The role of language in engineering competence

Conference or Workshop Item

THE ROLE OF LANGUAGE IN ENGINEERING COMPETENCE

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Abstract— *The behaviour of engineered products is becoming less evident from their outward appearance. Thus many current engineered products have unseen properties that become evident only after protracted investigation, analysis or use. Nevertheless marketing staff, potential users, disposal experts, financiers and so on will wish to make informed decisions about products and commonly their choices will be based on more accessible descriptions, explanations, scenarios and accounts of a products use rather than their direct experience. Engineers usually work with others in enterprises that produce things or provide services. The engineer rarely provides the service or makes the goods but, as a professional, the engineer guides the rest of the enterprise and persuades others to take particular courses of action. It is clear that an engineer's central interest is the artefact. Interestingly the artefact may be in the process of design or the subject of a feasibility study and hence will have no material existence, but it will be circumscribed by a wide variety of texts including specifications, technical reports and standards. Using their specialist language and analytical techniques, the individual engineer will gain assurance about his or her view of the artefact through discussions with fellow engineers, but at some point they will have to convey that view to non-technical specialists. Within the enterprise the engineer will become either an advocate or an adversary of the artefact faced by other individuals or groups who because of their professional or cultural background will value things in different way. The role of the engineer is then as a protagonist or opponent of the artefact within, using Bruno Latour's evocative phrase, a "Parliament of Things". And competent engineers, as competent advocates of artifacts, need fluent linguistic and rhetorical skills as well as analytical proficiency and the knowledge that will give them the confidence to project their views. The paper examines the implications for engineering education.*

Key Words— *Language, Engineering, Documentation*

INTRODUCTION

Engineers work as specialists in enterprises that make, maintain, deploy or use artefacts. The engineer is likely to be one of a number of professionals with special interests and will be working alongside financial specialists, marketing staff, materials specialists, lawyers and so on. The engineers special interest is with the artefacts that the enterprise produces or employs within the organisation.

Developments in technology are creating products with a behaviour that is not immediately obvious from their outward form: complex integrated circuits performing radically different functions are encapsulated in almost identical packages; novel materials simulate traditional appearances; consumer goods with enhanced functions appear to be similar to basic models; software that transforms the behaviour of a computer can be downloaded without any material exchange. Thus engineered products have properties that are not readily apparent.

Engineers usually work with others in enterprises that produce things or provide services. The engineer, as a professional, guides the actions taken within the enterprise and works with other professionals with different interests and who, in the global workplace and marketplace, may be situated in different locations and members of different cultures. The individual engineer provides a voice in support of the artefacts within a pool of different professional cultures laden with competing interests, disparate guidance and contradictory advice.

It is clear from engineering texts that an engineer's central interest is the artefact. Interestingly the artefact may be in the process of design or the subject of a feasibility study and hence will have no material existence except as the subject in a variety of texts. Even after production has started the artefact will be circumscribed by production reports, production procedures, marketing documents, legislation, trade agreements, engineering standards, test schedules, tables of measurements, instruction manuals and so on.

In providing explanations on how to use an artefact to users, labelling an artefacts functions, in persuading fellow professionals of the merits or problems surrounding an artefact, engineers must be proficient language users and hence rehearsing language skills is an important part of an engineering training.

GROWTH OF IMPORTANCE OF LANGUAGE

Products generally evolve as derivatives of earlier products. This is not because people lack imagination, but because the users have to find a place in their lives for novel artefacts and have to understand how the new artefact might be used. Change is rarely to do with radical shifts in functions but more to do with making a familiar function available to a larger audience or improving the reliability or quality of a familiar product.

Production economics have pushed many current product developments towards the substitution of mechanical devices by electronic components. Initially this may have little effect on the function of the product or on its appearance. With a familiar form, the user knows what to use the product for and how to use it. A shift to electronic components has allowed manufacturers to alter the shape and size of products away from traditional forms. This can present the user with the conundrum on how the product is to be used.

Mechanical and electromechanical components of products are frequently replaced by electronic components that perform similar functions. Telephone dials, cameras and tape recorders are examples where electronic components substitute for mechanical components. There are a variety of reasons why such substitutions take place, but one effect is that the physical appearance of the products is no longer governed by the construction of elaborate mechanical assemblies. Products lose their traditional shapes and the way products are operated is altered. To exploit the knowledge that the public has of traditional forms of products, the newer electronically based products often have controls with functions indicated by icons with shapes inherited from older products. The arrow symbols used on tape recorder to indicate controls for the forward movement of the tape, for example, have been retained even on fully electronic voice recorders which no longer incorporate moving parts.

The change in construction of products like telephones has meant that different actions are required to access familiar functions. For example, lifting the handset from a cradle once automatically connected the telephone to the dialling registers in the telephone exchange. Now, on many handsets, picking up the handset does not provide the connection; a button has to be pressed. The button is commonly labelled with an icon which is the outline of the handset of an earlier generation of phone and unlike the shape of the phone that the user has picked up. The form of the handset carrying the icon is on the right of Figure 1 and the icon appearing on the handset is on the left.

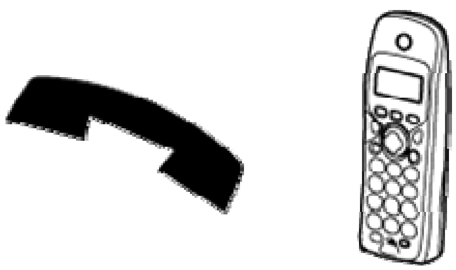

FIGURE 1
THE ICON INDENTIFYING THE BUTTON TO CONNECT THE PHONE TO THE EXCHANGE AND THE HANDSET, WITH A DIFFERENT SHAPE, THAT CARRIES THE ICON.

Figure 2 provides a series of examples of where the displayed icon is in the form of a technology that preceded the technology of the product carrying the icon. First, the indicator that shows the state of charge of a battery on a mobile phone is an outline of a cylindrical battery although the phone has a battery of quite different shape and form.

A camera with a digital timer indicates that the timer is operational by displaying the dial of an analogue clock and the directory of telephone numbers on some electronic telephones harks back to paper directories with a picture of an open book as the icon that represents the directory. An indicator to show that a microscopic electret microphone is live and ready to record is indicated on a voice recorder by an image of a bulky studio microphone of an earlier generation. The video mode on a digital camera is indicated by the picture of an old fashioned cine camera with the film reels clearly visible, although in practice the video will be recorded in a solid state memory in an integrated circuit. Telephone answering devices also commonly incorporate solid state memories, but the icon on the control that sets the recorder into operation commonly looks like a tape cassette or a pair of tape reels from an earlier technology.

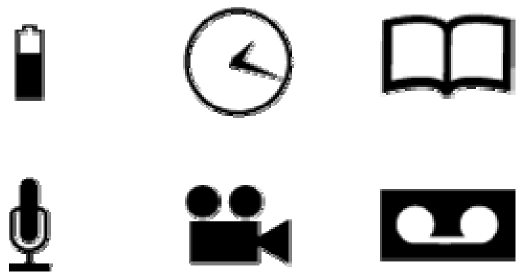

FIGURE 2
ICONS BASED ON EARLIER TECHNOLOGIES:
UPPER ROW CYLINDIRICAL BATTERY ON A MOBILE PHONE USING A FLAT FORMAT BATTERY, ANALOGUE CLOCK TO INDICATE A DIGITAL TIMER, BOOK TO INDICATE AN ELECTRONIC TELEPHONE DIRECTORY.
MIDDLE: EARLIER GENERATION TELEPHONE HANDSET ON A HANDSET WITH INTEGRATED DISPLAY AND KEYPAD.
BOTTOM: STUDIO MICROPHONE ON A PORTABLE RECORDER; MOVIE CAMERA BASED ON FILM ICON ON A CAMERA WITH SOLID STATE STORAGE; REEL TO REEL TAPE ON AN ANSWERPHONE WITH SOLID STATE STORAGE.

The growing capability of electronics has allowed manufacturers to combine what were separate functions within one package. For example, most telephones will incorporate a clock, mobile phones can incorporate cameras and cameras can record sound as well as pictures.

FIGURE 3
FOUR ICONS FORMED USING A PICTORIAL GRAMMAR.
THE FIRST THREE USE A STRIKETHROUGH TO INDICATE A NEGATION: NO SOUND, NO FLASH AND TERMINATE CALL. THE FINAL SYMBOL COMBINES TWO ICONS TO INDICATES A TIMER FOR TIMING MOVING IMAGES.

The operation of more sophisticated products presents the user with a more elaborate task and the manufacturer with the problem of how to signal to the user how to operate the product. With the increased range of functions come the requirements to identify the product’s functions, to indicate how the product should be operated and what its operational state is. One possibility is to combine icons on products to form a pictorial grammar. Figure 3 offers some examples of hybrid icons where pictorial symbols are combined. One universal symbol is a line striking through another symbol to indicate a negation. Other symbols are simply combinations of established icons such as the symbol for indicating that video recording is limited in duration by a timer.

TEXT AS AN ALTERNATIVE

Since combinations of icons are not in common use, the use of an iconic grammar can be confusing. And in some instances there is no obvious tradition to provide an icon to stand for a particular function. A more familiar way of describing more complex functions is through language.

For example, CD's, which may carry software or music, reveal visually very little about their content and usually include some textual explanation on the CD label and in the jewel case. CD's are following the long tradition established by music recordings such as wax cylinders and vinyl records, but CD annotation may also reveal its content as software and include installation instructions. Without the instructions the CD may be unusable and thus, for the user, the text is a part of the product. Thus the product in most instances is not a material artefact, but the use of a material artefact. At one time the material artefact or its iconic controls revealed how the artefact should be used, but now the use may have to be explained.

A CD player that can play conventional audio CD's looks very similar to a CD player that can play audio files encoded using the MP3 format. Similarly a CD player that can play commercially manufactured CD's only looks similar to a CD player that can operate with CD's that can be written on by a PC. The sellers of CD players will want to indicate on the added capabilities of their product and commonly they will do this by adding text to the images of the products appearing on the packaging, by describing the added features in the user manual and adding decals bearing added text to the product's casing. The extra text is likely to include the abbreviations CD-R/RW and MP3. Without these indications the user may be unaware of the added capability and therefore not able to use the material product as intended.

High tech products with new functions or new kinds of controls require new behaviours on the part of the users. If the users are unable to operate the controls on the product then the product will not behave as intended and not fulfil its promised function. The changed behaviour of the user is an integral part of the product. For example, a rubbish bin with an automatically opening lid has to be explained to the purchaser since there is no established tradition for how such products should behave:

> *When disposing rubbish, bring your hand into the inductive area, the lid will then open automatically within 0.5 seconds. The indicator light will then turn green. After the rubbish has been disposed, remove your hand away from the inductive area; the lid will then close automatically within 0.5 seconds. The indicator light will then turn red when the lid is closing.[i].*

Text is one way of bringing about behavioural changes in users. Changes can be stimulated by voice and sound or moving images, but text is less intrusive economical in using users time and can be delivered in context. More sophisticated use of language is possible using alphanumeric displays. The small screen of a mobile phone, or a camera, can carry a menu of items that can be scrolled. The mobile phone menu includes items such as “Dictionary”, “Send by set” and “Save”. The menu system is hierarchical so selecting an item may bring up a further menu with terse statements about actions that can be taken.

The rubbish bin is an example of product with a function that make use of sensors so the product does automatically what previously required manual intervention. The user simply does not need to be reminded about what to do since the product works automatically, however the user may need to be aware that the function is being performed. The user manual is then likely to be the place where automatic functions are noted and the explanation will include text. Autofocus and auto exposure on cameras are examples of functions that are now frequently substituting for what was one a manual task.

Static labels can combine with very simple and cheap indicators or controls to provide low cost ways of indicating the state of products. For example a rotary control labelled “Max” and “Min” can provide an indication and an opportunity to control, for example the volume of a radio.

A weakness of text is that there is not a universal way of writing and text on a product or packaging has to be altered to serve different language groups. In practice this can involve a simple change since products also have to be modified technically or labelled in different ways to meet the requirements of local consumer and safety laws.

Print technology is also undergoing developments that allow sophisticated changes to labels without interrupting production. Language delivered on screens, including the small LCD screens attached to all kinds of consumer products from toys to washing machines, can be stored in its many variations in electronic devices and the user can be given the choice of language. Menu's on digital cameras, for example, will often be available in a variety of languages.

Many products are delivery channels for other products. A PC is a delivery channels for word processing software. A radio is a delivery channel for sound production networks. A telephone handset is a delivery channel for voice services. The users and the service providers have an interest in users looking beyond the delivery device to find out about the services offered even before they make a selection. Thus CD players, radios, TVs and telephone handsets can display service details and these are commonly displayed as text, effectively using a textual communication link between the service provider and the user. With a massive expansion in available services, textual channels for communicating with users provide compact and efficient ways of guiding users in their choice. The textual channel is therefore an important component of a service and the capability of supporting a textual channel is an important feature of delivery technologies.

The product of an engineering enterprise is itself an activity that is transformed or facilitated by some artefact. The production of the artefact is therefore a significant part of the engineering enterprise, but its goals are not achieved if the clients or customers do not integrate the behaviour of the artefacts with their own. For example, engineers may design and build cameras for detecting vehicles and their speed that are intended to enforce speed restrictions on the road, but unless the operation of the cameras is explained to the policing authorities and the motorists then the product will fail to moderate the heedless drivers. Engineers may build sophisticated radio networks and radios providing digital broadcasting, but unless instruction is given on the use of the novel radios then consumers will not tune in to the new services or buy the radios. Thus the packaging, which is what at the point of purchase the purchaser sees, on a radio has to include the sentence:

> *More than 80% of the UK population can receive digital radio transmissions. For details of whether you can receive DAB please refer to* www.digitalradionow.com *or ask for a leaflet in store[ii]*

In addition, to the textual components of products, the user manuals that influence the behaviour of the users and the packaging that influences purchasers products can also become a complex of text, icons and logos put there for legal and commercial purposes but nevertheless and integral part of the product. Text is therefore an integral part of present day products and the design of the product therefore includes the sentences and words that the product, its manuals and its packaging display.

THE PRODUCT IS MORE THAN THE GOODS

Today we are familiar with dealing at a distance with bureaucracies of various kinds — banks, governments, retailers, and possibly universities — which are represented by people we have never met. Our interaction with them is informed by paper records and database contents thus who we are is, in part, stored in high-tech records[iii]. People engage in bureaucratic interactions because they wish to influence what is to happen to them and the result of the interaction is, ultimately, an effect that they feel. Our discussions and actions are governed by records and texts of specialist kinds and these records and texts stimulate conversations that generate new records and texts even about people we have never met.

The same applies to the non-humans. Engineers, for example use CAD systems to draw diagrams, plans and schedules and they write reports and part of being an engineer is to have satisfying conversations stimulated by diagrams, plans, reports and schedules as though the conversation was about some artefact[iv]. The artefact may not be built or it may have been destroyed nevertheless it influences the engineers and their actions. Plans, for example, may cause the engineers to request manufacturing machinery and raw materials or a diagnosis of a failure may cause an engineer to impose speed restrictions on a vehicle. Financiers, too, will have conversations about artefacts, but their conversations are stimulated by balance sheets, costings and financial instruments.

Documents shape people’s behaviour perhaps more precisely that the artefact they explain or describe. The artefacts themselves can be too extensive, too distant, contain parts hidden from view, parts that are microscopic, parts whose operation is obscure, the artefact may not yet have been built or may have been discarded or destroyed. For example the Ariane 5 rocket broke up on its launch and an enquiry discovered

> *The failure of the Ariane 501 was caused by the complete loss of guidance and attitude information*

And the cause was attributed to defects in specifications and designs that were not a material part of the launcher yet influenced the deliberations of the enquiry. The enquiry concluded the fateful

> *loss of information was due to specification and design errors in the software of the inertial reference system.*

The erroneous documents were translated into faulty software which was installed in the launcher. In their investigation the investigators turned to the material of the launcher since “*all the launcher debris fell back onto the ground*” but “*Recovery of material proved difficult, however, since [the] area is nearly all mangrove swamp or savanna.*” Nevertheless the enquiry had available

> *telemetry data received on the ground …, trajectory data from radar stations, optical observations (IR camera, films) [and the results of the] inspection of recovered material.*

And a recommendation was made that in future they should aim to

> *Provide more data to the telemetry upon failure of any component, so that recovering equipment will be less essential.*

It is hardly surprising that data records informed the enquiry because the launcher was destroyed, but the subsequent discussions used the report and by implication the data records to describe the launcher and to explain its operation although it was no longer an integral material artefact. In this way the launcher continued to have an existence after the disastrous crash. The enquiry also recommended that the launcher software be reviewed, although clearly the manifestation of the software in the launcher was destroyed. In this case the review was to be carried out on the text of the software that had been processed and turned into the code that had become part of the launcher. The text of the software therefore did not travel with the rocket but was still considered to be a component part that survived the crash.[v]

Thus products live on in linguistic form even after cancellation or loss of their material components. For example, the Avro Arrow aircraft was

> *Designed as a defence against Russian bombers during the Cold War, … was a source of great pride … With its cancellation came inevitable and surprisingly durable accounts that have become Arrow myth and legend[vi]*

The Arrow remains a talking point although the order was given to destroy "*all 37 planes and blueprints*".

Huge civil engineering constructions have an obvious material existence, for example:

> *Washington's Grand Coulee Dam is an engineering marvel, the largest concrete structure ever built.*

But the structure is mirrored in a collection of documents:

> *In the 68 years since its creation, the power plant has accumulated more than 200,000 construction and maintenance drawings. … so far they have scanned and vectorized about 25,000 documents*

And it is clear that maintenance engineers refer to these documents to plan modifications and maintenance since they are seen to be "*critical engineering resources*"[vii]

Similarly when

> *the first of the two oil tankers [were] converted into Floating Production, Storage and Offloading (FPSO) [its] transformation include[d]… in excess of 100,000 engineering documents[viii]*

Documents are therefore integral parts of engineered artefacts and guide people in the operation, construction, maintenance and diagnosis of the material aspect of products. Since documents, through their use of language, can refer to the past or the future they can help to shape the identity of goods that no longer have a material form or are yet to be made.

THE PROCESS

Obviously, products do not emerge spontaneously from factories. Aristotle explained that people deliberate about their *technê* and because there are greater uncertainties surrounding a *technê*, people are more measured than if they were involved in science[ix]. This deliberation, according to Aristotle, can be good or bad and cannot simply be the recall of scientific knowledge. Good deliberation must consist of faultless inferences and contribute to the production of a worthy product. Generally, Aristotle writes, this deliberation requires inquiry and calculation. In today's industrial organisation, engineers are at the centre of this deliberation, which is often hidden from the product's users but becomes evident when projects are abandoned and commentator's remark on the wasted effort. Such as when

> *The entire Elliott 503 Mark II software project had to be abandoned, and with it, over thirty man-years of programming effort be abandoned[x]*

Or the effort is translated into financial terms, when, for example,

> *The Pentagon announced the cancellation of the … Comanche helicopter program, a weapons system from the cold war era that became the victim of new technology and rising concerns over military costs … a program that … cost $8 billion but has yet to produce a single aircraft.[xi]*

Or the work that has been carried out on one product is transferred to another

> *Intel Corp. is canceling the next generation of its desktop and server chips as it moves up its schedule for releasing processors with two cores on a single piece of silicon. … However, given the work done by its engineers, Intel will be able to accelerate its schedule for releasing dual-core processors[xii]*

But this raises a question: if there is no significant material result then what is it that is lost in the cancellation of a project and what is it that can be transferred to another product. And it is the effect of deliberation on the people involved in the project. Creating a product is

> *as much a matter of getting different people to share a common perspective, to agree on the most significant issues, and to shape consensus on what must be done next, as it is a matter of concept formation, evaluation of alternatives, costing and sizing.[xiii]*

Larsson points to the use of non-verbal devices

> *Where verbal language was not enough, they used gestures, chairs, sketches, prototypes and all possible types of objects to visualize and describe what they wanted to 'say'.*

But the aim is to negotiate meaning which "*is collaboratively constructed in the negotiations, discussions and arguments that designers continuously have in their everyday work*" and involves "*the telling of stories*"[xiv]. The stories are about a specific product, the way it might be constructed and the way it might be used.

There is seldom a question about what product people are working on. When, for example

> *Lucent Technologies Inc. confirmed … that it's canceled its SpringTide Service Switch series[xv]*

there is no doubt about which products are involved. The debates, announcements and conversations construct a product identity

> *for any particular product, a language is 'invented' which allows a description of the ongoing experience of that product …. In other words the product is constructed in words as it is constructed in reality. As the process develops, discourses … start to emerge surrounding the product and accordingly the product begins to assume some sort of identity.[xvi]*

The location of this deliberation and construction of a product's identity are the incessant meetings that take place in engineering enterprises. Rosalind Williams, an erstwhile Dean at MIT, suggests that meetings are "*a primary site of technological action today*" [xvii], and it is clear that professionals of all kinds in enterprises spend much of their time debating the options that will influence the products of their organisation. Part of the discussion that takes place is to assign people to roles and to select who can join in deliberation, with the aim of ensuring that the deliberation is of a suitable standard. The engineer, for example, is asked to produce considered accounts, reports and justifiable designs — internal products for the enterprise that influence production. But not everything is recorded and much time is spent in conversation in the

> *…meetings that produce the specifications; the discussions around rough calculations and sketches that create understandings among the participants;*

> *the arguments about interpreting test results and prototype qualities that contribute to 'feel' and 'intuition' about aspects of the design; and the debates about whether the design is 'done', if the specifications have been 'met', and if the result is 'good'…[xviii]*

Informal as well as formal communication takes place. Since the creation of a product involves many different professions in possibly many different locations

> *the process is fundamentally social, requiring a lot of interaction and communication between the people involved. Additionally, good design often relies upon the ability of a crossfunctional team to create a shared understanding of the task, the process and the respective roles of its members. The negotiation and bargaining for common ground are essential.[xix]*

To be effective, any professional, including the engineer must be able to contribute to meetings.

THE ADVOCATE

In the first instance an engineer involved in the creation, operation or maintenance of an artefact has to have self-confidence in the desirability of the artefact and the harmlessness of its side effects: "Can it be fabricated?", "Will its performance be adequate?", "How might it be used?" and "How should it be discarded?". At this stage the engineer will translate wider interests into engineering terms thus a wider interest in global warming may get translated into a requirement for low power consumption or concerns about water pollution may be translated into the proscribing of certain chemicals in production processes.

The engineers will refer to an inventory of components, structures and scenarios that are invisible to non-engineers hence employ a specialist vocabulary and particular ways of describing artefacts and explaining their behaviour. Using their specialist language, the individual engineer will gain confidence in their view of the artefact through discussions with fellow engineers, but at some point they will have to convey that view to other specialists, in marketing, finance or legal departments for example, who see the artefact in different ways and use a different vocabulary to describe it. Within the enterprise the engineer will become either an advocate or an adversary of the artefact confronted by other individuals or groups who may take a contrary view and who because of their professional or cultural background will have a different repertoire of associations, will value things in different ways and will have a different ethical vocabulary. The role of the engineer is then as an advocate or adversary for or against the material artefact in, using Bruno Latour's evocative phrase, a "Parliament of Things"[xx]. The effectiveness of an engineer is then in constructing a secure and valid case, being able to present that case to engineers and non-engineers. Engineered artefacts are thus for many actors partially or wholly constructed from language and promoted or demoted through descriptions, explanations, accounts and diagnoses. The construction of artefacts is as much linguistic as it is material and requires competent advocates.

THE PROFESSION

In the longer term, the engineers' view of products, the associated collective conversations and the records that stimulate them define a profession that has made a claim for a certain kind of competence.

Things like transistors, capacitors, electrons are named and form an inventory of things that the engineering profession deals with. As the history of electrical terms shows this is a slow process that involves invention by individuals and debate within the profession. For example, in the nineteenth century,

> *Oliver Heaviside, who published several notes on nomenclature, proposed the use of the term impedance as a linguistic analogy to resistance. W H Preece, an influential figure, rejected the use of the term impedance. … Preece hints at competing analogies including 'retardation', 'throttling', 'hindrance' and 'choking' … Currently the word 'impedance' is in common use and Preece's preferences have been displaced.[xxi]*

Participants, who believed that discussions about impedances and other nascent electrical terms were worthwhile, naturally formed a collective alongside the material artefacts they wished to explain and describe (such as the telegraph and the telephone). Those that become users of a dominant terminology come to form the rump of a professional group identified by the language that they used. And the words that they adopted signalled the non-humans that they felt they were entitled to speak about. These artefacts appeared in the locations and instruments that the professionals used. Thus the capacitor started out as Volta's condensor, acquired the name of capacitor and now appears symbolised in the electronic engineers' computer based modelling tools. The capacitor, including its name, is institutionalised and helps to form the profession of electronic engineers, comprised not only of people but their tools, the locations for their tools and their vocabulary. The profession is also constituted from its debates and discussions that led to the institution of capacitors, transistors, gates and integrated circuits. This formation of an institution required a collective effort in which a specialist language plays and continues to play a central role.

Professionals wishing to claim a special kind of competence also need the help of other groups so that they can have a secure and stable place in a wider society. They need others to be convinced that the profession has a valuable role, for example, engineers must persuade entrepreneurs and armies that there is a place for factories, CAD design suites and transistors in the entrepreneur's and general's view of the world. And they need to persuade the public that the changes in ways of life that engineers and their artefacts bring are worthwhile and not unnecessarily disruptive.[xxii] Such persuasion requires articulate specialists. Without them the professional group becomes invisible.

CONCLUSIONS

The profession of engineering is constituted from the language that engineers use and supported by the conversations that their artefacts stimulate.

The artefacts, however, also need support. It is more difficult for an artefact to promote itself as its functions become increasingly buried inside packaging determined by its aesthetics rather than its mechanics. It is more difficult to persuade users of the value of artefacts as the intended use slips further away from traditional ways of life. The variety and complexity of function make it difficult for a product to speak for itself without the use of language. But products are not naturally language users. The engineer thus has to add language to a product to advertise its functions and modes of use of the product by incorporatung textual labels, textual displays, instruction manuals and descriptions of modifications. And in the development of the product the engineers themselves, without the material product to hand, must invent stories in which the proposed artefact has a place and in which it gains its identity.

Language use is then a vital skill for the engineer who has to address the users through the medium of the artefact, address other professionals through meetings and using reports, address fellow engineers in technical meetings and using the specialist tools of the profession.

For those educating engineers this implies if their students are to become accepted as members of the profession then they must become fluent language users. Their fluency must extend to communicating with fellow engineers, potential users of engineered artefacts and other professionals. In growing global markets and with the growing numbers of global engineering enterprises, there is a growing demand for language skills in several languages. But as a first step, aspiring engineers must be proficient in the use of their first language, and this requires engineering programmes to provide the opportunity for students to rehearse the production of explanations, specifications and arguments both in writing and face to face. Moreover it also requires teachers who can constructively improve the linguistic skills of their students, and provide illustrations of the textual components of products and development processes in engineering enterprises.

REFERENCES

[i] Automatic Dustbin User's Manual, Models DZT-8-2, DZT-20-1, DZT-27-1, DZT-50-1, Nastech International Ltd., London, UK, (c.2004).

[ii] Intempo radio packaing, Model KT-01, Intempo Digital , Altringham, Cheshire, UK, (c.2004).

[iii] Monk, J., “The Digital Unconscious”, *Virtual/Embodied Presence/Practice/Technology* Wood, J.(ed.), Routledge: London, 1998, pp. 30-44

[iv] Monk, J., “Ceremonies and Models”, *The Book of Models*, Hughes, R. & Monk, J. (eds), Telematics: Milton Keynes, UK, pp.32-49, 2003.

[v] Lions, J.L., “Flight 501 Failure”, *Report by the Inquiry Board*, European Space Agency, 19 July 1996

[vi] Kingsley, J., Who ordered Canada’s Avro Arrow destroyed? Toronto Star, Feb 2, 1998, p.A6

[vii] Mills, C., “Get That Dam Up to Date”, *Desktop Engineering*, 8, No5, Jan 2003

[viii] “Halliburton Announces Major Milestone Toward Completion of Barracuda-Caratinga Project in Brazil,” Press Release, Halliburton, Public Relations, Wednesday October 13, 2004

[ix] Aristotle, Nicomachaen Ethics, Crisp, R.(ed), Cambridge University Press, 2000, 1112b

[x] Hoare, C.A.R., “The Emporer’s Old Clothes”, *Communications of the ACM*, 24, No2, 1981, pp.75–83

[xi] Business Digest, *The New York Times*, Feb 24, 2004, Section C, p.1

[xii] Burt, J., “Intel's Dual-Core Chips Bump Next-Gen Pentium 4, Xeon”, *eWeek*, May 7, 2004

[xiii] Bucciarelli, L.L., “Reflective Practice in Engineering Design”, *Design Studies*, 5, No. 3, 1984, pp.185–190.

[xiv] Larsson, A., “Making Sense of Collaboration: The Challenge of Thinking Together in Global Design Teams”, *Proceedings of GROUP 2003*, Sanibel Island, FL, USA, November 9-12, 2003.

[xv] Jander, M., “Lucent Silences SpringTide”, *Light Reading*, Nov 06, 2002

[xvi] Lloyd, P.A., “Storytelling and the Development of Discourse in the Engineering Design Process”, *Design Studies*, 21, 2000, pp.357–373.

[xvii] Williams, R., “All that is solid melts into air, Historians of Technology and the Information Revolution”, *Technology & Culture*, 41, No 4 October 2000 , pp.641–668.

[xviii] Minneman, S.L., “The Social Construction of a Technical Reality: Empirical Studies of Group Engineering Design Practice”, Ph.D thesis, Department of Mechanical Engineering, Stanford University, CA, USA, p.63.

[xix] Larsson, A., Törlind, P., Mabogunje, A. & Milne, A., “Distributed Design Teams: Embedded One-on-One Conversations in One-to-Many”, *Proceedings of the Design Research Society International Conference*, Brunel University, September 5-7, 2002. Durling, D. & Shackleton, J.(eds) Staffordshire University Press: Stoke on Trent, UK:, pp.604–614.

[xx] Latour, B., *We Have Never Been Modern*, translated by Porter, C., Harvester Wheatsheaf:, Hemel Hempstead, UK, 1993, pp.142–145

[xxi] Monk, J., “Working in the dark”, *Proceedings of the International Conference on Engineering Education*, Valencia, Spain, July 21–25, 2003, Valencia, Spain

[xxii] Latour, B., *Pandora’s hope*, Harvard University Press: London, 1999, pp.98–111