The Social Construction of Technology: Media's Role in "Disturbing" the Stabilization of Finchaa's Ethanol-Kerosene Blend ('K-50')[1]

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Abstract

This paper aims to show how the design, production and stabilization of a given artifact could be socially constructed. Grounded in Science and Technology Studies (STS), the perspective dubbed as "social construction of technology" (SCOT) provides us with analytical tools such as "relevant social groups," "stabilization," "interpretive flexibility of meaning" and "disturbance." On the basis of these analytical tools, this study tries to show the condition in which Finchaa Sugar Factory's ethanol-kerosene blend ('K-50') was to reach the stage of stabilization. More particularly, the study focuses on the "disturbance" – this is a technical word in SCOT – that the media staged and, as a result, nearly knocked K-50 out of market. The principal value of this study lies in bringing together engineering knowledge and the social sciences in the Ethiopian context. The study could somehow be taken as experimental in that it helps us to see the interface between the two areas – an interface which is given little or no consideration among either social scientists or technologists in many 'developing' countries.

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1. Introduction

1.1. The development and production of K-50: background story

This paper deals with the development of ethanol as alternative fuel in Ethiopia. The theoretical framework used here is known as the "social construction of knowledge" (SCOT), a framework developed by scholars working in a field which has become to be known as Science and Technology Studies (STS).
Now, coming back to the project under study: The project belongs to Finchaa Sugar Factory (hereafter simply referred as 'Finchaa'). Finchaa, which is one of the sugar factories in Ethiopia, produces ethanol from molasses. First initiated because of environmental concerns, Finchaa begun producing ethanol almost as soon as it started producing sugar. This was around the end of the 1990s. Initially, the factory started supplying its ethanol to pharmaceuticals and factories engaged in producing alcohol beverages.

At about the beginning of 1999, Finchaa had around 2 million litres of ethanol stock. Then, the factory management started to consider producing fuel for cooking stoves by way of getting a wider market. Chemical engineers started working and they came up with K-50. The product became to be known as K-50 because the product is a blend of 50 percent kerosene and 50 percent ethanol. The factory opted for the qualifying term "K" (acronym for kerosene) instead of "ethanol" because kerosene is popularly known as a fuel for cooking stoves in Addis Ababa and a few towns.

The designing and testing process of K-50 took around four years. The factory did some promotions. I myself had the chance of visiting a trade show in which K-50 was one of the products. This was in 2002. At this time, Finchaa had finalized the construction of ethanol-kerosene blending station in Addis Ababa. Soon after the exhibition and certain additional promotional activities, Finchaa made a business deal with private companies for the distribution of the fuel.

Once the distribution of the fuel started around July 2002, complaints started to surface. Newspapers reported incidents, that stoves using K-50 exploding in some houses, causing injuries to some people. These newspapers reported that some of the casualties that suffered serious burns needed to be hospitalised for some time. Finchaa administration and the engineers responsible for the design responded that K-50 could never be the problem by itself. They said that the main reason for the explosions was the improper use of the stoves.

1.2. Analytic tool and source of information

This research project focuses on the link between the design process and the social factors that shape the product. I will more specifically try to analyse the role of the different social groups that attribute differing meanings to the technological artifact under discussion. The model or tool that my analysis will employ is the social construction of technology (SCOT). Unlike many other tools, I have found SCOT very appropriate for analysing the various variables involved in the story of K-50. (I used the term story here because the artifact doesn't still seem to be, in the language of SCOT, "stabilized.")

Interviews and unpublished materials were my main sources of primary data from Finchaa Sugar Factory. Other sources I used include newspaper articles and my own personal observations. Last but not least, I consulted secondary sources, including books and articles on SCOT.

2. Theoretical framework

In the field which has increasingly been identified as "Science and Technology Studies (STS)," social scientists and technologists have been able to develop various conceptual frameworks in order to describe or define as to what determines the design, production and marketability of technological products. Among these frameworks, actor-network theory (ANT) and social construction of technology (SCOT) have been widely used. According to ANT, a given technological artifact or scientific theory is a product of a network of actors. Bruno Latour, a French sociologist of science and one of the key figures to develop ANT, preferred to use the term 'actant' instead of 'actor' because he believed that the network also includes non-human actors. Since the term actor has the obvious implication that we are referring to a human agent, Latour coined the word 'actant' so that it could also be used to describe non-humans. In order to illustrate how Latour describes actants, Peter-Paul Verbeek writes: "A pile of matter that we call an 'automobile' can only exist as such in a context that includes also gasoline, gas stations, pumps, refineries, highways, auto mechanics, automobile manufacturing plants, and so forth. What exists 'in itself' is only metal and synthetic material" (Verbeek 2005: 149). Gas stations and manufacturing plants are equally actants as the mechanical engineer that designs the automobile or the user that drives it.

Those who subscribe to the perspective known as the social construction of technology (SCOT), on the other hand, emphasize the social context in which artifacts are designed, produced and used. According to the SCOT approach, a technological artifact would get certain traction when meaning is conferred on it by social forces such as the designers, market forces, users' needs and demands, etc. Put concisely, a technological artefact is a social construction.

Trevor J. Pinch and Wiebe E. Bijker are known to have developed SCOT. Following the tradition of sociology of scientific knowledge, Pinch and Bijker have been able to establish SCOT as one of the powerful tools that researchers in science and technology studies could employ. In this regard they have also supplied us with key concepts such as "relevant social groups," "interpretive flexibility of meanings," "closure," "disturbance," etc. As already noted from the outset, it is this theoretical framework that is used instead of ANT or any other framework. "Why SCOT?" one may ask here. The conceptual tools that SCOT employs are very appropriate for analyzing a new products' entrance to the market. More importantly, the concept of "disturbance" is very appropriate to discuss the kind of resistance that a product like K-50 encounters. However, in order to fill the gap that SCOT leaves out I will briefly look into some other useful approaches in the concluding section of the paper.

Now, I will be defining some of the key terms that stem from the perspective under discussion. By social relevant groups, Pinch and Bijker are referring to the main agents – institutions as well as individual persons – that affect the status of the artifact right from its production to the stage when it will be in the hand of users. Referring to the expression in question, they write:

The term is used to denote institutions and organizations (such as the military or some specific industrial company), as well as organized or unorganized groups of individuals. The key requirement is that all members of a certain social group share the same set of meanings, attached to a specific artifact. In deciding which social group are relevant, the first question is whether the artefact has any meaning at all for the members of a social group under investigation. (Pinch and Bijker 1984: 414).

Drawing on the SCOT approach, I have also categorized 'interested' groups into relevant social groups and described their respective role (see section III, subsection 3.1 below).
The term "interpretive flexibility of meanings" denotes the variety of perspectives through which different social groups look at the artifact. In the case of K-50, for example, those who developed it see it as "smoke-free," "environmental-friendly," etc. whereas the end-users may see it as a product which is "dangerous" or as an

"explosive" material. Thus, the way a given technological product is perceived depends on the position that individuals or social groups hold vis-à-vis the product.

"Stabilization" refers to the phase when a technological artifact reaches some kind of closure whereby it attains reputation as a product in the market. At this stage the product in question may not need any more improvement unless the producers would like to provide additional application for potential customers. When a new product is introduced into the market, it is a usual practice that it would go back to the designers in order to correct the defects or imperfections that end-users have encountered. It would therefore take a number of tos and fros before an artifact reaches a stabilization or relative "serenity."

The term "disturbance" depicts the resistance that a new product encounters. In current economic setting the media plays a very important role in promoting or discouraging the marketability of products. As has already been pointed out, the concept of "disturbance" is a useful analytical tool for depicting the resistance that K-50 met in its attempt to establish itself as a marketable product. The focus of the paper is all the more on the phenomenon of disturbance because K-50's life-span was short and this was only limited to the first few months of its childhood. In other words, out of the various phases that a product should pass through, in the case of K-50 it was the resistance phase that came out remarkably well.

3. Findings and interpretation

3.1 Relevant social groups and the interpretive flexibility of meanings

The development and introduction of K-50 as alternative fuel has involved many groups of people as well as organizations and associations. Obviously, I had to identify the agents (in the form of individuals, companies, professional associations, or media) before classifying them into "social relevant groups." As already noted above, the major agent responsible for developing K-50 was Finchaa Sugar Factory. Behind Finchaa, there are funding agents such as the Ethiopian government as principal owner of the factory, and African Development Bank (ADB) as the financier of construction of the factory. ADB was also responsible for enforcing the construction of an ethanol plant as additional complex so that the factory could also make use of the by-product molasses instead of disposing it into the Finchaa River. Environmental protection was therefore high on the agenda of the bank – environmental protection

was seriously considered because Finchaa was tributary of Blue Nile, which supplies 80% of the water to the Nile.

Other agents include:

	Organization/people	Role
1	Ethiopian Science & Technology Commission (ESTC)	Funding research project
2	Addis Ababa University, chemical engineering	Laboratory test of the product
3	National Alcohol and Liquor Factory	Laboratory test
4	Oil Companies, viz. Shell, Mobil, Total, Agip	Stakeholders
5	Environment protection agencies	
6	Distributors of K-50	
7	People using cooking stoves	
8	Media (radio, television, newspapers)	Promotion or resistance
9	Professional associations	Promotion or resistance
10	Stove providers/manufacturers	

Now the next step is to classify these agents into "relevant social groups." According to Pinch and Bijker (1987: 30), a "relevant social group" is a group whose members "share the *same* [emphasis mine] set of meanings, attached to a specific artifact." Here then comes the challenge: How are we able to find socially relevant groups who share the same meanings? Well aware of this difficulty, Pinch and Bijker themselves have questioned whether a group is homogenous (ibid: 32-34), and, as a result, have shown how an apparently homogenous social group (for example, cycle users) could further give rise to a separate relevant social group (women cyclists). As Pinch and Biker underlined in the course of their discussion[3], it is not still impossible to classify the agents I mentioned above into relevant social groups for the purpose at hand here. In other words, when I identify a certain relevant social group it does not mean that all the members I put together share exactly the same meaning; rather they may share a very general meaning.

[3] "We want to stress that our model is not used as a mold into which the empirical data have to be forced…. The model has been developed from a series of case studies and not from purely philosophical or theoretical analysis. Its function is primarily heuristic…." p.38

I have accordingly classified the agents I mentioned above (which are about 12) into three relevant social groups. The first group I call "artifact developers." This category consists of Finchaa Sugar Factory (including the administration as well as the engineers who developed K-50), the Ethiopian government, African Development Bank, Ethiopian Science and Technology Commission (ESTC), Addis Ababa University, National Alcohol and Liquor Factory, oil companies, professional associations, and environmental protection agencies. Members of this group seem to share the meaning that K-50 is an environmental friendly product that could serve as alternative fuel for people using cooking stoves. (As I shall show soon, some of the members of this first group will also be mentioned under the group I will call "artifact resisters." To pin down an example here from the outset, I would take ESTC because, though it is the principal financier of the development of the artifact, it has finally proven that its voice is rather divided. There is no absolute homogeneity of interest in the other agents either.)

The second relevant social group I would call "resisters." I am using the term "resister" here not in the negative sense of functionalist explanations use it. Rather, I use it, following Ronald Kline, in the sense that it is a "means of negotiation."[4] Thus, when an artifact is resisted by users, it doesn't mean that these users are creating trouble for the company producing the product. In fact, in most cases resistance is an effective way of assisting the company to improve on its artifact. It would therefore contribute positively to the perfection of the product in question. For resistance would ultimately direct the designers to the flaws or inconveniences that were overlooked or simply neglected for one reason or the other. To put it differently, resistance means returning the artifact to its designers so that they could do something to it.

When it comes to the group I call resisters in this study, the media would comes to the forefront. I would like to further qualify the media as "confronting resister" because it was this force that has all along actively objected to the use of K-50. (I will shortly discuss this.) But in this group again I include some of the agents I already mentioned in the first group, namely a segment of the factory's administration, ESTC, Ethiopian Society of Chemical Engineers, and oil companies. As the engineer who had been responsible for the development of K-50 related, some members of the administration of the factory were totally against the very project itself.

[4] After reviewing various interpretations of what resistance means in the context of the introduction of technological artifacts, Kline maintains: "In my view, resistance is a common means of negotiation among producers, mediators, and users that helps to create socio-technical change." (Kline 2003: 52)

The position of the oil companies has been obscure from the very start. Although their role as resisters is not visible, the engineers I interviewed implicate them as the possible voices behind the media. I describe the position of the oil companies and that of the administration of the factory that opposed the artifact from the start as "obscure resisters" because their part is not explicit enough.

The next two members I included for the second time are very interesting agents for my analysis. These are the Ethiopian Science and Technology Commission and the Ethiopia Society of Chimerical Engineers. I say they are interesting because these same two organizations were at first unambiguous in giving their support, the first financially and the second morally because it had almost awarded the engineer principally responsible for the design before it announced that it had retracted its decision. I describe this agent "faltering resister" because it is after the media outcry that they started to withdraw their support. When it comes to the Commission (which again I dub as "faultering resister"), it did not only withdraw its support but it didn't take it much time to publicly declare its opposition; in fact, by doing so, it joins in the media's chorus of disapproval.

The third relevant social group is the group I call the "end users." These are people who used K-50 as fuel for their cooking stoves. I describe them as end users because, as I shall show soon, the media made their protests in the name of the users. Hence, I have found it very convenient to dub people who actually use the fuel as end users for the sake of clarity.

Furthermore, the meaning that these (end-) users give to the artifact in question is also somehow divided. First, they see in it, after the advertisement of the producers, as soot- and smoke-free material. Later on, after reported explosions (and obviously some of them have suffered the hurt first-hand), they started to conceive it as "dangerous material."

3.2 Re-focusing: "disturbance" and the respective responses

This subsection is of course the most important part of the paper. Its focal point is the resistance that K-50 has encountered and the accompanying responses. Before I go to the actual analysis, I would like to answer one crucial methodological question: What is the need to focus on the difficulties that the artifact encountered? Bijker (1990) points out that when we are dealing with social relevant groups surrounding a

given technological artifact, our analysis must "focus on problems and solutions." According to Bijker (*ibid*: 58), it is around this relation of problems and solutions that the interpretive flexibility of meanings is formed. He contends that, whether we are studying the atom or a social system, "not much would be learned by looking at it in a steady state."[5] (*ibid*) Focusing on the "disturbances" surrounding an artifact would give us a better look at the meanings that different social groups attribute to an artifact. Besides, as I already noted when I was introducing the term "disturbance," K-50's public life was so short lived that it doesn't have an extended 'biography'. We do not have therefore much to talk about the other phases of its lifetime.

When it comes to my analysis, I will take up the media's reactions and subsequent responses from different parties. After about a couple of months that K-50 became available for sale on the market – the beginning of the sales was around July 2002 – the government owned radio and television came up with news that stoves using K-50 had exploded and caused minor and serious injuries on few individuals. Then, a private newspaper by the name *Addis Admas* – a popular weekly Amharic[6] newspaper – came out with a creepy article[7]. A closer scrutiny reveals that the article is actually sloppy. However, its power lies elsewhere – it employed highly appealing and powerful imageries.

The article's title is in the form of a catchy rhetorical question: "What has K-50 to do with '*findata'*?" Literally speaking the Amharic word '*Findata'* means explosion. However, the term was rather used in a way to represent something cryptic and negatively powerful imagery. The word was used as a disparaging nickname for "restless" teenagers. A young man risks or, in some cases, would like[8] to be called '*findata'* if he is taking part in in-group skirmishes, or if he is harassing young girls in school, or if he is a persistent problem to his own family, etc. In this regard, the term *findata,* over and above its literal meaning (i.e. explosion), was uploaded with powerful imagery. Then, the writer of the newspaper article relates that it had become a fashion to use the word 'K-50' instead of *findata* in order to describe those allegedly troublesome teenagers. Here is where the major part of the attack started.

[5] Following his rigorous review of the history of the bicycle, Bijker comments: "So, in describing the artifacts I tried to avoid the uninformative states of equilibrium and stability. Instead, the focus was on the problems as seen by the various social groups." (1990: 58).
[6] Amharic is the national language of Ethiopia.
[7] *Addis Admas*, August 18, 2002.
[8] Some young men were proud of being called '*findata'* – they feel that it lends them the image of a rebel-hero. But, for other segments of the society (I mean for those who effectively use it), the term triggers the image of troublemaker.

Then, it resumed thus:

Soon after the eulogies that we listened by radio and television, that it is "odourless," "smokeless," or what have you, K-50 has become ominously dangerous…. As I have learnt from legal experts, the Finchaa Sugar Factory must be brought to justice. No sooner than it [K-50] was on the market, it spreads its fire all over Addis Ababa. Amazing! Addis Ababans have become highly concerned and frightened. In two weeks time alone, about fifty people have been blazed by fire. When you see the victims, their faces burned and roasted, oh, how terrifying and alarming it is! One of the explosions has even taken the life of one young and beautiful girl. Do our young people whom we call *findata* commit such an atrocity beyond doing some minor troublesome things? By no means! The only problem is their immaturity. When it comes to K-50, we have got an entirely different story. K-50 would rival 'Satan's' works. [translation mine]

The article doesn't stop its assault at this. It goes on and on in this fashion. Let me add one more striking statement which the writer has made around the end of the article. After sneering at the factory for its pretentious, or, to use the newspaper's own expression, "green-peace-like" environmental concerns, the writer finally slips down the slippery slop and appeals for justice presuming that (1) what he lists all along is true, and (2) that all are instances of criminal acts.

When new technological artifacts enter into the market, especially when they are homegrown, various studies have made it clear that they would be easy preys to such ominous objections. Having a brief visit into Bijker's highly illuminating illustrations would be sufficient to show how such objections are strikingly similar even if they are from totally different contexts. Referring to the obstacles that cycle users had been encountering around the end of the 19th century, Bijker quotes mocking cheers (e.g. "Monkey on a gridiron" (1990: 47)) that pedestrians and cart drivers directed against cyclists. An excerpt from an account that dramatizes the cyclist/pedestrian encounter is read as follows:

Pedestrians backed almost into the hedges when they met one of them [cyclists], for was there not [sic] almost every week in the Sunday newspaper the story of some one being knocked down and killed by a bicycle, and letters from readers saying cyclists ought not to be allowed to use the roads, which, as everybody knew, were provided for people to walk on or to drive on behind horses. "Bicyclists ought to have roads to

themselves, like railway trains" was the general opinion. (F. Thompson quoted in Bijker 1990: 48)

An attack against women cyclists were much worse. An excerpt taken from 1900 *Münchener Zeitung* reads:

Unashamed, proud like an Amazone, the graceful lady displayed herself to men's eyes. We ask: Is this the newest form of bicycle sport? Is it possible that in this manner common decency is being hit in the face without punishment? Finally: is this the newest form of advertising for certain female persons? Where is the police? (quoted in Bijker 1990: 49)

It does sound like the Ethiopian writer who literally cries "Where is justice!" when he writes against the ethanol-kerosene blend. In fact, the newspaper article I have been discussing so far has, interestingly enough, been trying to caricature (I do not know whether this was deliberate on the part of the writer) the writing style of a period when Emperor Menelik II introduced telephone, railway, vehicles, etc. to Ethiopia.[9]

Now, I will pass to the reactions of the other relevant social groups. First, I will look at the responses of what I called "faltering resisters." (Recall that I called the foregoing parties as "faltering resisters" because they switched from support to objection after the reported explosions.) From this category again, I will only discuss the response of the Ethiopian Science and Technology Commission (ESTC)[10]. Again here *Addis Admas* (25 August 2002) was instrumental. This time the newspaper invited readers on the issue of K-50 under a title: **"K-50 Fuel: Untimely Born Foetus?"** In his interview with *Addis Admas*, the person representing ESTC pointed out that designing an appropriate stove for using the new fuel was part and parcel of the project. Thus, he accused the factory for not doing its assignment. When asked as to what ESTC did on its part (as one of the principal stakeholders of the project), he said that his office had been expecting a project report from factory. And yet, so he

[9] Emperor Menelik, who ruled Ethiopia from 1889 until his death in 1913, was known (among other things) for his highly enthusiastic "modernization" endeavours. When telephone was for example introduced for the first time – this was around the end of the 19th century, it provoked a serious objection from priests. Clerics representing the Ethiopian Orthodox Church appealed to the emperor that he should not use it since it was the "the work of Satan himself." Similar objections were expressed when the emperor took subsequent measures in order to introduce other new technological devices. (Paulos 1992)

[10] The other agent that came up with a second-thought about K-50 was the Ethiopian Society of Chemical Engineering. Like ESTC, it withdrew its support after the uproar. It expressed this by literally withdrawing its intention to award the inventor.

contended, his office had learnt, like anyone, from the news that the factory had started selling the fuel for consumers.

The issue of "appropriate" stove has therefore come out as a result of this conflict. In relation to this, the newspaper had also interviewed the manager of a workshop producing cooking stoves. The stove producer argued that the main problem of K-50 lies in that the wick stove (the stove most people use for kerosene) was absolutely unsuitable for k-50. He added that the factory had approached him once so that his workshop could produce the "suitable" stove for K-50 but this didn't come to fruition because "the factory was not ready to fund the research component of the production."

The factory then made a formal reply to all these and other accusations (*Addis Admas*, September 7, 2005). It insisted that the factory had made all the routine tests and proved that the wick stove is appropriate given "it is used carefully."

When I asked Mr. Mesfin Abate (the person who designed K-50) about the preliminary tests, he answered that they had made all the necessary tests including "customer tests." He conceded that two incidents of fire discharge had occurred during customer tests and these were due to "malfunctioning of the stove." When I asked him of his personal opinion on what he thinks is the principal reason for the reported accidents, he related:

…people [who use the wick stove] are accustomed to add kerosene while the stove is functioning; besides, they do not clean the surface of the stove. K-50, by its very nature, catches fire easily; thus, it needs serious safety precaution. We had tried to create awareness regarding its use by distributing leaflets on which we wrote all the necessary precautions that users must follow. (Taken from reply to my interview questions.)

For Mr. Mesfin, the wick stove is a suitable stove for using K-50. The problem lies in the way people use it. That is what he stresses repeatedly. However, be this as it may, this reply presupposes that the stove users are well informed or, at the very least, can read and write. Besides, it must be noted that even before the introduction of K-50, reports show that one of the sources of fire accidents in the capital is the misuse of the wick stove when people use it to cook with kerosene. While this fact is not hidden to many people, including the Finchaa Sugar Factory, the expectation that people would prevent dangers by reading a manual is implausible. An inquiry into the

identity of the actual users of the stoves would have sufficed to foresee that people do not read manuals because they do not read at all. Secondly, even if they have some education, it may not be adequate enough to form the habit of reading manuals.

The problem here is that, as Bijker (1997: 77) points out, we have only the comments of the "vocal" agents. As one can see from the analysis, the end users are conspicuous by their absence. We do not hear their voices. That is why I tried to fill the gap by commenting on the situation of the end users. In fact, I do not need any systematic generation of data at the moment in order to comprehend the situation of the users. Most people who actually use the wick stove at individual homesteads are uneducated women working for small amount of monthly salary in these homesteads. Thus, what is missing in the controversy for and against the use of K-50 is the condition in which it is actually used at the household level. Their absence in the controversy therefore seems an expression of their absence in other dominant discourses.

Now, to conclude the last two subsections, let me briefly come back to the interpretive flexibility of meanings. For the media, K-50 is something that "explodes;" it is something that is very dangerous. For Finchaa and the principal engineers involved in the design of K-50, it is environmentally-friendly artifact and a homegrown invention that assists the country in reducing its reliance on imported fuel. For the end users, though we do not hear their own voices, we could gather that their inclination would be to share the meanings of the media. For, as I have gathered from my interview with those involved in the project, immediately after the media's reports sales had sharply dropped down. At this moment, K-50's major consumer is one ceramic factory – it uses it for heating its furnaces. Other factories are also considering adopting it for the same purpose. The fact that K-50 is now being used mainly for other purposes other than what it was intended for originally would very well demonstrate how the meaning of a given technological artifact is socially constituted.

3.3. Stabilization (closure)

As the above analysis shows, the destiny of K-50 has not yet been determined. Thus, it has not been stabilized. However, it is still possible to conjecture its direction. At this point, what Pinch and Bijker (1987) discuss of closure is very useful. Of very special importance here is the distinction they make between two types of closures, namely

"rhetorical closure" and "closure by redefining the problem." The first type refers to when advertising becomes the prime instrument to end "controversy":

To close a technological "controversy," one need not *solve* the problems in the common sense of that word. The key point is whether the relevant social groups see the problem as being solved. In technology, advertising can play an important role in shaping the meaning that a social group gives to artifact. (1987: 44)

Extending this logic to the case of K-50, it is possible to argue that the artifact has reached the stage *where it is now* as a result of negative rhetoric closure.

But more appropriate to the case of K-50 is the second type of closure that Pinch and Bijker discuss. In other words, "closure by redefining the problem" seems to explain the possible direction that K-50 might follow in the future.[11] In spite of the fact that, and also because of, the opposition that it encountered, its use seems to get forcefully redefined. In other words, though it has become a problem when it is conceived or interpreted as a household fuel, its future *as industrial fuel* seems to be brighter.

4. Conclusion

Different theoretical models are employed in order to analyse the development, introduction, and use of different technological artifacts. Although the field of science and technology studies is a relatively new area of study, it has generated a good number of theories or theoretical models. The social construction of technology (SCOT) is among these.

As I have tried to demonstrate above, it is the SCOT model that the analysis of this paper has employed. Following SCOT, I have analysed the story of the development and introduction of K-50, which has been developed as alternative fuel in Ethiopia. One of the key steps in such an analysis is identifying the relevant social groups and subsequently analyzing the meanings each ascribe to the given artifact. The logic

[11] Pinch and Bijker (1987) relate that although the air tire had encountered an opposition from cyclists, it was not a problem at all for sporting cyclists: "…the meaning of the air tire was translated to constitute a solution to quite another problem: the problem of how to go as fast as possible. And thus, by redefining the key problem with respect to which the artifact should have the meaning of a solution, closure was reached for two of the relevant social groups." (1987: 46)

behind this is that it is the relevant social groups that "constitute" an artifact (Bijker 1990: 85). In other words, it is the "interpretive flexibility," or the meanings that different social groups give to an artifact that makes the artifact "working" or "non-working." Bijker maintains:

The "working" and "non-working" of an artifact are socially constructed, rather than intrinsic properties of the artifact. One artifact (in the old sense) comprises different socially constructed artifacts, some of which may be "working", while others are "non-working." (1990: 83)

In this regard, my analysis has also tried to canvass the role of each social relevant group in the constitution of the meaning of K-50. At this moment, as I am writing this paper, K-50 has two diametrically opposite meanings. For the media and for most people who used it for some time, K-50 is "non-working." Whereas for the factory producing it and for the industry currently consuming it as well as for factories which are considering using it, it is "working" in the sense that it still exists and functions. What I would like to reiterate at this point is that the functions of technological artifacts is something that is socially constituted. This is what the SCOT approach is trying to demonstrate.

The other point I would like to touch upon in this conclusion is the strength of SCOT in comparison to actor-network theory (ANT), and, shortly afterwards, the relative strength of the latter compared to the former. One of the strong sides of SCOT lies in that it enables us to follow the views of all the actors involved in the development and use of a technological artifact. When it comes to ANT, it rather gives priority to the "script" of the designers. What the designers think or what they are supposed to have conceived plays a dominant role in analyzing an artifact. In this regard, an analysis that follows the ANT approach would seem to undermine the place of users. In their "Introduction" to the book *How Users Matter: The Co-Construction of Users and Technologies* (2003: 3-4), Nelly Oudshoorn and Trevor Pinch very well highlight the contribution of SCOT in this respect. When Bijker notes that "there is no artifact which is not constituted by a relevant social group" (1990: 85), he is emphasizing the significance of the user and other relevant social groups in the construction of a technological artifact.

Now let me turn to ANT. What would have been ANT's contribution were it the approach used here instead of SCOT? The notion of "script" as used by Madeleine Akrich and Bruno Latour (1992) would have enabled me to analyze the discrepancy between the designer's "inscription," on the one hand, and the "description" of the end users, on the other. As I have shown when I discussed the designer's point of view,

there has been repeated contention that the problem lies in users not being careful when they use the fuel. In this regard, the claim seems to be that the consumers have "misread" the technology. On the part of the users (at least, as I understood it via the media), on the other hand, the factory (a category which includes both designer and producer) had provided the wrong text. It follows from this that ANT would have been very useful in bringing out this aspect of the issue very well[12].

Finally, the principal value of this study lies in bringing together engineering knowledge and the social sciences in the Ethiopian context. The study could somehow be taken as experimental in that it helps us to see the interface between the two areas – an interface which is given little or no consideration among either social scientists or technologists in many 'developing' countries. The importance of the field of Science and Technology Studies, and methodologies such as "social construction of technology," "social shaping of technology," "actor network theory," and variety of approaches in the field of Philosophy of Technology ("phenomenology of technological artifacts," to mention one) is in this regard unquestionable. Especially, for countries which rely much on imported technological products and have little incentive for home-grown technological artifacts, such approaches could chart new ways of developing or adopting new technologies. Lack of such perspectives would immediately lead us to misconstruing the situation we found ourselves in whenever we encounter difficulties like one that marred K-50. In the case in question, we have seen that both designers and users seem to panic instead of trying to understand the problem as an aspect of the development of a new artifact. The designing or producing factory saw in media commentaries nothing but an act of sabotage whereas the media looked at the product as an instance of premeditated evil doing. The noted sociological and philosophical perspectives would therefore help us to avoid such hasty and quick-tempered generalizations, and, instead, illuminate the manner in which technological artifacts are designed, produced, and appropriated or used by consumers.

[12] I would also like to point out the conspicuous absence of the gender aspect here. Employing one of the various gender approaches in science and technology studies might have generated an entirely different type of data that might in turn enable us to come up with a different meaning or interpretation of the story under discussion in this paper. As I have already noted in the course of my analysis, despite the fact that (in effect, because of) most end-users of the fuel under discussion are obviously women (most of whom are uneducated and poor housewives or housemaids), their voice in the hot controversy is completely absent. And this absolute disregard is actually a function of their absence in other dominant discourses.

Appendix

Main Interview Questions for experts involved in the development of the project

1. When was project K50 conceived?
2. Who took the initiative to develop it?
3. Which institutions were principally involved in the project?
4. Was it tried before this in other countries?
5. What were the engineering and economic rationales to conceive and develop this product? (Please describe and comment on the design process)
6. How many years did the research take? (Please indicate the duration)
7. When did the final product reach the users?
8. Were there prior attempts to introduce (or orient users about) the artifact (i.e. K50)?
9. Were there objections/competing interests that were actually or potentially obstacles to the development of the artifact?
10. Who were the principal distributors? How many are they?
11. What were the principal problems that users of the product encountered?
12. What was the response of the public?
13. What was the response of the media? Was the reaction of the media exaggerated?
14. What was the response of professional associations to the problems that the product or the way it was handled by users created (such as Chemical Society of Ethiopia, Society of Chemical Engineers, etc.)
15. Was there any response from government agencies (such as Science and Technology)
16. What do you think is the major source of the problems? (Please elaborate this point as much as you can)
17. What were the measures taken by the producers/distributors?

    (a) immediate actions_____ (b) long term actions _____
18. What is the current status of the project? What is its prospect? What measures are being taken to prevent similar problems? What actions are planned in order to reverse/redress the negative image that the media or any other agencies created?
19. Does Gaia project have something to do with K50? If yes, is it a continuation of K50 or is it an attempt to substitute it? If the answer is no (i.e. there is no connection between these two projects), is it intended as just another alternative fuel like K50? (Please comment on this project as extensively as you can)
20. Please feel free to add anything not included above.

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