

Communication Trends in Engineering Firms: Implications for Undergraduate Engineering Courses*

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The role of communication in the professional life of practising engineers continues to grow in importance. In recognition of this fact, most undergraduate engineering courses include some tuition on oral and written communications. Course instructors need to review and constantly update such communication courses in the light of rapid advances in communications technology, particularly if these courses are to provide students with adequate preparation for whole-life learning in professional careers in industry. The paper reports the results of a recent survey of communication trends in Irish engineering firms, and assesses their implications for the content and teaching methods of undergraduate communication courses for engineering students. Some practical recommendations are made in the light of these survey findings.

INTRODUCTION

RECENT YEARS have seen a rapid rise in the number of international, high-technology and computer-related manufacturing firms moving to Ireland. These firms offer a wide range of job opportunities for engineers, and many of the new computer-related firms are at the cutting edge of the IT industry. Given the rapid evolution of communications technology and the growth in the IT industry in Ireland, we were interested in exploring the impact of these developments on the communication tasks of the engineer.

Our study has focused on several issues:

- What kinds of communication tasks do engineers perform at work?
- What difficulty, if any, do they experience in carrying out their communication tasks?
- What kind of communication tools do engineers use at work?
- Are undergraduate engineers getting the right kind of preparation for the communication tasks they will be expected to perform when they enter the world of work?

This study has been carried out as part of ongoing research into the development of suitable communication courses for undergraduate engineers [1, 2]. The study should be seen in the context of the government's current efforts to develop a national strategy for the 'Information Society'. A

central focus of this government strategy is to ensure that our educational system is responsive to the need to use these new technologies of communication to create competitive advantage [3].

METHODOLOGY

The main objective of the study was to gather information on the communication practices of engineers at work in order to review the content of undergraduate communication courses for engineering students. We were particularly interested in feedback from younger graduates who, because they graduated only recently, would be in a position to identify gaps in their undergraduate training quite readily.

A questionnaire was developed to focus on workplace communications tasks; it used both open and closed questions to elicit both quantitative and qualitative information, and was pretested on a small sample of graduate students. Questions covered:

- the type and frequency of communication tasks;
- what percentage of the working day was spent in communication;
- whether the respondents' writing load had increased over time;
- what problems, if any, were caused by ineffective writing in their workplace;

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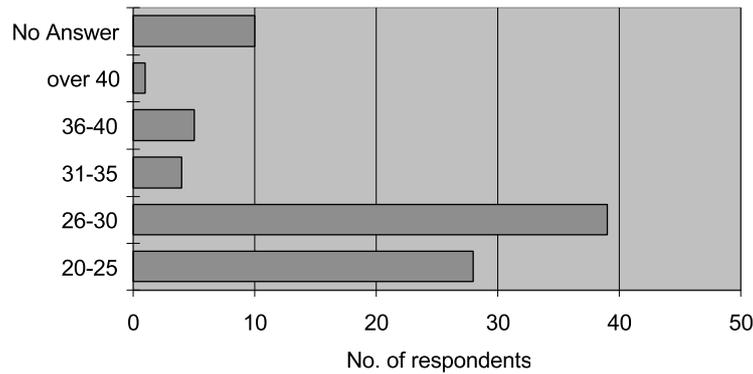


Fig. 1. Age distribution of respondents.

- what tools they used for oral and written communication;
- what their perceptions were of what should be included in communications courses for undergraduate engineers.

We were also interested in the respondents' efficiency in using the tools of communication technology. The complete questionnaire is presented in the Appendix for information.

Questionnaires were distributed by post to 250 engineers employed across a range of engineering occupations and firms in Ireland. Since we were mostly interested in the adequacy of undergraduate communication training for work, two thirds of those surveyed were graduates of NUI, Galway of not more than five years standing. The total number of respondents was 87 and represented 34.8% of those surveyed; 67 of the respondents were male, and 19 were female. This response rate was sufficient for our purposes, and there was no need for a second contact to elicit a higher response rate.

RESULTS

Background information on respondents

Sixty-three of the respondents worked for multinational firms in a modern high-technology environment; 24 worked for Irish-owned firms. The majority (59.7%) worked for large firms (more than 200 employees) and were young men, aged between twenty and thirty years old. Figure 1 shows the age-range of the respondents.

The respondents were employed in a range of professional activities and most of them were engaged in technical engineering applications.

Table 1. Time spent writing at work

% Time spent writing	Number of respondents
less than 15%	22 (25%)
15-24%	20 (23%)
25-35%	25 (29%)
40-50%	10 (11%)
60-75%	9 (10%)

However, over 30% of the respondents were employed in a management capacity, while 2% described their position as Director.

Analysis of data on type and frequency of writing tasks

Most of the respondents (62%) wrote in collaboration with others. The majority (72%) reported that their writing load had increased over time. Time spent on writing at work is detailed in Table 1.

Table 2 shows the types of writing the respondents were mainly engaged in. Most of them were engaged in the day-to-day routine writing tasks of the engineering office environment, writing letters, memos, reports and proposals. The majority used e-mail and faxes. The other main writing tasks involved preparing agenda and taking minutes at meetings, and writing instruction manuals. One third of respondents wrote instruction manuals.

Problems caused in the workplace by ineffective writing

Many of the respondents (41%) reported that ineffective written communication led to problems in their workplace. The kinds of problems experienced varied from inability to decipher hand-written notes, to misinterpretation, to inefficiency and to time wastage. Respondents commented that miscommunication hinders problem resolution, and if work instructions are not written simply and clearly, misunderstandings

Table 2. What is written

What is written	Number of respondents
Manuals	29 (33%)
Letters	41 (47%)
Memos	58 (67%)
Reports	70 (80%)
Proposals	48 (57%)
Minutes	47 (54%)
E-mail	66 (76%)
Fax	61 (70%)
On-line help	6 (7%)
Web pages	6 (7%)

Table 3. What the respondents found most difficult about writing (in order of frequency of mention)

Topic	Numbers who mentioned
Clarity and conciseness	26
Audience adaptation	14
Time management	9
Mechanics	8
Organisation of particular documents	8
Graphics	2

arise. Some mentioned that miscommunication causes irritation, mistrust and aggression.

Several respondents mentioned that such writing gives a poor impression of the firm to clients and others outside the business. It looks unprofessional: 'It conveys a sense of carelessness which does not belong in our business.'

Keyboard skills

Very few of the respondents have received formal training in keyboard skills. Indeed, only ten of the eighty-seven respondents claimed to have done so. Seventy-six declared they had received no formal keyboard training, while one had received 'limited' training.

What do they find most difficult about writing?

Those who responded to this question mentioned a range of issues. These issues are listed in Table 3, in order of frequency.

Issues of style concerned many of the respondents. In particular, they mentioned:

- the difficulty of communicating effectively with non-native speakers of English;
- presenting technical material simply and clearly for non-technical audiences;
- writing reports without jargon;
- trying to be clear and concise;
- using graphics effectively in order to communicate complex ideas clearly.

Oral presentation

Sixty-eight of the respondents (78%) reported that they are required to give oral presentations as part of their work, many of them on a regular

basis. Figure 2 shows the types of computer software the respondents use for presentations and communications, and Fig. 3 shows their main presentation media.

As can be seen, most respondents use the Microsoft Office suite of software for communications and in the preparation of presentations. The main presentation media, in order of frequency, are the overhead projector, handouts, flipcharts and computer slide shows. Drawings made up a large proportion of the 'other' category.

Suggestions for undergraduate communication courses

Their suggestions for what should be taught on communication courses for undergraduate engineering students included (in order of frequency of occurrence):

1. Oral presentations
2. Keyboard skills
3. Basic MS Office applications
4. Report writing
5. Effective written communication
6. Meeting skills
7. Audience awareness
8. Mechanics of communication
9. Telephone skills
10. Group communication skills
11. Web page design
12. E-mail
13. Graphic design

DISCUSSION OF RESULTS

One of the most significant findings of this study was the high percentage of respondents (41%) who reported that ineffective writing causes problems in their place of work. This has serious cost implications for industry at a time when global competition is increasing the pressure to cut costs and improve efficiency.

Plain language can communicate a message more effectively and prevent misunderstandings that waste time, energy and resources and can lead to frustration [4]. Many of the respondents reported that they had problems expressing themselves simply and clearly, and recommended that

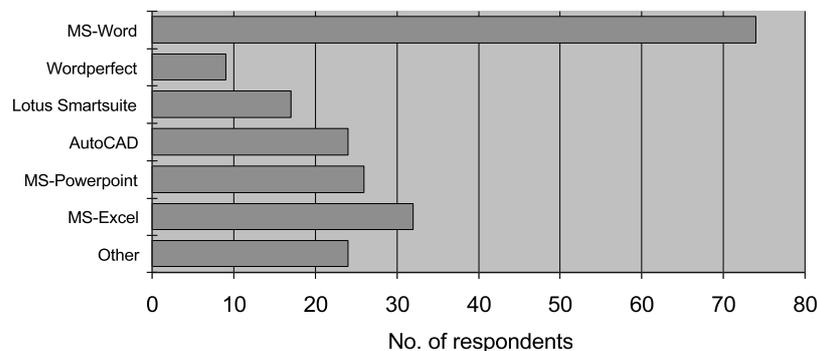


Fig. 2. Presentation software used.

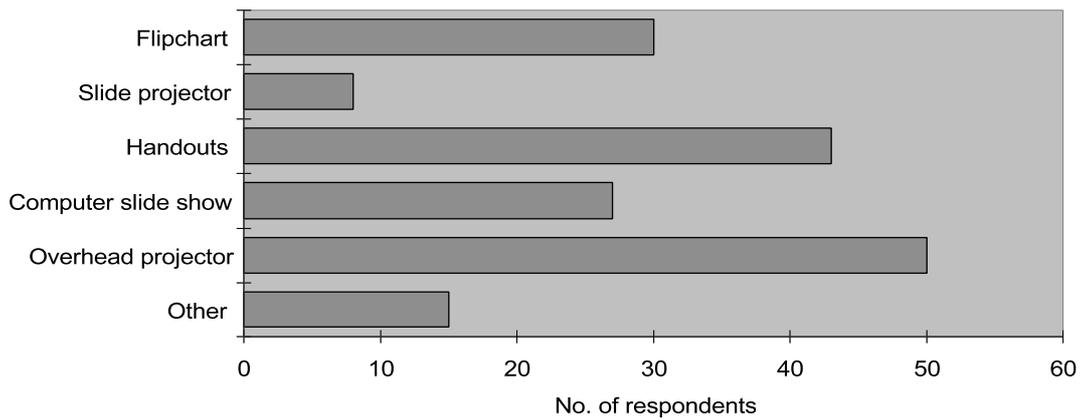


Fig. 3. Presentation medium used.

this problem be addressed in undergraduate communications courses. Traditional elements like correctness in grammar, spelling and punctuation were mentioned by many respondents and also recommended for inclusion on the undergraduate curriculum.

A second significant finding was the extremely high numbers of respondents (78%) who had received no formal keyboard training. This lack is clearly causing problems for the respondents, and also has major cost implications for firms. Writing productivity is greatly diminished if people lack this basic skill. Keyboard skills appear high on the list of priorities for what the respondents feel they should be taught. In the USA, by contrast, high-school children are taught to type and to drive as a matter of routine. Clearly, Americans recognise that these are two basic survival skills for the late 20th century, and include these skills in the high-school curriculum.

The recent (1996) Forfás report calls for a review of all curricula by the Higher Education Authority and the Department of Education [3], 'to ensure that they incorporate the skills required to participate and gain employment in the Information Society'.

This is one obvious skill that has not been adequately addressed. Second level school curricula should include word-processing skills for every pupil.

A third significant finding was the very high emphasis on speaking skills. Respondents placed these first in order of priority. They mentioned oral presentations, but also gave high priority to the oral skills needed for effective participation in meetings, skills in group communication, negotiation, interviewing, and dyadic communication; telephone skills and listening skills were mentioned by several respondents.

Many of the respondents showed a sophisticated awareness of the need for audience orientation and adaptation. Typical comments included the following:

- 'I think that the most important lesson of communication is that the message must be received

clearly—inappropriate use of 'big' words only causes confusion.'

- 'Communication [must be] based on the receiver of information and not the provider, i.e. technical reports [should be written] in clear basic English if being prepared for a non-technical person.'

A surprising result was the lack of emphasis placed on the newer communication media—the World-Wide-Web and e-mail. Very few recommended that these media be included in the undergraduate curriculum. And, finally, only one person mentioned video conferencing.

CONCLUSIONS

The survey reveals a major skills gap at a very basic level of young people who are preparing to work in modern industry. There is a clear need to address the lack of keyboard skills, and the appropriate place to do that is in the secondary school curriculum. This lack in their preparation for the modern world of work is seen as a major drawback by the respondents, and needs to be addressed immediately.

The survey points to the need to focus more effectively on a range of interpersonal oral communication skills in undergraduate communications courses: group communication, negotiation skills, listening skills, and telephone skills. Respondents placed these higher on their list of priorities than written skills. At present, assessment of undergraduate communications skills generally gives priority to report writing and, to a lesser extent, formal oral presentations [5].

This emphasis on a range of oral communication skills can, however, be readily integrated into other undergraduate courses that share an element of common purpose in communication. As an example, a course in communications for industrial engineering undergraduates at NUI, Galway has already been integrated into a course on engineering design [2]. The teaching and learning of design necessitates group project work

which, in turn, makes an excellent forum for learning and practising the range of oral skills mentioned by respondents. It has proven possible for the specialist communications instructor to become formally involved in developing group communication skills, through incorporating these elements into the communication curriculum, and putting them into practice in the design project work. This integration is achieved as follows: in Semester I, separate groups of up to eight students work together on projects with environmental themes such as recycling, pedestrianisation, pollution, energy use, etc. Each group meets once per week to discuss the project, and assessment of this element of the course is based entirely on an individual oral presentation and written report. During Semester II, students work in pairs on more detailed engineering design projects, assessment for which is based on formal oral and written presentations and on the effectiveness of communications within each group.

Such an approach is well received by students [1] and feedback from industry is very positive. There are, nevertheless, problems with this approach: the activity of design is often seen as irrational, and proposed design solutions frequently lie outside the fixed domain covered by the curriculum. Because of this, the development of assessment criteria for project work in engineering design is perceived as a difficult task. Nevertheless, such criteria remain absolutely essential to the objective and fair assessment of all undergraduate project-based learning. The question of how to assess a design course incorporating a significant communications element has recently been addressed in detail in reference [6].

Finally, the survey points to the need to address more effectively the question of style for written communication, audience adaptation and preparation of instruction manuals. Overall, the survey was a useful and informative instrument for the improvement of communication course offerings for undergraduate engineers.

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APPENDIX

Questionnaire

Personal Details

Age:

Gender: M F

Academic Qualifications

Primary Degree:

Postgraduate Degrees and Diplomas:

Job title: _____

Type of firm: Irish owned
 Multinational

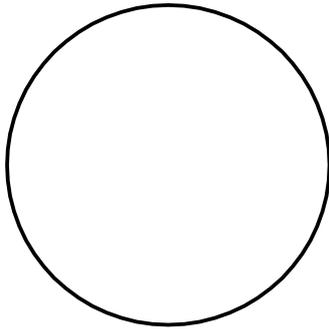
Main product:

Number of employees:

- Less than 25
 26–50
 51–75
 76–100
 101–150
 151–200
 More than 200

Writing

Indicate on the pie chart the typical breakdown of your working day.
What percentage of your working day is spent word processing/writing?



Do you write in collaboration with other people?

If yes, explain how

What do you write?

- Letters
- Memos
- Reports
- Proposals
- Minutes of meetings
- E-mail
- Fax
- On-line help
- Web page
- Instruction manuals

How many per week, on average?

Has your writing workload increased over time?

Y/N

What communication tools do you use?

(e.g. MS Word, WordPerfect, Corel Draw, AutoCAD, DTP package, etc.)

Do you have to do oral presentations as part of your work?

Y/N

How many per week, on average?

What aids do you use for presentations?

- | | |
|---|--|
| <input type="checkbox"/> Flipchart | <input type="checkbox"/> Computer slide show |
| <input type="checkbox"/> Slide projector | <input type="checkbox"/> Multimedia |
| <input type="checkbox"/> Overhead projector | <input type="checkbox"/> Video |
| <input type="checkbox"/> Posters | <input type="checkbox"/> Handouts |
| <input type="checkbox"/> Simulations | <input type="checkbox"/> Other (specify) |

Does your firm produce documentation for products sold internationally? Y/N

Is your firm involved in localisation? Y/N

Does anyone edit your work? Y/N

What aspect of written communication do you find most difficult?

Have you had any formal keyboard tuition? Y/N

Is bad writing a problem at your place of work? Y/N

What kinds of problems does it cause?

Based on your experience on the job, what do you think should be taught in college communication courses for engineering students?

Ivan S. Gibson graduated in the UK in 1969 with a First Class Honours degree in Mechanical Engineering after having served a five-year apprenticeship. This was followed by research and design work in marine propulsion in the Netherlands, and working as a boatyard manager and design consultant in Ireland. For the past twenty years, he has lectured on a wide range of engineering topics in Ireland, Canada and the Netherlands and specialises in teaching and consultancy work in engineering design.

Anne Keane is a lecturer in Technical Communication at the University of Limerick, Ireland. She has taught communication to engineering students for fifteen years. She is interested in the development and assessment of communication courses for students in engineering and related disciplines. Her other main interests are in technical editing and the production of distance learning texts in technical areas.