Business Research, 41*, 161-174.

Gatignon, H. & Robertson, T.S. (1985). A propositional inventory for new diffusion research. *Journal of Consumer Research, 11*, 849-867.

Gatignon, H. & Robertson, T.S. (1991). Innovative decision processes. In T.S. Robertson & H.H. Kassarjian (Eds.), *Handbook of consumer behavior,* (pp.316-348). Englewood Cliffs NJ, Prentice-Hall.

Gerwin (1988). A theory of innovation process for computer-aided manufacturing technology. *IEEE Transactions on Engineering Management, 35*(2), 90-100.

Granovetter, M.S. (1973). The strength of weak ties. *American Journal of Sociology, 78*, 1360-1380.

Groen, A.J. (1994). *Milieu en MKB: kennis en kennissen. Milieu-innovaties in de grafische industrie modelmatig verklaard*. PhD-thesis. Groningen: Rijksuniversiteit Groningen.

Jacoby, J., Berning, C.K. & Dietvorst, T.F. (1977). What about disposition? *Journal of Marketing, 41* (April), 22-28.

Kassarjian, H.H. (1971). Incorporating ecology into marketing strategy: the case of air pollution. *Journal of Marketing, 35* (July), 61-65.

Kennedy, A.M. (1983). The adoption and diffusion of new industrial products: a literature review. *European Journal of Marketing, 17*, 31-88.

Kimberly, J. & Evanisko, M.J. (1981). Organizational innovation: the influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. *Academy of Management Journal*, *24*, 689-713.

Labay, D.G. & Kinnear, T.C. (1981). Exploring the consumer decision process in the adoption of solar energy systems. *Journal of Consumer Research, 8*, 271-278.

Lanjouw, J.O. & Mody, A. (1996). Innovation and the international diffusion of environmentally responsive technology. *Research Policy*, *25*, 549-571.

Leonard-Barton, D. (1981). Diffusion of energy conservation and technologies. In J.D. Claxton, C.D. Anderson, J.R.B. Ritchie & G.H.G. McDougall (Eds.), *Consumers and energy conservation*, (pp.97-107). New York, Praeger Publishers.

Maidique, M.A. (1980). Entrepreneurs, champions, and technological innovation. *Sloan Management Review*, *21* (Winter), 59-76.

McDougall, G.H.G., Claxton, J.D., Brent Ritchie, J.R.. & Anderson, C.D. (1981). Consumer energy research: A review. *Journal of Consumer Research, 8*, December, pp.343-354.

Mohr, L.A., Webb, D.J. & Harris, K.E. (2001). Do consumers expect companies to be socially responsible? The impact of corporate social responsibility on buying behavior. *The Journal of Consumer Affairs, 35* (1), 45-72.

Osterhus, T.L. (1997). Pro-social consumer influence strategies: when and how do they work? *Journal of Marketing, 61* (October), 16-29.

Ottman, J.A. (1992). *Green marketing. Challenges & opportunities for the new marketing age.* Lincolnwood IL: NTC Business Books.

Porter, M.E. & Van der Linde, C. (1995). Green and competitive: Ending the stalemate. *Harvard Business Review*, *73,* (5) 120-134.

Roberts, J.A. (1996). Green consumers in the 1990's: profile and implications for advertising. *Journal of Business Research, 36*, 217-231.

Robertson, T.S. (1971). *Innovative behavior and communication*. New York: Holt, Rhinehart and Winston.

Robertson, T.S. & Gatignon, H. (1986). Competitive effects on technology diffusion. *Journal of Marketing, 50* (July), 1-12.

Rogers, E.M. (1995). *Diffusion of innovations*. New York: The Free Press.

Shrum, L.J., McCarty, J.A. & Lowrey, T.M. (1995). Buyer characteristics of the green consumer and their implications for advertising strategy. *Journal of Advertising, 24* (2), 71-82.

Sultan, F., Farley, J.U. & Lehmann, D.R. (1990). A meta-analysis of applications of diffusion models. *Journal of Marketing Research, 27*, 70-77.

Suraphol Apaiwongse, T. (1991). Factors affecting attitudes among buying-center members toward adoption of an ecologically-related regulatory alternative: a new application of organizational theory to a public policy issue. *Journal of Public Policy & Marketing*, *10*, 2 (Fall), 145-160.

Urban, G.L. & Hauser, J.R. (1993). *Design and marketing of new products.* Englewood Cliffs NJ: Prentice Hall.

Verhallen, Th.M.M. & Raaij, W.F. van (1986). How consumers trade-off behavioural costs and benefits. *European Journal of Marketing, 20* (3/4), 19-34.

Warkov, S. (1981). Adopting solar and conservation. In J.D. Claxton, C. D. Anderson, J.R.B. Ritchie & G.H.G. McDougall (Eds.), C*onsumers and energy conservation,* (pp 123-129). New York, Praeger Publishers.

Zimmer, M.R., Stafford, T.F. & Stafford, M.R. (1994). Green issues: dimensions of environmental concern. *Journal of Business Research, 30*, 63-74.