

Enhancing student communication skills: The development of the PCR Communication Model for engineers

David G. Dowling

Professor of Engineering Education
University of Southern Queensland

Toowoomba, Australia

E-mail: dowling@usq.edu.au

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INTRODUCTION

Communication is a critical part of engineering practice. Engineers communicate with members of the engineering team, with other engineers, with other professionals, with business people, with researchers, and with members of the public. The results of a recent Australian project [1] gave an insight into the importance of a range of communication skills from the perspective of 250 experienced engineers. Just over one-third of the 64 competencies in the study had a mean rating of between four and five on a five-point scale, including all eight of the communication competencies, with six of them being ranked in the top ten competencies. Eight competencies were rated as *critical* (5 on the scale) by more than 50 per cent of the participants, including four of the communication competencies.

A student's life is communication-rich, with lectures, tutorials, practical sessions, presentations, excursions and social interactions providing opportunities for them to hone their communication skills. They rely on their communication skills to acquire knowledge, understanding and new skills. They then use their communication skills to complete assessment tasks to demonstrate their achievement of the learning objectives defined for a subject. However, many Australian students mistakenly believe that communication is just about reading, writing and speaking in English. The PCR Communication Model for engineers was developed to, firstly, demonstrate to students that there are many other factors that contribute to the effectiveness of verbal, visual and non-verbal communications and, secondly, to help them become more effective communicators.

In the first section of the paper a number of well known theories are reviewed with a focus on the key concepts that facilitate effective communication in an engineering context. In the second section, these concepts are used to develop a communication model that will help student understanding; a model they can use to inform the

development of the many communication items they will prepare while they are at university and during their career.

1 EXPLORING COMMUNICATION MODELS

Research in the communication field is undertaken by people from a number of disciplines such as psychology, the social sciences, mass media, and journalism. Many theories have been developed and generally they are associated with one or more of those disciplines. Communication theories may also be categorised by the type of communication, for example: inter-personal communication; mass media; or organisational behaviour.

1.1 The purpose of communication

Writing around 300 BC, Aristotle stated in his treatise on rhetoric that the primary purpose of communication was persuasion; that is, creating a desired response in the listeners [2]. Aristotle defined three elements of persuasion in speech-making: the character (ethos) of the speaker; the production of a certain attitude in the hearer; and the argument itself [2]. Of these elements of speech-making (speaker, message, and listener) Aristotle believed that it was the listener that held the key to the success of the speech, i.e. whether the purpose of the communication was achieved.



Figure 1: A model of Aristotle's components of speech-making

Figure 1 shows the key concepts of Aristotle's model of speech-making. These fundamental concepts are still valid today, not just in speech-making, but also in many other forms of communication. The most important concept is that the *purpose* of a communication is to create a desired *response* in the listener.

1.2 Communication is a process

Lasswell [3] used a five component question to suggest that communication is a process: *Who >Says what > In what channel > To Whom > With what effect?* When compared to Aristotle's model, the only new component is the concept of a *channel* of communication i.e. the way a message is transferred from the speaker to the listener. The paper [3] also introduced two other concepts: *message handlers* and *message controllers*. It suggested that printers, distributors, broadcast engineers, and telephone technicians were examples of message handlers, while radio announcers, editors, and censors were examples of message controllers.

1.3 Communications are transmitted and received

A year later Shannon and Weaver [4] reported on a model they had developed that was based on contemporary telecommunications technology. Through the use of the terms *Information Source* and *Destination* rather than *Speaker* and *Listener*, this model expanded the notion of communication beyond speech. The model also introduced two additional components: a *transmitter* and a *receiver* (see Figure 2). They also highlighted the fact that a message can be subject to interference, which they called *noise*, and this can mean a message may not reach a receiver, or may be misinterpreted by the receiver. An example of the impact of noise is the difficulty of having a conversation in a crowded room.

This type of model is often referred to as a *transactional* model and has been criticised because it is unidirectional and disregards the personal dimensions of communication.

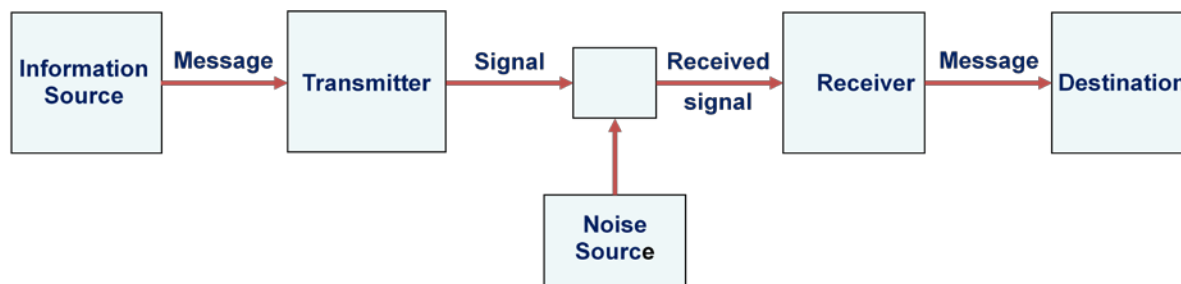


Figure 2: The Shannon-Weaver communication model (Source: [4], P7)

1.4 The communication gatekeeper

The concept of a *message controller* [3] re-emerged in later models, although the terms *intermediary* or *gatekeeper* were used to describe this role [5]. In gatekeeper models the intermediaries are located between the *source* and the *destination* where they occupy a position of power as they may change, or even stop, a message before it is received by the audience. Some contemporary examples of gatekeepers are: editors; reviewers; public relations consultants; and TV directors and producers. An example of this two-step communication process is a radio talk-back session where a delay of at least four seconds is built into the transmission process to allow the producer to terminate a conversation if it goes 'off-topic'.

The gatekeeper role is widely used in engineering practice where, typically, reports, designs and correspondence require the approval of supervisors or company directors before they can be forwarded to clients. This is a critical role as the gatekeeper is responsible for ensuring that the information in a message is both accurate, precise and meets the company's legal and quality requirements.

From the models described in the preceding sections it is apparent that the key concepts to be included in a communication model are: *Purpose; source; transmitter; message; channel; gatekeeper; noise, receiver, destination, and response.*

1.5 The factors that influence communication

The SMCR model [6] was developed after a lengthy analysis of the communication process, beginning with the purpose [2] of communication: '*... all communication has as its purpose, its goal, the production of a response. When we learn to phrase our purposes in terms of specific responses from those attending to our messages, we have taken the first step towards efficient and effective communication*' ([6] p.12). This reinforces the importance of purpose: *who do we aim to affect; and how?*

The SMCR model [6] is reproduced in Figure 3 and shows the ingredients of a person-to-person communication. Because of the combined roles of the source and receiver, the figure only shows four components: **S**ource; **M**essage; **C**hannel; and **R**eceiver. This model is extremely useful as it lists the key factors that influence each of the four components of a communication. In this person-to-person model, the source and encoder are combined in one person and the decoder and receiver in a second person. For other forms of communication these two roles may be separated, for example, one person may write a storyline for an advertisement which is then encoded by others to produce different messages (e.g. text, graphics and video) for the different channels that will be used, such as print, radio and television.

Berlo [6] used the term *fidelity* to describe the quality of a communication. A high fidelity communication will have the desired response from the receiver, a low fidelity communication will not, perhaps because the message was distorted, or not understood. *'Noise and fidelity are two sides of the same coin. Eliminating noise increases fidelity; the production of noise reduces fidelity'* ([6] pp.40-41).

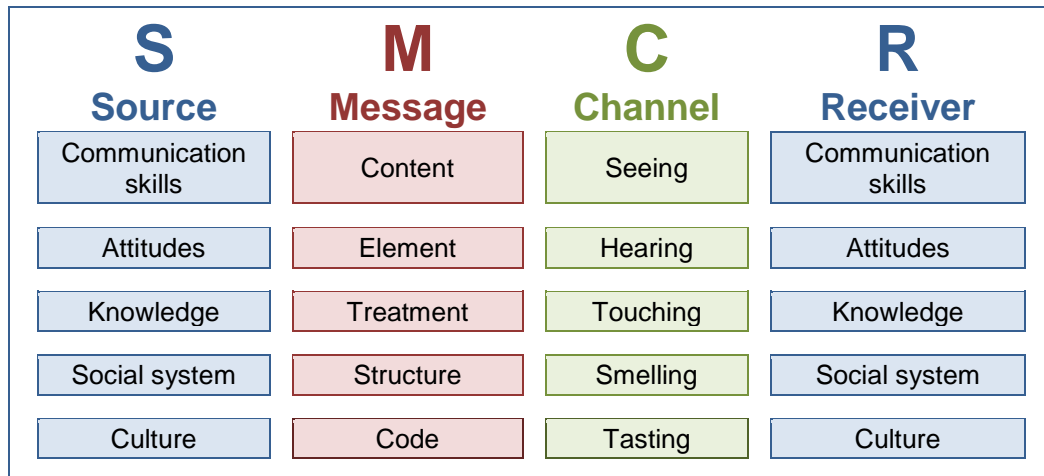


Figure 3: Berlo's model of the ingredients of communication (Source [6] p72)

1.6 Forms of communication

In addition to verbal forms of communication such as speaking, writing and reading, there are non-verbal and visual forms of communication. Non-verbal communication is the term used to describe methods of communication that do not use words. Some examples are: facial expressions, hand movements, food, music, and the ambience in a restaurant. A message may be totally communicated by verbal methods, for example an email, by non-verbal means, such as a hand gesture, or by a mix of these communication methods. Knapp reported that *'In a normal two-person conversation, the verbal components carry less than 35 per cent of the social meaning of the situation; more than 65 per cent of the social meaning is carried in the non-verbal band'* ([7] p. 15).

Non-verbal methods of communication are not well-defined and they are learned through experience. The variety of meanings that can be conveyed when they are used may mean that people misinterpret these forms of communication. For example, culture influences the way non-verbal communication methods such as dress, gestures and time are interpreted. In addition, non-verbal communication methods often involve different senses (the channels in Figure 3) than verbal methods, for example, smell, taste and touch.

Visual communication methods are used to convey messages in many professions and are particularly important for engineers. This is because a visual method may be the only way to communicate a design, construction details, or the condition of a component. Some visual communication methods use both verbal and non-verbal communication methods, for example, a plan incorporates words and symbols as well as non-verbal information.

1.7 Feedback

Many communications are two-way processes, for example, a conversation between two people. As the conversation continues, the roles of participants change from source to receiver and back again. In other forms of communication such as report writing, *feedback* on initial drafts can be an important part of the process of preparing quality reports. The concept of a feedback loop grew out of the cybernetics work

conducted by Weiner [8] [9]. While Berlo [6] and others acknowledged this fact, Wyer [10] was the first to suggest that a feedback loop should be incorporated in any model of the communication process.

1.8 Communication contexts

Foulger's [5] ecological model of the communication process captures the key concepts of the previous models, including the feedback loop, and incorporates some new concepts (see Figure 4):

- Senders are called *creators*: People use their creativity when they develop a message and they learn about different media through experimentation and use.
- Messages are created and consumed using language, in the context of media.
- Receivers are called *consumers*: This seemingly subtle change in terminology highlights the fact that the receiver can choose whether to receive a message or not. This is emphasised in the figure by the direction of the arrows which go from the consumer to the message. This is an important concept as it highlights the power the consumer (or audience) has in the communication process.
- *Contexts*: People create and interpret messages within the contexts of their perspectives, for example, languages and relationships.

In this interactive model, feedback is depicted at a much higher level of abstraction than the messages.

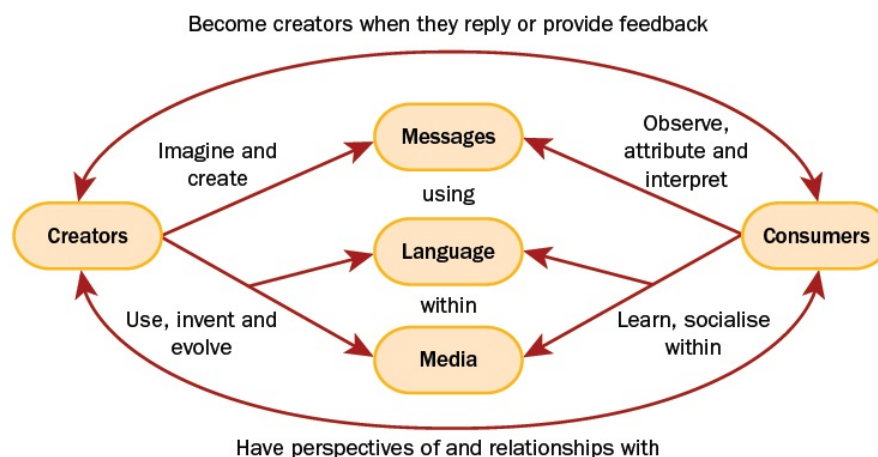


Figure 4: An ecological model of the communication process (Source [5] p. 7)

2 A COMMUNICATION MODEL FOR ENGINEERS

In this section, the key concepts and components from the models discussed in the previous section are synthesised to develop a model that can be used by students and engineers to plan and analyse a communication. The simple transactional model reproduced in Figure 5 also includes the terms *assemble* and *transmit* to indicate that communication may consist of a number of messages that are assembled to create a *communication package*, which is then transmitted using one or more channels.

For example, when someone speaks, they use their voice to transmit words, and the pitch, tone and volume of their voice to add other levels of meaning to those words and the message. They may also use facial expressions and body language to transmit other components of the message. Thus, the communication package consists of the message in words; the message conveyed by the pitch, tone and volume of their voice; and the non-verbal messages. The non-verbal components of the message may be assembled either consciously or unconsciously. For example,

the speaker may deliberately frown to convey the seriousness of a message, or they may be unaware that they are frowning.

For the same reason, the words *receive* and *interpret* were included at the consumer end of the model. This is because a consumer may receive different components of the message from different channels. These components have to be accessed, interpreted and synthesised to recreate the message(s). The aim of the creator is to ensure that all of the elements of a message are consistent, i.e. when the consumer interprets the non-verbal and other elements of the communication package they reinforce the main message. The alternative is that the consumer receives mixed-messages.

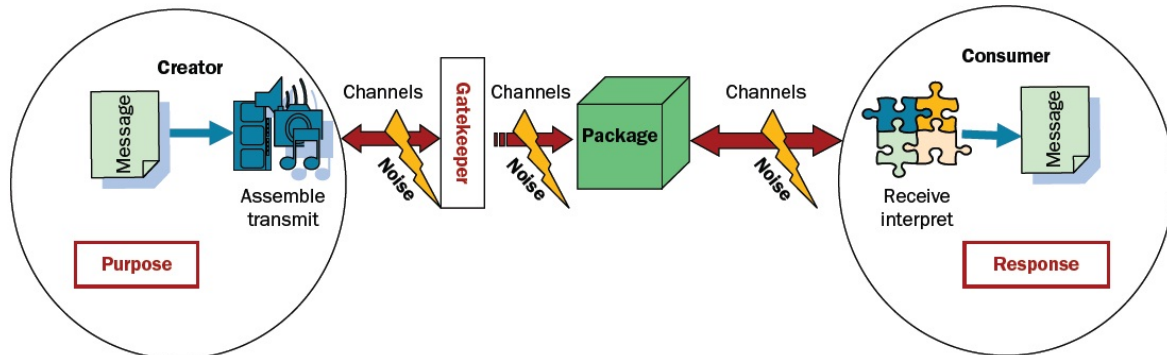


Figure 5: A transactional communication model (Source [11] p. 215)

In the model, a communication is mediated by a gatekeeper, may be affected by noise, and could be delayed, or unsuccessful, because the consumer may choose when, or if, to access the package.

Figure 6 shows the next stage in the development of the PCR model. A feedback loop has been added. It shows that while the roles of the people are reversed, the components are the same as the components in the initial communication. This type of two-way communication model is often called an *interactive model* and each person has two roles, i.e. creator and consumer. To avoid confusion they are called communicator A and communicator B in Figure 6.

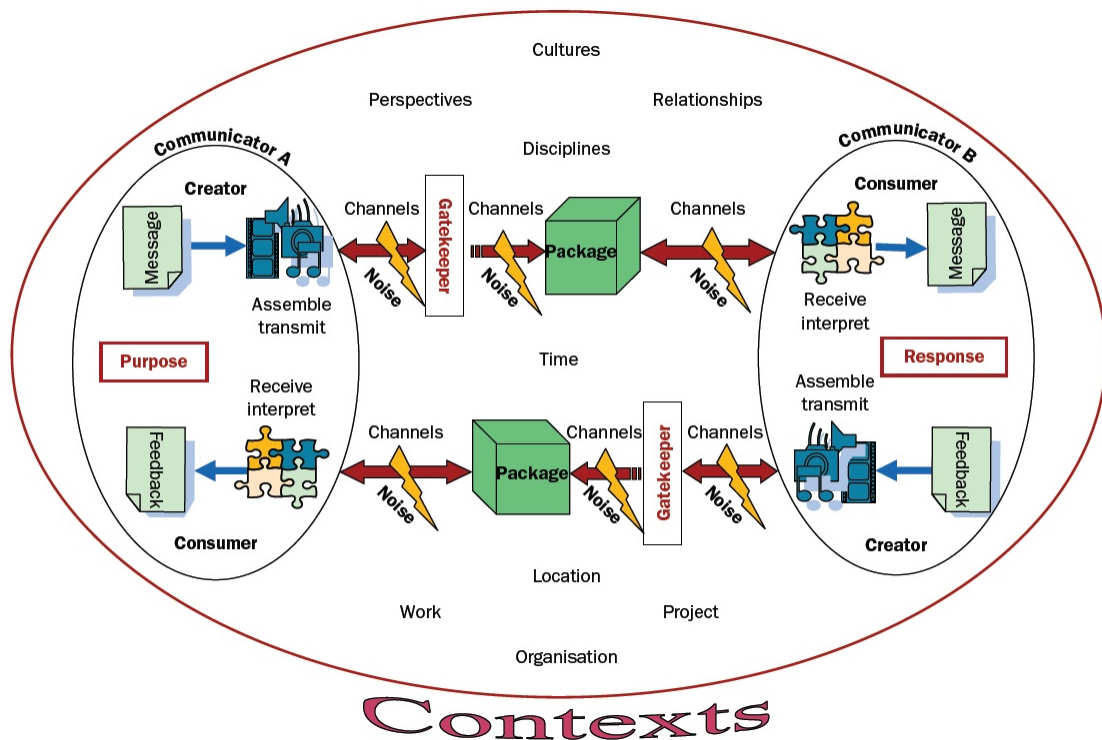


Figure 6: The PCR Communication Model for engineers (Source [11] p. 215)

Figure 6 also includes the contexts identified by Foulger [5], as well as the contexts in which engineering work is undertaken. While the PCR Communication Model [11] shown in Figure 6 is by no means a universal model of the communication process, it is a useful framework for understanding engineering communications. PCR is an acronym for *Purpose — Communication — Response*.

There are ten components in the PCR Model, with the eight components of the *Communication package* sandwiched between the Purpose and the Response. To help students remember the eight components they can be described using some key words beginning with the letter 'C': *Creator, Communication package, Colleague (gatekeeper), Channel, Corruption (noise), Contexts, Connection and Consumer*.

3 APPLYING THE PCR COMMUNICATION MODEL

The PCR Communication Model was developed to help students understand the communication process, and to help them plan their communications. Students can use the Model to explore and analyse examples of complex engineering communications such as: a contract for a large project; a set of design specifications; a set of construction plans; or a detailed plan for a full-day visit to a manufacturing plant by a delegation from a foreign country. By identifying all of the verbal, visual and non-verbal communication methods used in those communications, and the channels (including the senses) used to convey the messages in the communication package, students gain an appreciation of the importance of the planning phase of a communication, particularly a complex communication that consists of many messages and a number of communication channels.

The PCR Communication Model can also be used by students to plan and develop effective communication packages, including business letters, project reports, plans, models and presentations. When used as a planning tool, student's use their understanding of the PCR Communication Model to inform their work as they apply each step of the following ten-step process [11]:

- Step 1 *Define the purpose of the communication, including the desired response from the consumer*
- Step 2 *Identify the characteristics of the consumer*
- Step 3 *Define the timing and other business requirements for the communication*
- Step 4 *Consider the contexts in which the communication will occur*
- Step 5 *Identify and write drafts of the elements of the messages that are to be communicated*
- Step 6 *Select the most appropriate communication method, channel and media for each element of the message*
- Step 7 *Assemble the communication package*
- Step 8 *Forward the package to the gatekeeper for checking and approval*
- Step 9 *Deliver the package to the consumer*
- Step 10 *Provide an opportunity for the consumer to respond*

This ten-step checklist may be used for all types of communication; however, the size and type of the communication will dictate the complexity of each step. For example, while the process may be quite straightforward for a business letter, it is likely to be extremely complex for a tender proposal for a multi-million dollar project.

4 SUMMARY AND ACKNOWLEDGMENT

Engineers need a sound understanding of the communication process to enable them to communicate effectively with members of the engineering team, with people in other professions and, importantly, with members of the community. The PCR Communication Model was developed to enhance student understanding of the communication processes and contexts used by engineers. The components of the Model were discussed in detail and a ten-step process was provided to demonstrate how the PCR Communication Model may be used to plan a communication by engineering students and professional engineers.

Permission to publish extracts from [11] was obtained from John Wiley & Sons, Australia, the publishers of the text: *Engineering your future: an Australasian guide*.

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