A Snapshot of the Subject Matter of Computing Ethics

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***Abstract*—This paper describes a content analysis study that analyzed the subject matter of computing ethics. The purpose of the study was to begin the process of providing a coherent concept of the subject matter of computing ethics. The snapshot presented is based on article titles from four prominent journals with a computing ethics scope. This paper discusses subject matter themes that emerged from the article data. The most dominant subject matter themes were privacy, information and communication technologies, and design and development.**

Keywords—subject matter, computing ethics, definition, themes, privacy, design, development, ICTs

I. INTRODUCTION

Computing ethics is a profoundly diverse field of study. With ethics being a part of humanity and computing fast becoming such, it can be difficult to maintain a sense of scope with regard to computing ethics. The concept of what computing ethics is about can become fuzzy and its meaning easily blurred. This paper attempts to bring focus to the computing ethics field by providing a snapshot of its subject matter.

A call for focus was issued when Walter Maner stated "no one has provided a complete and coherent concept of the proper subject matter for computer ethics" [7]. Much has changed in the world and in computing since Maner's call, and though the field has moved forward in many ways, the subject matter has vastly expanded along with technology. The goal of this paper is not to prescriptively provide a concept of the subject matter, but rather to begin describing the subject matter of computing ethics. Doing so is important to better understand what is meant by the term *computing ethics*, to clarify the work of the computing ethics discipline, and to situate topics within the literature.

This analysis addresses the following question: What is the subject matter of computing ethics? The answer was sought through a qualitative and quantitative content analysis of journal article titles from several prominent journals with a computing ethics scope. The results provide evidence that computing ethics remains broad and complex, but the results also define topical areas that dominate the subject matter of computing ethics. The results can assist researchers and educators by establishing discipline boundaries and by highlighting both material-rich and underrepresented topics.

A glimpse at the results of this study shows that topics associated with the IEEE ISTAS conference are receiving attention by writers and researchers in computing ethics journals. *Privacy* and *design and development* emerged as major multi-journal themes. Furthermore, prominent topics included sustainability, openness of software, collaboration, issues and implications, technologies (e.g., ICTs, emerging), the Internet, social networking, trust, the digital divide, and humanitarian engineering.

II. JOURNALS AND SCOPES

Four journals served as data sources for exploring the subject matter of computing ethics. The primary criterion for journal selection was that the journal had a foundational scope of computing and ethics. The researcher operated under the *computing* definitions of [1, 8], the *ethics* definitions of [2, 3, 11], and the *computing ethics* definition of [4]. An important consideration that some writers bring to light, such as [9, 10], is the use of the term *ethics* to mean social issues in computing versus genuine ethics issues. The journal scopes include the terms *ethical* and *social* together. Consistently throughout the literature, the ethical and the social are inseparable terms and concepts. The researcher's stance in the study was that the ethical and social are intertwined and cannot be separated. As [6] stated, a moral philosophy "characteristically presupposes a sociology," meaning a social group underpins ethics.

Other considerations for journal selection included popularity, impact, and primary avenues amongst prominent authors in the field of computing ethics. The following list states the selected journals, along with links to the websites containing the published scopes.

1. *ACM Computers and Society* (ISSN: 0095-2737)

   http://www.sigcas.org
   http://dl.acm.org/citation.cfm?id=J198

2. *IEEE Technology and Society Magazine* (ISSN: 0278-0097)

   http://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=44

3. *Ethics and Information Technology* (ISSN: 1388-1957)

   http://www.springer.com/computer/swe/journal/10676

4. *Journal of Information, Communication, and Ethics in Society* (ISSN: 1477-996X)

   http://www.emeraldinsight.com/products/journals/journals.htm?id=jices

III. METHODOLOGY

The methodology for the study was a mixed-method content analysis. The researcher followed a qualitative analysis process similar to that discussed in [5] and the researcher broke down the titles by themes, phrases, and words for qualitative coding. The researcher, via software, also unitized the data set by words to conduct a quantitative frequency analysis for comparison. This study involved the use of software applications to analyze and visualize the data.

The researcher retrieved the journal article data from online databases provided by the publishers of the four journals. Each of the publishers published journal content in different formats. Therefore, the researcher took manual and programmatic steps to clean the varied data sets. The researcher saved the article titles, author(s), and number of pages in plain text files delimited by year, volume, and issue. After concluding the collection phase, the researcher organized the articles by Title, Author(s), Year, and Publication.

The researcher used a sampling approach for the journal articles. *IEEE Technology and Society Magazine* began publication in 1982, *Ethics and Information Technology* in 1999, *ACM Computers and Society* in 1972, and the *Journal of Information, Communication, and Ethics in Society* in 2003. The study excluded editorials without titles, commentaries, reviews, introductions without titles, book excerpts, bibliographies, interviews, and comment pieces from the sample.

From the journals' beginning dates to 2012, and given the exclusions, the four journals published a total of 1,745 articles. The sample limits for the journal data were complete volumes published from 2009 to 2012. From 2009 to 2012, the four journals published a total of 346 articles, a sample size of approximately 20%. In quantitative terms, the sample size would satisfy the minimum sample size required (315), given a confidence level of 95% and a confidence interval of ±5. The confidence interval given the actual sample size is 4.72.

IV. DATA ANALYSIS

A. Meta-data

Table I shows the number of articles per journal in the complete data set of 1,745 articles from beginning dates to 2012. The difference in portion percentages in the full set (Table I) versus the sample data set (Table II) is a function of the inception dates and fluctuations in issues per year across time. For example, *ACM Computers and Society* changed from four issues per year to two issues per year in 2011. Table II shows the number of articles and percentages of the sample, by journal, used in the study analysis.

TABLE I. ARTICLE META-DATA (BEGINNING - 2012)

Journal	First Year	Number of Articles	Percentage
ACM Computers and Society	1972	559	32.03%
Ethics and IT	1999	347	19.89%
IEEE Tech. and Society Mag.	1982	651	37.31%
JICES	2003	188	10.77%

TABLE II. ARTICLE META-DATA (2009 - 2012)

Journal	Number of Articles	Percentage of Sample
ACM Computers and Society	48	13.87%
Ethics and IT	107	30.92%
IEEE Tech. and Society Mag.	117	33.82%
JICES	74	21.39%

B. Initial Issues and Impressions

1. The varying formats of the online journal databases made retrieving the data tedious.
2. Filtering of journal content matter and non-descriptive content occurred during data collection.
3. Journal *special issues* were easily identifiable, even without explicit notation.
4. Prominent computer ethics authors published regularly in and across the four journals.
5. The journals shared a variety of themes, but each journal had a unique *content identity*.
6. Authors in *Ethics and Information Technology*, a philosophy-oriented journal, were more likely to use analogous language in titles.

C. Reducing the Data

Initially, the researcher selected the data from 2009-2012, and planned to qualitatively code the journal titles along with the abstracts. The researcher performed the title and abstract analysis on 29 articles published in *IEEE Technology and Society Magazine* in 2009. The initial process indicated that an abstract brings clarity to an article title's meaning, but would quickly make the coding scheme obtrusive.

Therefore, the researcher qualitatively coded the titles of the 346 journal articles in the study sample, while using the abstracts if necessary to clarify title terminology. The general expectation of article titles is that titles are thematically representative of the content contained in the article. For most articles, the abstract was not necessary for the coding process. However, sometimes titles required reference to the abstract to help determine meaning. The journal article titles that required the most abstract verification were from the *Ethics and Information Technology* journal. Overall, the iterative process led the researcher to a manageable amount of thematic data for exploring the subject matter of computing ethics based on the data set.

D. Coding

After organizing the article data in Excel, the researcher imported the data into the analysis tool Dedoose

(www.dedoose.com). The researcher then analyzed the data per the analysis plan. The researcher read the titles word by word to derive codes, using a combination of in vivo, descriptive, and thematic coding. If necessary, the researcher verified the meaning of terminology by examining article abstracts. Throughout the process, labels for codes emerged that were reflective of the content. The labels often came directly from the text and became the coding scheme. A total of 831 unique codes emerged from the article data, a testament to the broad and complex nature of computing ethics. Table III presents codes that were applied four or more times in the article data.

TABLE III. TOP CODE APPLICATION COUNTS

privacy	23	understand(ing)	5
ICT(s)	23	challenge(s)	5
design/development/model/creation	19	friendship	5
ethics	14	digital divide(s)	5
technology	14	humanitarian engineering/development	5
use	10	capabilities/capacity	4
trust	9	role	4
Facebook	9	evaluate/evaluation	4
cyberspace/web space/ (online) environment	9	explore	4
social network sites/technology	8	study/studying	4
analogies	7	identity (affect)	4
sustainability (general)	7	regulation(s)	4
Internet	7	information justice	4
issues (ethical)	6	security (cont/cost)	4
implications (ethical)	6	(Google) Street View	4
information technology	6	emerging/new technologies	4
software (free)	6	robots	4
reality	5	software (open source)	4
case studies	5	global	4

E. Journal Patterns

Table IV presents the dominant patterns (topics) by journal that emerged from the article titles. The patterns contribute to each journal's unique content identity. The topic most common across the journals was *privacy*: a dominant pattern in all four journals. Common topics across three journals included *information and communication technologies (ICTs)* and *design/development*. Top patterns in two journals included *technology*, *Internet*, and *ethics (general)*.

TABLE IV. TOP TOPIC PATTERNS BY JOURNAL

ACM Comp. & Soc.	**IEEE Tech. & Soc.**	**Ethics & IT**	**JICES**
use	privacy	design/development	ICT(s)
privacy	technology	ICT(s)	ethics
(Google) Street View	design/development	trust	case studies
ICT(s)	sustainability	ethics	cyberspace/online
–	humanitarian engineering	friendship	role
–	challenge(s)	privacy	analogies
–	security (contribution/cost)	social networks	study/studying
–	Facebook	capabilities/capacity	design/development
–	Internet	issues (ethical)	privacy
–	–	information tech.	Internet
–	–	technology	–

F. Themes

The researcher used the thematic framework (definition themes) presented in [4] to organize the codes that emerged from the article titles into meaningful clusters. The definition framework pre-established interconnections. Therefore, the journal themes took on the form of topics using codes that emerged from the article titles. Such an approach also made the code mapping process efficient and simultaneously assessed if the definition framework in [4] appropriately delineates the subject matter of computing ethics. The topical patterns derived from the article titles denote the subject matter of computing ethics. Though a wide range of topics emerged from the article data, all codes and patterns fell within the thematic framework.

Definition Themes from [4]:

- Interdisciplinary
  - Disciplines
  - Ethics
  - Theories
- Collaborative
  - Codes/Principles/Considerations
  - Life/General
  - Work
- Scholars and Professionals
- Methodically Study
- Practically Affect
- Contributions and Costs
- Global Society

Some of the article codes contextually fall into multiple categories. For example, the *digital divide* can be *Practically Affected*, while at the same time might be perceived as a *Cost*. *Surveillance* can be thought of as something to be *Practically Affected*, a *Contribution or Cost*, or a *Computing Artifact*. Therefore, identical codes can exist under more than one theme due to varied term meanings.

The following tables (Table V, Table VI, Table VII, Table VIII, Table IX) illustrate the definition themes along with sample subject matter codes/topics.

TABLE V. INTERDISCIPLINARY AND COLLABORATIVE TOPICS

Themes	**INTERDISCIPLINARY**			**COLLABORATIVE**		
Thematic groups	***Disciplines***	***Ethics***	***Theories***	***Life/General***	***Work***	***Codes/P/C***
Sample codes	bio-technology	business ethics	Aristotelian friendship	biculturalism	cooperative workflows	etiquette
	computer science	information ethics	critical theory	gender	multi-tasking	morality
	engineering	robotics ethics	pragmatism	race	software work	social contract

TABLE VI. SCHOLARS AND PROFESSIONALS TOPICS

Theme	**SCHOLARS and PROFESSIONALS**
Sample codes	computing professional
	designers
	humanitarians
	nanotech enterprises
	policy makers

TABLE VII. METHODICALLY STUDY AND PRACTICALLY AFFECT TOPICS

Themes	**METHODICALLY STUDY**	**PRACTICALLY AFFECT**
Sample codes	assessment	ICT pollution
	critique	democracy
	critical systemic thinking	file sharing
	ethical discourse	Internet content filtering
	mental models	normative structure

TABLE VIII. CONTRIBUTIONS/COSTS AND COMPUTING ARTIFACTS TOPICS

Themes	**CONTRIBUTIONS and COSTS**	**COMPUTING ARTIFACTS**
Sample codes	autonomy	autonomous systems
	classroom visual accessibility	cyber cafés
	human enhancement	electronic books
	liability	new media
	social memory	smartphone recordings

TABLE IX. GLOBAL SOCIETY TOPICS

Theme	**GLOBAL SOCIETY**
Sample codes	Aboriginal communities
	Pan-European
	aging populace
	millennials
	students (undergraduate)

G. *Frequencies and Comparison*

The researcher also conducted a quantitative analysis of the article data. The reason for quantitative description in this study was to ensure that the codes and topics derived from the qualitative analysis did not venture far from the terminology and emphasis of the article authors. The frequency analysis offered a purely statistical description of the data. The researcher compared words and frequency counts to the qualitative codes and application counts.

Table X displays the top frequency counts for the subject matter. *Information* tops the list, which the researcher expected, as *information* is a qualifier for many bigrams and phrases in computing. *Privacy* was the second highest frequency, which supports the findings of the qualitative analysis. Privacy is the most dominant topical pattern in the subject matter of computing ethics within the timeframe examined. *Ethics*, *ethical*, *social*, *technology*, *moral*, *communication*, *ICT*, and *systems* complete the top ten frequencies.

TABLE X. SUBJECT MATTER - TOP FREQUENCY COUNTS

information	40	age	8	designing	6
privacy	38	communities	8	evaluation	6
ethical	34	computer	8	free	6
ethics	33	computing	8	networking	6
social	30	design	8	networks	6
technology	26	online	8	research	6
moral	20	society	8	students	6
communication	13	web	8	sustainability	6
ICT	13	world	8	artificial	5
systems	13	capabilities	7	business	5
virtual	13	case	7	decision	5
digital	12	development	7	developing	5
implications	12	friendship	7	divide	5
internet	12	good	7	education	5
issues	12	human	7	future	5
trust	12	humanitarian	7	gender	5
engineering	11	identity	7	ICTs	5
new	11	IT	7	knowledge	5
rights	10	justice	7	media	5
software	10	management	7	normative	5
approach	9	sites	7	open	5
facebook	9	study	7	policy	5
robots	9	transparency	7	revolution	5
security	9	using	7	understanding	5
technologies	9	analysis	6	view	5

The qualitative application counts and quantitative frequency counts have commonalities. Considerable overlap exists between the top counts in both sets of raw results. Also, the researcher combined similar top frequency words by root for comparison with the dominant topics that emerged from the qualitative analysis. Fig. 1, illustrates the commonalties.

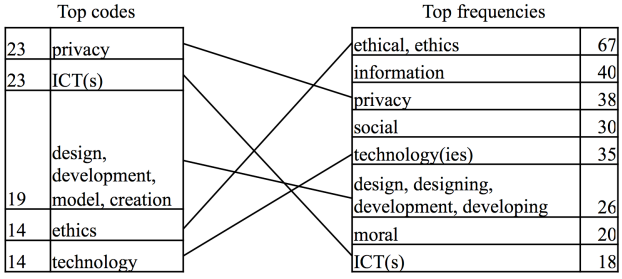

Fig. 1. Top Code and Frequency Comparison

The top five qualitative patterns are contained within the top eight quantitative patterns. Both analysis methods show consensus on the patterns of *privacy, ICT(s), design/development, ethics,* and *technology*. The remaining top frequency words are *information, social,* and *moral*: three foundational concepts in computing ethics. When the combined results are ranked, the following list is the output:

1. Ethics (81)
2. Privacy (61)
3. Technology (49)
4. Design and Development (45)
5. Information and Communication Technologies (ICTs) (41)

The descriptive results also confirm that the interpreted meanings do not stray from terminology used in the article titles.

V. Conclusions

The number of unique codes (831) and the variety of topics within the sample article data are evidence of the breadth and complexity of computing ethics. Still, the definition themes proved an effective framework for categorizing the varied subject matter. And the distilled subject matter is synonymous with the definition of [4]. Therefore, the definition themes *are* the subject matter of computing ethics.

In a topical sense, the most popular subjects in journals with a scope of computing ethics are *privacy* and *design/development*. *Trust* is another popular topic. The principle computing artifacts are *technology*, *ICTs*, and *cyberspace*. Authors also focus on the *use* and *methodical study* (e.g., analogies, case studies, evaluation, etc.) of technologies. Expectedly, the *ethical*, the *moral*, and the *social* are prominent.

Other topical themes worth noting are specific technologies such as *Facebook*, *social networks*, *Google Street View*, and *robots*. An interesting consideration about the technology themes is their contribution to the other major themes. Facebook, Google Street View, and social technologies suggest issues of privacy and trust, while robots suggest issues of use and capabilities. *Sustainability*, *software* and *information freedom*, *friendship*, and *humanitarian engineering* receive recurring attention throughout the literature as well. Generally, writers are attentive to the *Internet* Age and many of the technologies and *global* issues that this era has generated.

The data indicates that privacy and ICTs receive the bulk of attention. Although both of these topic areas are extremely important, perhaps they are over-represented. Topical areas that would benefit from more exposure include the integration of *applied ethical analysis* into the *engineering process* and technology *dependency*. *Sustainability*, in all its forms, has received some attention, but certainly deserves more prominence. Such areas are ripe for research and even if it is happening, suitable amounts are not being published in the surveyed journals.

The subject matter patterns are limited to the timeframe examined: 2009-2012. The patterns cannot be generalized over the life of the journals. Based on initial analysis, the patterns shift over time. For example, in *IEEE Technology and Society Magazine*, throughout the 1980's *nuclear* was a significant pattern, although that is not the case *ACM Computers and Society*.

VI. Recommendations

Several future research opportunities, specifically related to this study, have emerged regarding computing ethics. The subject matter analysis was limited to 2009-2012; therefore an analysis of all article data from the selected journals would give a more comprehensive view of the subject matter and disclose pattern shifts over time. Another area for study related to the articles is the network of authorship and influence in the sphere of computing ethics publication. With regard to computing ethics education, an exploration of the link and overlap (or not) between the subject matter themes and what is being taught in computing ethics courses would be valuable.

This study can also be built upon by a deeper discussion of the dominant themes that emerged. Interesting examples would be studies that explore the concepts and key debates of privacy, design/development, use, trust, virtual environments, and sustainability. The studies should build on the topics as discussed in the journals. For example, is the design/development concept the same across the journals, are virtual environments viewed positively or negatively, and what does the computing ethics community mean by the term *trust*. Similar work could happen at the more abstract level of definition themes, for instance an appraisal of the interdisciplinarity of computing ethics. Such expositions would provide valuable information beyond the snapshot of themes presented herein.

Regarding lessons learned and study reflection, the mixed method approach proved effective for the type of data collected. Given further study, a more computational approach would save time in terms of data collection and cleaning, while a deeper computational analysis (i.e., data/text mining) might expose interesting patterns in the data. In terms of content, although the subject matter is extremely varied, the results of this study can give guidance to instructors when choosing content to teach computing ethics. For example, an instructor might choose to cover only the material-rich dominant topics. However, the researcher recommends a combination of dominant topics and minor topics needing more attention. Also, rooting computing ethics discussions and courses in an adequate definition will provide meaningful guidance for the topics explored.

A point of assurance, as mentioned in the Introduction, is that journals are publishing work in the very important area of design and development. The extent of design and development publication was an important finding of this study. Based on a preliminary review of articles published since 2012, it is clear that the prominent themes and topics presented in this paper are continuing to receive attention. The existence of journals and conferences related to computing ethics, and its many aspects, is fundamental to education and ongoing conversation about the topics that compose the subject matter of computing ethics. Such venues must remain active and focused on the issues facing cultures and modern societies.

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