

ENGINEERING SUSTAINABILITY MARKETS: WHY T-SHAPED ENGINEERS NEED COMMUNICATION DESIGN

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Abstract: Numerous authors have described the importance of the T-shaped engineer—one who has both a specialisation, and further knowledge that connects their specialisation to other disciplines and to the wider needs of society and the environment. This approach has particular value when ascribing sustainability a fundamental role in the design process—indeed it suggests a paradigm shift in ways of thinking engineering. Design and production processes, and their teaching, are shifting to deal with global realities which have cast many traditional approaches as limited at best, and at worst, destructive.

Few authors exploring the T-shaped professional and sustainability, however, have recognized the importance of communication design—the strategic process of creating the form, content and delivery of information, including marketing and advertising—within the design process. Currently this tends to be relegated to the ‘commercialisation’ stage, which arrives after the important work is done. This is now an out-dated model. Sustainability is very low on the scale of consumer appeal—in some cases having the opposite effect. The very best of intentions can amount to nothing if the product fails to inspire consumers to buy it, and most products, sustainable or not, fail in the market place. Many engineers and writers on engineering reveal an underlying assumption that if a product can save the world, consumers will buy it. This is a dangerous fallacy—irrefutably built on admirable ideals—yet a fallacy just the same. Consumers have long been recognised to be frequently illogical and even self-adverse.

This paper will argue that a knowledge of marketing and advertising, and semiotics—that is, of products which ‘speak to’ consumers in a language they respond to—must be built in to any engineering process from the very first stages—especially when engineering for sustainability. The paper demonstrates firstly that many engineers, and especially those who see value in sustainability, have a psycho-social profile that works against them considering advertising and marketing as being important considerations. Secondly, it makes a case that communication design must not be seen as subsequent, but as weaved into the innovation and production stages from the beginning. Finally, it describes key considerations to help engineers utilise communication design as part of their interdisciplinary teams.

1 ISSUES WITH CURRENT MARKETING FOR SUSTAINABILITY

1.1 The environmental imperative

Spangenberg (2004, p. 78) notes that ‘Environmental problems like land use, waste generation, loss of biodiversity and greenhouse gas emissions are increasing continuously with economic growth’. The evidence suggests that global climate change is a major issue, which requires that significant mitigation processes and policies be enacted. It is crucially important that products are made with sustainability as their foremost imperative. The most recent report from the Intergovernmental Panel on Climate Change (IPCC) shows that ‘GHG [Greenhouse Gas] emission growth has accelerated over the last decade’ despite increasing numbers of mitigation policies (Edenhofer et al., 2014, p. vii). They see that

temperature increase below 2°C is possible but not if 'individual agents advance their own interests independently' (p. 5). Between 2000 and 2010, most increase in GHG emissions came directly from 'energy supply (47%), industry (30%), transport (11%) and buildings (3%) sectors' (p. 7). The driver contributing the largest increase in CO₂ emissions is economic growth (p. 8) and they estimate that without additional efforts aimed at reducing GHG emissions, global mean surface temperature will increase by 2100 by 3.7 to 4.8°C. With climate uncertainty factored in, the estimate becomes 2.5°C to 7.8°C (p. 8). This suggests significant climate change is likely without increased mitigation.

The IPCC (p. 18) note that one of the key difficulties in addressing global climate change is the current economic system: 'Infrastructure developments and long-lived products that lock societies into GHG-intensive emissions pathways may be difficult or very costly to change, reinforcing the importance of early action for ambitious mitigation (robust evidence, high agreement).' A key mitigation strategy proposed by the working group is efficiency enhancements and behavioural changes (p. 20) and they state that 'behaviour, lifestyle and culture have a considerable influence on energy use and associated emissions'. Significant change is needed in consumption patterns, for example, 'mobility demand and mode, energy use in households, choice of longer-lasting products', as well as 'dietary change and reduction in food wastes' (p. 20).

There are two clear imperatives here: firstly, that engineering and design must consider all stages of product life cycle, including energy requirements, waste, and infrastructure support; and secondly, that techniques for shifting consumer and stakeholder behaviour must be a key part of the approach. Designing for sustainability is worthless if the new products do not displace non-sustainable products in the market place, and the only way this can happen is if customers buy them. My argument here is that making sustainable products attractive to consumers has to be an equally important imperative.

1.2 Issues with consumer buying behaviour

Consumers are often not logical thinkers in their buying behaviour. This is vitally important when looking at making sustainable products successful in the market, and Prakash (2002, p. 287) notes that 'notwithstanding the claims about the concern for the natural environment, mass consumer markets for green products in most categories have yet to develop'. Ritchie & McDougall (1985) relate that although people may express pro-conservation views, this may be due to social pressure, but may not actually reflect their true feelings. Even when consumers do have pro-conservation attitudes and values, these are often not reflecting in their actions. We do not find, for example, that pro-conservation households use less energy than others. This disconnect between consumer attitudes and consumer behaviour is a significant concern in areas around sustainability marketing (Prakash, 2002; Ritchie & McDougall, 1985). Findings have indicated a lack of association between energy consumption and consumers' conservation-related views. (McDougall, Claxton, Ritchie, & Anderson, 1981). We have also seen that conservation programs which attempt to use nationalistic or altruistic appeals tend to be unsuccessful (Ritchie & McDougall, 1985, p. 16), and that consumers make purchases based primarily on self-interest (Ellis & Gaskel, 1978; Ritchie & McDougall, 1985). Ritchie & McDougall (1985, p. 17) report that: 'In many studies it has been found that consumers will not decide to take conservation actions even when it is in their economic self interest to do so'.

Psychologist in behavioural economics, Professor Hersh Shefrin (BBC, 2013) notes that people are much less logical, and much more prone to psychological errors than has previously been thought: 'Basically human psychology is just too flawed to expect that we could avert a crisis.' The evidence suggests that appeals to logic, or morality, or warnings of environmental disaster, are largely ineffective in instigating behavioural change, because cognitive biases are too powerful. For example, Ritchie & McDougall (1985) report the behaviour of motorists in times of acute gasoline shortage, where they have 'lined up at gasoline stations with their motors running, using up valuable fuel' and note the tendency of people having purchased fuel efficient cars to increase their annual mileage; and that consumers will often not choose sustainable alternatives even when it is in their economic interests to do so.

There are clearly difficulties with consumer perceptions of sustainability that make sustainable marketing problematic. Habit and inertia are significant here. People have cognitive biases which impact significantly

on their decision-making (Cummins & Nistico, 2002; Kahneman & Tversky, 1996; Tversky & Kahneman, 1974). One of these biases is that they tend to trust what they already know, even beyond logical limits. Shifting from a comfortable position requires time and energy, which people often feel they do not have, but their cognitive bias exacerbates the difficulty, tending to steer them away from any decision making. To add to this, products described as sustainable, or environmentally friendly, are often perceived to be less reliable, or less effective, than traditional products. Advertising strategies have relied heavily on the myth of 'scientific formulae' to sell products, and sustainable products are often associated more with 'home remedies'. While one may alleviate guilt about being environmentally unfriendly, the other promises swift action with a minimum of effort. The latter thus works well with consumer self perceptions of being overworked and lacking in leisure time. McDonald & Oates (2006) relate this to 'degree of compromise' versus 'degree of confidence', where the first involves the nuisance value of actions required 'having to travel further, pay more, or sacrifice performance' whilst the second involves the degree a consumer feels their actions will actually make a difference to the wider problem. Another factor which impacts consumer buying habits is the perception that green products are more expensive than less environmentally friendly ones. This is acceptable for certain niche markets, but in the main consumers resist paying higher prices for more environmentally friendly goods (Prakash, 2002, p. 288).

'Green' as a selling point is not a successful strategy. Thøgersen (2006, p. 146) notes that 'environmental concern and the willingness to sacrifice for the environment seem to have peaked somewhere between 1990 and 1992'. Indeed, with news media now finding negative stories on 'green NGOs and businesses' to be more newsworthy, many managers are tending to downplay associations of their products and sustainability (p. 145). Whilst mass advertising encouraging people towards more sustainable practices have proven ineffectual, research indicates that targeted campaigns have potential for more success. Where they have failed in the past is that they have tended to be directed at 'curtailment behavior' (Ritchie & McDougall, 1985), which runs contrary to self-interest. The potential here is in appealing directly to target markets by offering products that 'speak their language', and appeal to their perceptions of identity; in short, which appeal to them using exactly the same advertising techniques that are already working.

2 ADVERTISING AND MARKETING

2.1 Psychological theories of advertising

There is no doubt that marketing and advertising have been powerful contributors to the growth of consumer culture. Numerous studies have shown a clear correlation between advertising budgets and success, not only in terms of brand equity, economic conditions, customer loyalty, and higher margins, but also in direct benefits to shareholders (Boulding, Lee, & Staelin, 1994; Farquhar, 1989; Keller, 2002; Van Heerde, Gijsenberg, Dekimpe, & Steenkamp, 2013). Yet few people understand *how* advertising works. Indeed, whilst one in two people say that they trust TV ads, most people believe that advertising does not work on them (Kilbourne, in Jhally, 2010). Even many advertisers are happy to quote department store pioneer, John Wannamaker's famous statement: 'I know I waste half the money I spend on advertising. The problem is, I don't know which half.' (Rothenberg, 1999). Nonetheless, millions of dollars each year are spent by manufacturers on advertising budgets.

Most consider Henry Ford's introduction of 'mass production' with his Model T—a 'one size fits all' car that dominated the automobile market—to signify the major economic and cultural development of the twentieth century. I would argue, however, that Ford's rival, Alfred Sloan Jr. at General Motors, made a leap that was even more significant: 'Alfred Sloan Jr. . . . understood that the automobile industry's salvation depended on changing consumers' attitudes; the auto had to be transformed from a low-cost form of transportation into a symbol of attainment, one that could induce consumers to continually upgrade . . . Chevrolet sales overtook Ford's in 1927 and never turned back the lead' (Rothenberg, 1999). Price and utility were not the determinants they were originally thought to be. From this point on, the issue for manufacturers became not one of creating products, but of creating markets.

Although Sloan recognized the importance of appealing to the non-rational side of consumers, the notion of ourselves as motivated by purely rational thinking persists. The evidence, however, shows that

consumers have, at best, limited or 'bounded' rationality (Decision Technology Ltd., 2010, pp. 5-13). From the early Twentieth Century, the discipline of psychology was found to be a powerful tool in understanding and appealing to consumer incentives for purchasing. There are strong arguments to suggest that individuals make many more decisions based on irrational impulses than on rational thinking, and these irrational impulses are wired into our DNA (BBC, 2013). This is important not only for an understanding of how advertising appeals to individuals, but for dealing with climate change and other global issues. Over the last hundred years marketing and advertising have become increasingly more sophisticated in how they target and communicate to consumers. We have used a number of different approaches, from Freudian perspectives of the subconscious to Pavlovian and other behaviourist models, to understanding the psychology of the individual consumer.

There are numerous theories to explain the psychological determinants of success in advertising a product. People tend to buy what others are buying, often displaying herd behaviour, making decisions based on their perception of who they are, or more accurately, who they would like to be; indeed, on how they like to see themselves. From Freud, we regard identity as a key factor in understanding why people buy what they do. Perhaps the most important question to ask when trying to understand consumer behaviour is 'what kind of person are they?' We might ask questions like: 'do they see themselves as tough, independent, a bit macho?' or 'do they see themselves as intelligent, sensitive, reserved?', 'outgoing, impulsive, image-conscious?', or 'elegant, sophisticated—is social position important to them?'. These can be strong determining factors on whether someone will buy a BMW, a Volkswagen, a Mini Cooper, or a Ford F-150. The degree to which aspects like price, or sustainability, are concerns are also part of the makeup of a subject's personality. This does not mean that someone who would normally fit the personality type of an F-150 owner would never buy a Volvo station wagon, but statistically it is much less likely. And this is an important point in communication design, and one that moves us into the realm of behaviourist approaches. Advertising is never directed at an individual, although advertising and service design use personas (individual personality types who sit in the mid range of a target market) to 'stand in' for a market segment. Advertising and marketing are directed at statistically significant groups. No group's characteristics is expected to accurately represent every member—indeed the totality of characteristics may not represent any one member at all. Instead market segmentation works by having most characteristics represented in most members of the market segment. This is what makes segmentation such an effective tool in marketing, and many years have been spent defining and refining market segments to categorize buyers in the most effective way.

2.2 Market segmentation approaches

Consumer research techniques centred on demographics, personality types and lifestyle market segmentation, as opposed to consumer beliefs, have proven to be efficient tools in predicting consumer behaviour. Personality types define people as fitting into certain groups, based, for example, on Everett Rogers' categories for confidence in the uptake of new products—Innovators, Early Adopters, Early Majority, Late Majority, and Laggards. Another market segmentation approach is exemplified by the VALS system (VALS was originally an acronym for Values and Lifestyles, but today VALS increasingly uses psychological traits and key demographics, but has kept the VALS branding), which uses 'tailored marketing strategies for targeting, positioning, and communications' and works to strengthen 'demographic characterizations by explaining the deeper psychological drivers of consumer behavior' (Strategic Business Insights, 2015). VALS groups are divided into the following categories: innovators, thinkers, achievers, experiencers, believers, strivers, makers, and survivors. Whilst 'thinkers' and 'believers', for example, tend to be more family oriented and driven more by ideals, types like the 'experiencers' and 'makers' tend to be directed more towards self-expression.

Research has found that the likelihood that consumers will purchase green products has little correlation with market segmentation demographics. That is, people with a propensity to shop green cannot be categorized effectively according to age, levels of education, gender, and the like (Derksen & Gartrell, 1993). Demographic variables show little association with environmentally concerned behaviour (Derksen & Gartrell, 1993; McDonald & Oates, 2006). That is, the traditional market segments are of little use in predicting consumer behaviour when it comes to sustainability. McDonald & Oates (2006) offer an alternate market segmentation system specifically directed at consumers' green activities and

sustainability perceptions. This gives the following groups: 'optimists', 'pessimists', 'no trouble', 'too much trouble', 'cherry picker', 'chicken or egg', 'balanced', and 'no pattern'. Whilst this is useful to us in a number of ways, it underpins an approach that is fundamentally flawed in that it presupposes an appeal to consumers *based on* issues of sustainability. Currently, the only effective approach is to appeal to consumers through traditional market segments, and based on appeals to traditional drivers, like security, sex appeal, family relationships, and the like. It requires an understanding of semiotics—how products 'speak' to consumers. This is the approach that advertisers have mastered over the last century, and is currently being used to sustain and grow commodity cultures throughout the world today. This is the competition for sustainable products, and the techniques used by that competition have been vastly successful. This is the domain of communication designers—specialists who understand marketing, advertising and semiotics.

It is important to understand that target markets, consumption behaviour and types of products are not necessarily related. For example, all cars have similar mechanical structures, and in the most part, similar effective uses—to get from one place to another—yet, as we have seen from the time of Alfred Sloane Jr.'s revelation, cars are successfully designed, styled, marketed and advertised to a wide variety of different personality types and market segments. An electric guitar might seem the kind of product a particular VALS type might be drawn to, yet a simple look into the advertising for these instruments shows them advertised through differentiated semiotic signifiers—verbal and visual language—to groups as widely differentiated as the radical 'experiencers' to the conservative, nationalistic and family-orientated 'believers'. The product is irrelevant. What is crucially important are the signifiers that direct the product to the appropriate market.

The success of this approach is based on the knowledge that we do not buy toasters, cars, milk, etc.—we know that these things do not provide happiness. In fact, we buy 'being liked', 'being socially popular', 'being successful', 'being sexually attractive'. These are the promises that advertising makes to us and this strategy is what has made it a multi-billion dollar industry. It is important to recognise also, that the same cognitive biases come into play whether we buy bridges, trains, or ships, or a pair of jeans. Target markets can be identified to fit a given product, but more importantly, a product can be branded to appeal to any target market that uses, or would consider using, that type of product. Once a target market is identified, then it becomes the task for advertisers to understand them to the extent they are able to speak to them using signifiers the target market understands and responds to. It is at this stage that personality profiling becomes more useful. Stávková, Stejskal, & Toufarová, (2008, p. 277) suggest 'there are no activities more important for . . . consumer behaviour research, connected with consumption, than the personal characteristics'.

2.3 Personality types and Engineering

Myers-Briggs is one of the most used and best-respected systems of individual personality profiling for marketing. Although it is often used to indicate where individuals fit within particular profile segments, its use in marketing is in how these segments behave with respect to buying habits. This can be used in conjunction with market segmentation systems like the VALS system described above. In the Myers-Briggs system, individuals are tested for responses to a large number of questions, and then allocated scores in pre-determined categories to give 16 personality 'types'. These types are combinations of the following personality characteristics:

Introversion (I) or Extraversion (E)
Intuition (N) or Sensing (S)
Thinking (T) or Feeling (F)
Judging (J) or Perceiving (P)

Thus an ENTJ type is most likely to have the character of a bold, imaginative and strong-willed leader, whilst an ESFJ personality is more likely to be caring, social and popular. When looking at marketing to specific groups, it is helpful to be able to think of the likely key characteristics of people that make up that group. It is also particularly useful when developing groups in industry, as a preponderance of one personality type, or the wrong mix of types, can lead to difficulties in functionality.

While the Myers-Briggs system is sometimes used to suggest employee appropriateness, many different personality types often fit the same jobs. Interestingly, however, one personality type—the INTP type—has such a strong correlation with one particular occupation that in some Myers-Briggs users, the type is titled after that occupation. It is simply called ‘Engineers’ (for example, see Personality Max, 2015). The Engineer personality type is someone who tends to be focussed on the future, imaginative, easy going, yet private. They tend to be logical, analytical thinkers who can be impersonal and objective. They tend not to favour rigid rules, and often don’t obey them. They are often autonomous, independent thinkers. This may sound like a typical horoscope, and if the personality profile is correct, I would expect many engineers to be dubious at this point, and while there will be many engineers who do not exhibit all of these characteristics, the Myers-Briggs system can be surprisingly accurate over large numbers. It has been shown, for example, that the Myers-Briggs score you get at 17 will have very little variation over your lifespan regardless of your career choices or unexpected incidents.

One of the reasons this is worthy of note is that engineers tend not to like advertisers, because advertisers place less importance on how the product looks or functions, or even the aesthetics of the advertising or communication. They tend to care more about how many of the products are shifted. Designers like form and function; advertisers like results. The ‘Engineer’ personality can see advertising as fake, manipulative, as it deals with emotion and persuasion rather than facts and accuracy. Yet, like everyone else, engineers are constantly and successfully marketed to. An excerpt from a presentation titled ‘Marketing to Engineers’ notes that content and accuracy is most important to engineers: ‘So, as a marketer, you must ensure that the content is correct before anything else’ (CFE Media, 2014). Trew Marketing (2014) found that the most important element in information presented to engineers is that information is ‘technically accurate’, followed by ‘it includes detailed diagrams and images’, then that ‘it’s current’. Way down the scale is that it is ‘professionally designed’, that ‘sources are well-cited’ and lowest on the scale is that ‘it includes quotes or testimonials from users, vendors or industry leaders’. Importantly, the research suggests that engineers are ‘sceptical of marketing’.

3 MULTIDISCIPLINARY TEAMS AND THE ‘T-SHAPED’ ENGINEER

Schneider & Hall (2011) report in ‘Why Most Product Launches Fail’, that a principle reason that most products fail in their first year is consumer resistance to change: ‘American families, on average, repeatedly buy the same 150 items, which constitute as much as 85% of their household needs’. They suggest that the problem is that companies focus almost entirely on design and manufacture, and leave marketing until it is too late. Until people who make products understand the psychological aspects of their products in the market place—what makes people want to buy them; and the economic priorities of the market—the broad scale success of sustainable design will remain unattainable. A key feature of top performers in the marketplace is the early involvement of customer thinking in the design process: ‘the front end of their process integrates the needs of the customer and the market’ (Edget, 2015).

Hassi, Peck, Dewulf & Wever (2009) state that “‘standard” engineering projects with a typical phased character in time and organisation structure are being replaced by innovation projects with a strong need for multidisciplinary teams bringing all the necessary knowledge together from the first idea generation phase.’ It is also clear that sustainable design projects require that sustainability be built into the brief, and that a team needs to have expertise in the areas of design, engineering, marketing and management (Dewulf, Wever, & Brezet, 2012, p. 457). Hassi et al (2009) suggests that working in interdisciplinary teams, the success of the venture is more likely to be predicated on personal, emotional qualities rather than departmental dictates. It is thus imperative that all parties have not only shared goals, but an understanding and respect for the input and value that each of the other team members can contribute. Competency and co-operation are more important in this respect than methodology or tools. The innovation process involving multidisciplinary teams requires ‘T-shaped’ people. T-shaped individuals have a strong knowledge of their own discipline (the vertical stroke of the T), which allows them to make tangible contributions to the outcome. This is combined with a broad understanding and empathy for areas that impact their discipline (the horizontal stroke of the T). Brown & Wyatt (2010) suggests this empathy for other disciplines is ‘expressed as openness, curiosity, optimism, a tendency toward learning

through doing, and experimentation. Hassi et al (2009, p. 6) describes it thus: 'T-shaped people . . . have a deep knowledge over a good part of technologies, entrepreneurial and/or design related issues and good understanding of interrelationship and consequences in the other fields. They should be both creative and analytical'.

Pascual, Boks and Stevels (2003) researched leading ecodesign conferences to find that in over 850 papers, over 60% of contributions were directed at technical issues, with managerial issues at about 10%. Hassi et al. (2009) suggest this as indicative of where multidisciplinary teams with T-shaped participants are needed. However, I argue here that without communication designers specialised in marketing and advertising, teams risk creating excellent sustainable solutions that fail in the market place. It is crucial that engineers working with advertisers and marketers have an understanding and appreciation of the importance of these elements in achieving the success of sustainable products. All participants need to be T-shaped, with a combination of depth in their own field, but also a breadth of understanding and openness that allows them to understand the context for their own skills in relation to the other skills needed for the task, and in relation to wider issues (Hansen & Oetinger, 2001, p. 108).

A key issue for many people, and if we believe the Myers-Briggs assessment of engineers—who place considerable value on honesty and personal morality—certainly a major issue for them, is the notion that advertising is morally reprehensible. Advertising is seen as evil because it manipulates people. Those who take the moral high ground will not want to see themselves or have others see them as manipulative or deceptive. People who are interested in producing and distributing sustainable solutions tend to have firm moral beliefs—seeing the big picture, the philosophical considerations, and the moral implications. My argument here is simple. Advertisers are talented, creative, and analytical thinkers who are as much aware of the urgent need for genuine sustainability as are people in any industry, but their talent is currently used by manufacturers to persuade people to consume products that are damaging our ecosystems. Changing a target market to buy what you want them to buy, even if it is in their interest, is a very long-term plan and as we have seen, fraught with possibly insurmountable difficulties. My position is that, even if this is possible, we do not have the luxury of the time it will take to enact this change. The most effective course of action is not to change the markets, but to build the market drivers *into* sustainable products from the earliest innovation stages of design. That is, build products to suit target markets, such that the products can then be advertised most effectively to appeal to markets *as they are*. You might find communication designers with advertising and marketing skills make good T-shaped people too. And just in case you were interested, it turns out I am an INTP personality type. Perhaps communication designers and engineers have more in common than we might have supposed.

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