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Communicating in the Workplace: Self-Reports by New UWI Electrical and Computer Engineering Graduates

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Abstract: *There is no existing research on communication practices in engineering workplaces in Trinidad and Tobago. The study maps the broad terrain of communicating in local industry by reporting quantitative data gathered by means of a questionnaire. Fifty-eight new hires in the field of Electrical and Computer Engineering were polled on the time spent communicating; common written genres produced; and the importance of communication to job performance and career advancement. The study revealed that in an eight-ten hour workday, new hires spend upward of two hours per day writing and three hours in formal oral communication scenarios. New hires can also expect that with and without substantial support they will be required to produce an array of communication artefacts. Respondents rated proficiency in writing, speaking and teaming as critical to career advancement.*

Keywords: *Workplace Communication; the Engineering Workplace; Electrical and Computer Engineering*

1. Introduction

In chronicling the rise of technical writing instruction, Connors (2004, p4), cited a "series of condemnatory articles about the illiteracy of engineering-school graduates" which began appearing in 1903. More than a century later, those complaints persist. The Institution of Engineering and Technology (IET) (2008, p182) found that while UK employers were "not critical of the engineering knowledge and understanding graduates bring to their first job", they were unhappy about "the lack of key skills that graduates possess": Deficiencies identified were weak interpersonal, teaming, and writing skills. Commenting on Trinidad and Tobago industry, Shrivastava (2004) lamented that there is an "insufficient deepening and broadening of competence", particularly in technical writing and communication skills.

Engineering schools across the globe are responding to this competence gap in a variety of ways (Reave 2004). Russel (2001, p261) has argued that regardless of the curriculum provisions addressing this deficit, it is necessary to understand "where students are headed", so that we may assess "the ways schooling helps [or hinders] them getting there". In this respect, counterparts elsewhere, and in the United States in particular, have a distinct advantage: their curricula can draw on a number of workplace studies that describe the communication contexts in which their graduates will work. This study addresses that research gap by describing, in broad quantitative terms, the communication demands made of novice engineers working in Trinidad and Tobago. Based on these findings, the paper makes recommendations for communication curricula in local undergraduate engineering programmes.

The study was limited to an examination of the work contexts of new graduates, employed in the field of Electrical and Computer Engineering. Recent graduates were chosen as it is likely that their adjustment to the workplace would bring into relief the unfamiliar demands that are being made of them. More significantly though, the focus on entry-level engineers was necessary as the paper makes recommendations for curriculum provisioning: The focus was therefore on the immediate demands that are being made of recent hires—the competences needed to gain employment, and to function effectively at the start of their careers.

The current study, which is a pilot of a larger study, focuses on recent Electrical and Computer Engineering graduates as a matter of convenience, since there was immediate access to this group of alumni from The University of the West Indies, St. Augustine Campus (UWI), Trinidad and Tobago.

2. Literature Review

Engineering education reform is achieved through interventions at three levels: accreditation, programmatic, and course. Relevant to Electrical and Computer Engineering graduates of the UWI, is the UK Standard for Professional Engineering Competence (UK-SPEC 2008), which specifies inter alia that graduates must have the ability to communicate; work with others; use ICTs; and retrieve information. Writing about ABET's programmatic criteria, Passow (2012) found the criteria unhelpful, as they do not indicate the relative importance of the various skills: This in turn impacts curriculum development as the depth of treatment to be accorded to each skill is unstated.

Similarly, UK-Spec provides no such clarification. By examining communication practices in local industry, engineering programmes can focus on what is most useful to our graduates.

Many technical communication specialists (Brinkman and van der Geest 2003; Dannels et al 2003) have made recommendations targeting the programmatic level, where instruction and assessment are threaded throughout the degree, as may be found in Communication across the Curriculum (CXC) approaches. Dannels et al (2003) reported a growing recognition of the "theoretical and pragmatic" value of CXC models to teaching communication. Reave (2004, p452) has claimed that "the most comprehensive preparation" is a CXC approach that offers "concentrated instruction, continual practice, situated learning and individualised feedback".

However, as Craig et al (2008) observed programmatic interventions do not take account of disciplinary idiosyncrasies. They argued that meaningful instruction and assessment must be contextualised by authentic workplace practices.

This study can be regarded as informing all levels of engineering education reform by:

- Localising accreditation specifications, by suggesting which skill-sets gain salience in local industry: The capacity to work with others may perhaps be more important than the ability to retrieve information;
- Advocating for CXC provisioning: The data presented later in the paper indicate that the ability to communicate well is indispensable in the engineering workplace and thus programmes must systematically teach and assess communication skills.
- Identifying focal points for communication courses and or communication-intensive interventions: The data presented identify, for example, target writing genres.

"Workplace communication" and "non-academic communication" are used synonymously (Odell and Goswami 1985; Faigley 1985). Workplace communication distinguishes itself from "academic communication" by:

- Being diverse: Workplace communication draws on overlapping communities of practice.(Faigley 1985).
- Having different stakes: Grades are the primary concern in the academy, while workplace communication can have far reaching legal and professional consequences (Leydens 2008; Shrivastava 2004).
- Having differing foci: Students need to demonstrate learning in their academic writing, while workplace communication serves varied organisational ends (Paradis et al 1985).
- Targeting varying audiences: Workplace communication targets a wide array of audiences, often complex and sometimes unknown, for which the engineer has to assume different writing personae and invent internal representations of the audience (Paradis et al. 1985). Typically, the student's writing persona is singular – they inhabit the role of student, and the audience is well-defined – faculty who assigned the task.

Workplace communication is not synonymous with 'professional communication'. Faber (2002), explained that 'professional communicators' are occupational writers whose primary responsibility is writing, as distinct from 'professionals who write' as part of their occupation. The investigation was confined to studying communication in local industry, where that communication is part of the daily work performed by respondents.

Research into workplace communication practices experienced a groundswell in the late half of the 20th century — Odell and Goswami's (1985) anthology on non-academic writing being a landmark publication in this period. However, there are only a few empirical studies in this large body of work which focus on the engineering workplace and even fewer depended on self-reports from engineers to describe their routine communication practices, as is the case with the present study.

In a survey of 243 Electrical Engineers in the United States, Vest et al (1996) found that engineers regard strong communication skills as critical to both the hiring and the promotion processes. They found that practising Electrical Engineers, regardless of their position within the organisation, spend most of their workdays communicating — 55% of their work time. The authors did not distinguish between time spent writing and speaking. Instead, they accounted for time spent communicating by examining who engineers communicated with — 58% with colleagues working on the same project; 20% with colleagues elsewhere in the organisation; and 22% with external parties.

Kreth (2000) surveyed 162 new graduates from a single, mid-western American university about their co-operative writing experiences. Co-operatives or internships allow students to apprentice for credit toward their degree. Co-operatives therefore provide authentic workplace experience within a programme of study. Although Kreth (2000) claims to have examined both graduates' experience of co-operative writing and their experience as full-time engineers, she only presented data about their co-operative writing experience. This data may have helped explain some of the workplace experiences of this study's respondents, since the respondents may be in the local equivalent of an apprenticeship — graduate-in-training (GITs) programmes. However, this investigation did not differentiate between alumni in GIT programmes from those in tenured engineering positions, because the interest lay in the workplace communication practices of new hires, regardless of their posts.

Sageev and Romanowski (2001) polled 208 graduates from a single university practising in the fields of Mechanical, Industrial, Chemical, and Computer and Electrical Engineering. The authors examined the relationship between the number of technical communication credits taken while at university and the impact on the engineer's career. They found that the "amount of instruction graduates received correlates with the career benefits they gained". Also, Sageev and Romanowski (2001) decomposed time spent on various communication tasks — 32% of the workday on writing; 10% on formal oral presentations and 22% on discussions (including informal, interpersonal communication). In total, the authors concluded that their graduates spent two-thirds of their workday communicating.

The findings from Vest et al (1996) and Sageev and Romanowski (2001)—largely accounts of time spent communicating and the importance of strong communication skills to job performance — were, where appropriate, compared to the data presented in this paper.

3. Method

This research examined the general communication demands made of recent Electrical and Computer Engineering graduates in local industry. Quantitative data were collected by means of a questionnaire. Alumni of the Department of Electrical and Computer Engineering, UWI (DECE), who are employed in local industry, were polled. They were drawn from the three graduating cohorts—2010/2011; 2011/2012; 2012/2013.

The questionnaire was piloted using a test-retest method. The questionnaire was administered twice to five graduates from a cohort other than those investigated, with a one month elapse between administrations. The coefficient of stability was found to be 0.71, which is acceptable according to Frey, Botan and Kreps (2010).

The questionnaire was distributed electronically to all 155 graduates for the 2010/2011; 2011/2012 and 2012/2013 cohorts. The questionnaire was mailed twice, with a three week interval between mailings and posted twice in a closed Facebook group for the DECE.

Seventy-nine (79) graduates completed the survey. Of those completing the questionnaire, seven were unemployed; five were in fields outside of engineering; and nine were working abroad. Therefore, 58 responses (n=58) were usable. The overall usable response rate was 43%.

Since the research investigated new graduates of the DECE there are no claims to generalisability to the larger local population of practising engineers or even practising Electrical and Computer engineers: rather, the paper offers a modest description of the communication demands made of new, Electrical and Computer Engineering graduates of the DECE, by local industry.

4. The Respondents

To every one female respondent there were two males. This is not in keeping with graduation trends of a 3 male: 1 female ratio (see Table 1). This could be as a result of over-representation of women in the sample — that is, comparably more women than men responded. The bulk of the sample — 90%, has been employed three years or less, indicating relative newness to the workplace (see Table 2).

Table 1. Respondents by Sex

	2010/2011	2011/2012	2012/2013
Graduating Cohorts	Male: 40 Female: 13 Male to Female Ratio: 3:1	Male: 31 Female: 7 Male to Female Ratio: 4.1	Male: 48 Female: 16 Male to Female Ratio: 3:1
Respondents	Male: 41 Female: 17 Male to Female Ratio: 2:1		

Table 2. Years of Work Experience

	Male		Female		Total (n=58)	
	count	%	count	%	count	%
Less than 1 year	18	31%	12	21%	30	52%
1 to 3 years	19	33%	3	5%	22	38%
More than 3 years	4	7%	2	3%	6	10%
Total	41	71%	17	29%	58	100%

New engineers working in the fields of control systems and energy systems made up more than half the sample or 55% (See Table 3). Included in the 'other' category were jobs in Acoustics and Standards Development, demonstrating that some graduates gain employment outside mainstream Electrical and Computer Engineering fields.

To determine the areas of specialisation in which graduates were working, respondents were allowed multiple-mode responses. Therefore respondents were allowed to indicate as many of the thematic areas in which they practiced. Thus, while there were 58 respondents, the number of responses for this item was 97.

Notably, 56% of the alumni worked in two or more thematic areas (see Table 4). Thus, the workplace is demanding fairly broad disciplinary competence from the novice. Of the 33 persons who worked in more than one thematic area, the most common pairing was Controls and Energy systems engineering —19 alumni.

Not surprisingly the single largest employer of new engineers is the oil and gas sector (see Figure 1). One encouraging sign, at least by way of suggesting diversity in engineering enterprise, is that a few new engineers were employed in software development and in

entrepreneurial pursuits. Taken together they account for 7% of the sample.

Table 3. Respondents by Thematic Area

	Total (n=97)	
	count	**%**
Communication Systems	15	15%
Control Systems	31	32%
Energy Systems	22	23%
Computer Systems	13	13%
Electronics	8	8%
Other	7	8%

Table 4. Respondents Practising in Several Thematic Areas

	Total (n=58)		
	count	%	
Practising in 1 thematic area	25	43%	
Practising in 2 thematic areas	28	48%	33 or 56% novices practising in more than one thematic area
Practising in 3 thematic areas	2	3%	
Practising in 4 or more thematic areas	3	5%	

5. Communicating in Local Industry

Most novice engineers, 48%, spent 21 – 40% percent of their workday writing (see Table 5), where the workday is eight-ten hours on average. This is comparable to Sageev and Romanowski's (2001) finding that their alumni spent 32% of their day on written communication. Writing time in this study was defined as time spent on official communication artefacts—reports, correspondence, or any item needed by or generated by the organisation's business process. At the minimum, therefore, novice engineers can expect that they may have to write upward of two hours per day.

Table 5. Time spent on Written Communication

% Time Spent writing per day	Number of respondents	% of Sample
Less than 20%	9	16%
21- 40%	28	48%
41-60%	13	22%
Greater than 60%	8	14%

Novices who claimed to write for more than 60% of their day, or more than five hours per day, may be over-estimating. However, when considered with a description of daily work tasks, some new engineers are given demanding, time-consuming writing tasks (see Table 6).

Of those polled, half communicated orally for 41%-60% of their working day and an additional 33% spent more than 60% of their day speaking to others (see Table 7). Oral communication activities were taken to include participating in team meetings and delivering oral presentations, but did not include time spent on informal, and or unplanned discussions. This is higher than Sangeev and Romanowski's (2001) finding that new engineers spent less than 32% of their day communicating orally — a figure which included informal oral communication. That local engineers are spending more time in formal, oral communication situations, may be explained by the ubiquity of

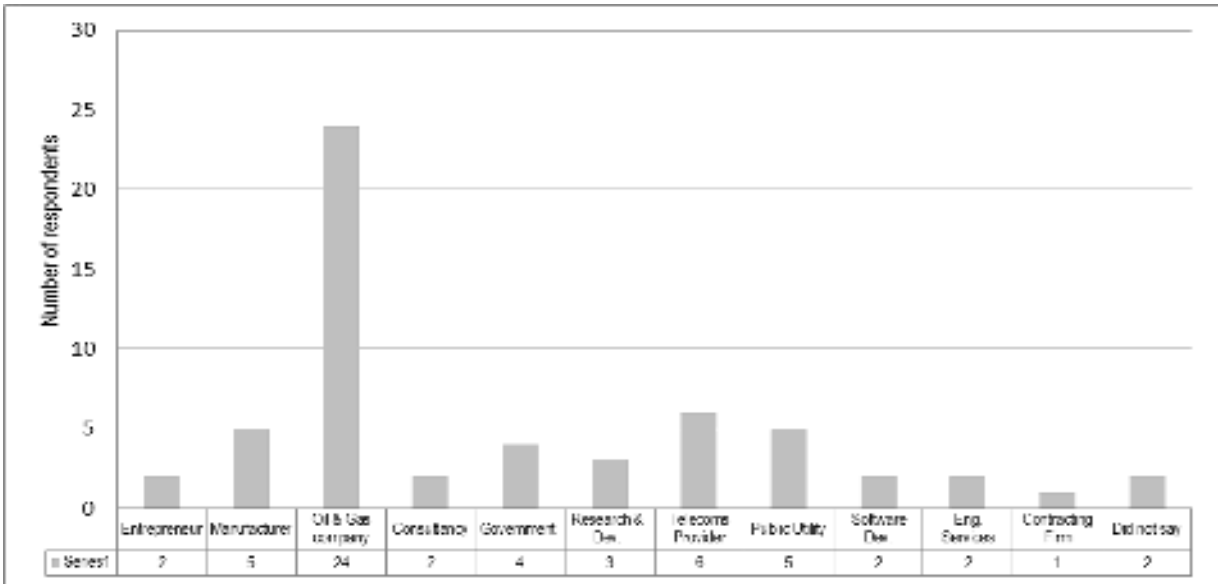

Figure 1. Novice Engineer by Employer Type

Table 6. Novices with Significant Writing Tasks

	Writing tasks (***bold italics***)
Respondent 1 Employed 1-3 years	I'm the only (key post with specialised skills) at (Company name redacted) and my primary responsibility is to administer (critical company installations). These (critical company installations) provide access to (key ICT resources in named Caribbean Territories) and they are used to change configurations, monitor performance and perform troubleshooting. I am also responsible for ensuring the (key company installations) meet a certain quality by doing ***detailed trends analysis, and forecasting.***
Respondent 2 Employed 1-3 years	My job entails engineering and to some extent executing various projects assigned to me. These projects are new changes to the plant requested by various plant personnel. I work directly under another Electrical Engineer, who reviews my engineering reports, etc. I also work along with him on his projects. Aside from these projects, I am also involved in the ***reviewing and revising of our CAPEX [capital expenditure] list of projects as well as aiding with generation of work orders, etc. in our Computerized Maintenance Management System.***
Respondent 3 Employed 1-3 years	Job functions include ***documentation of the software systems*** being designed. My documentation and ***reports also support and determine business activities and guide decisions of upper management***.

engineering teams supplanting the stand-alone engineer. Indeed, Sangeev and Romanowski's (2001) work was published over a decade ago: The engineering workplace has become incredibly complex (power systems using wireless telecommunication systems and advanced control systems for example) and globalisation of the physical workplace has given way to virtual workplaces with teaming on a transnational scale (Nair et al 2009; Spinks et al 2006).

Table 7. Time spent on Oral Communication

% Time Spent Oral Communication per day	Number of respondents	% of Sample
Less than 20%	2	3%
21- 40%	8	14%
41-60%	29	50%
Greater than 60%	19	33%

Table 8 presents data on time spent on communication in relation to the number of thematic areas in which respondents practiced. It is likely that the more areas of knowledge and practice drawn upon, the more complex the communication task and therefore the more time required for completing such tasks. The data does tentatively suggest that this may be the case: generally wider disciplinary practice involved more time on writing, with those practising in more than four thematic areas writing for in excess of 60% of their workday. However, this finding needs probing as many other factors affect time spent on writing — job duties; workplace dynamics; business practices, to name a few.

New graduates practising in just one thematic area communicated orally just as much as those practising in several areas, testifying perhaps once again to the critical role that engineering teams have in the workplace. Thus, regardless of the knowledge and technical skill-sets being drawn upon, a large part of 'engineering work' is accomplished via oral communication.

Novice engineers produced, on their own or through collaboration, a range of technical documents from technical reports to technical manuals: The most common was the technical report, followed by the technical presentation (see Table 9). In this multi-mode item where respondents could have indicated all the responses that applied — technical reports, technical presentations, field reports, technical proposals, and technical manuals — respondents did not list any other writing genres, though the option to do so was provided.

Table 8. Number of Thematic Areas and Time Spent on Communication

	Time spent on writing			Time spent on oral communication		
			Mode			Mode
Practising in 1 thematic area 43 % of Respondents	<20%	5	21-40%	<20%	2	>60%
	21-40%	13		21-40%	4	
	41-60%	6		41-60%	9	
	>60%	1		>60%	10	
Practising in 2 thematic areas 48 % of Respondents	<20%	4	21-40%	<20%	0	41-60%
	21-40%	14		21-40%	4	
	41-60%	7		41-60%	17	
	>60%	3		>60%	7	
Practising in 3 thematic areas 3 % of Respondents	<20%	0	21-40% and >60%	<20%	0	41-60% and >60%
	21-40%	1		21-40%	0	
	41-60%	0		41-60%	1	
	>60%	1		>60%	1	
Practising in 4 or more thematic areas 5 % of Respondents	<20%	0	>60%	<20%	0	41-60%
	21-40%	0		21-40%	0	
	41-60%	0		41-60%	2	
	>60%	3		>60%	1	

Table 9. Most Common Technical Documents

Document Type		Most common to least common →					
	Rank	5	4	3	2	1	Mode
Technical Reports	Count	21	19	18	0	0	5
	% of Sample	36%	33%	31%	0%	0.0%	
Technical Presentations	Count	18	19	7	6	6	4
	% of Sample	31%	33%	12%	10%	10%	
Field Reports	Count	13	6	18	6	15	3
	% of Sample	22%	10%	31%	10%	26%	
Technical Proposals	Count	4	13	12	17	12	2
	% of Sample	7%	22%	21%	29%	21%	
Technical Manuals	Count	2	1	15	18	22	1
	% of Sample	3%	2%	26%	31%	38%	

This finding needs to be treated with scepticism, as other responses indicated that new engineers prepare written artefacts other than those explicitly listed in the questionnaire. Indeed, the self-reports appearing verbatim in Table 6 point to an even wider writing repertoire — capital expenditure reports, work orders, and trend analyses — than respondents claimed for themselves.

The majority of novices received support in their workplace communication (see Figure 2). The most frequently used support is from peers — 67%. And, 40% of respondents received additional training in workplace communication. Of note is the employ of technical writers. Though few in number, as only five respondents indicated that they received this type of assistance, the hiring of technical writers may be indicative of new skill-sets being required by local industry: Hitherto there was no evidence that there is a local market for technical communicators. Table 10 indicates how these technical writers were distributed by employer type.

When asked about the relationship between communication ability and career advancement, new engineers felt that the ability to write, speak and collaborate well is essential to promotion (see Table 11).

Table 10: Workplace with Technical Writers

Employer Type	Number of Workplaces with Technical Writing Personnel
Oil and Gas	2
Public Utility	1
Software Development	1
Research and Development	1

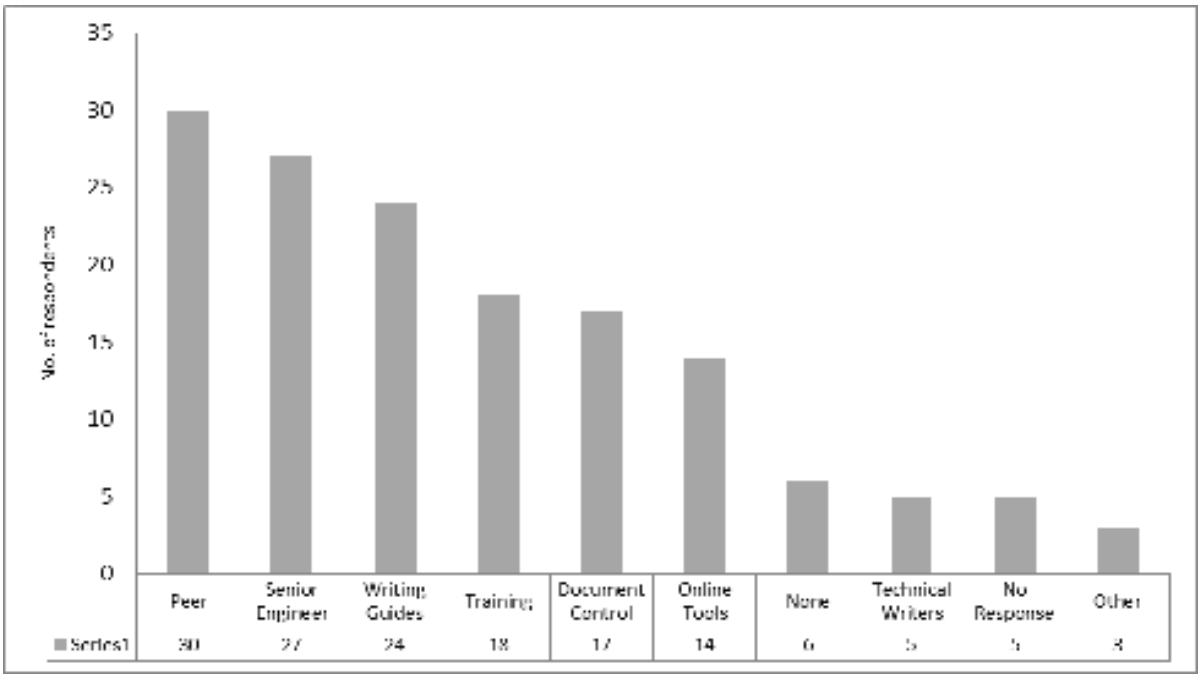

Figure 2. Workplace Support available to the Novice

Table 11. Communication and Career Advancement

Communication Skill	Likert Scale	Critical	Important	Neutral	Somewhat unimportant	Unimportant	mode
Ability to write	Count	34	18	5	1	0	Critical
	% of Sample	59%	31%	9%	2%	0%	
Ability to speak	Count	36	19	0	3	0	Critical
	% of Sample	62%	33%	0%	5%	0%	
Ability to team	Count	37	15	5	1	0	Critical
	% of Sample	64%	26%	9%	2%	0%	

Each skill received a modal ranking of 'critical'. A similar conclusion was drawn by Vest et al. (1996). They report that in the recruitment process, proficiency in technical writing and interpersonal skills are deemed the most valuable: While, all communication skills, and in particular strong presentation skills, are needed for promotion.

6. Discussion

For the new engineer, industry demands broad disciplinary competence, often favouring specialisation in more than one Electrical and Computer Engineering thematic area. This is paired with the need for strong communication skills. The majority of respondents reported that these skills are essential to their daily work and career advancement.

In keeping with trends elsewhere, local novices spend their workday in large part writing and speaking: 50% claimed to spend 41-60% communicating orally, while 48% spent 21-40 % of the day writing. Nominally, engineering graduates entering local industry can expect that five hours of an eight-ten hour workday will be spent communicating.

Novice engineers are expected to have a wide writing repertoire. Other than the technical report and technical presentation, some new engineers were expected to write, on their own or in collaboration with others, field reports, manuals, job orders, and proposals. In these tasks, engineers were supported by their companies through a slew of resources — training, writing guides, and reviews by senior engineers: Novices made overwhelming use of peer support. However, though few in number, some new engineers found themselves without writing support and had to rely on the training received in their degree programme.

7. Conclusion

If local, new hires spend over half of their workday communicating, then there is need to vigorously debunk the idea that engineers do not write nor do they need to write well — the vast body of work which predates this research and the current investigation demonstrate the groundlessness of this belief. Anecdotal evidence testifies to the widely-held, contrived dichotomy between the sciences and the humanities; invariably engineering students believe that "maths" and "language" are two unrelated disciplines and that pursuit of a math-based discipline is the surest escape from writing. It can be argued that for the entry-level engineer the biggest impediment to getting the job done and done well is their uninformed belief that they will not be required to write and speak formally and they therefore are not mentally prepared for these tasks.

If over half of the workday is absorbed by communication tasks, then employers are expending a large part of salaries for the communication artefacts needed for and generated by their business process. The stake that employers have in the communication preparedness of local graduates cannot be gainsaid in this regard. Indeed technical competence is enacted through communication: where communication is weak, the technical soundness is likely questioned or lost to its audience and becomes purposeless.

If local engineering programmes are to meet the needs of the job market then they must have curriculum provisions which substantially treat with communication skills. What specific communication-intensive interventions are needed is beyond the scope of this paper. However, this study does demonstrate that communication curricula need to prepare graduates for writing, with and without support, a range of 'mainstream' artefacts — correspondence, reports, technical reports, and proposals. Also, communication instruction is needed to prepare graduates to meet the rhetorical demands of writing scenarios that lie outside common genres — capital expenditure reports and trend analyses. While it is impossible to anticipate all the genres and emerging genres graduates will have to produce, a strong focus on developing rhetorical awareness will serve graduates well in unique communication situations (Leydens 2008).

Though few in number, some new engineers work in non-traditional enterprise — a trend which should be encouraged, as we seek to diversify our local economies. As more engineers find themselves in start-ups and entrepreneurial enterprise where organisational structures are fluid; resources are thin; and communication is even unpredictable; there is need to consider how communication curricula are meeting these needs.

Like Sageev and Romanowski (2001) and Vest et al (1996), this study treated communication practices as if they were objective fact, which can be described and understood in quantitative terms. This approach was

practical in this instance, as the study sought to describe in simple terms the day-to-day communication demands that are made of entry-level engineers. There is nonetheless a need for mixed-methodology and ethnographic investigations to derive a more nuanced understanding of communication practices in local engineering workplaces. Of immediate interest would be studies that examine:

1) What communication practices are common across a wider array of engineering workplaces — ones which hire civil engineers; mechanical and so on. Also, it would be useful to examine how specialisations and industry type may be making unique communication demands of new engineers. Communication in the field of Electrical and Computer Engineering has in this paper been treated as a monolithic whole. A more exhaustive examination of communication practices in local industry can inform curricula as there may very well be need for differentiation of instruction to meet the varying workplace demands. And since undergraduate programmes cannot cater to the every need of industry, such research may reveal where universities can provide ongoing training for practising engineers.

2) How well engineering graduates are faring in the world of work. There is need to evaluate the extent to which undergraduate programmes have prepared graduates for communicating in the workplace – whether that job is in a more traditional setting, like the oil and gas industry, or emerging enterprise; or whether the graduate is working locally or abroad. This data can inform curriculum reviews and provisioning.

Finally, this study depended entirely on self-reporting, like the studies by Sageev and Romanowski (2001) and Vest et al. (1996). It would have been useful to have external auditors, in this instance senior engineers or employers, comment on the data sets presented. Such auditors could verify the novices' accounts of their communication tasks and add clarifying details. In this regard, there is need not just to engage new hires but all levels of the organisational hierarchy to better understand the communication contexts in industry; to assess the preparedness of locally trained engineers; and to identify skills gaps.

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