Analysing UK Annual Report Narratives using Text Analysis and Natural Language Processing

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RESEARCH QUESTIONS

- Can we advance research on the lexical properties and narrative aspects of corporate disclosures using NLP?
- Can we publish what's already freely available?
- Are firms honest with us?
- Could the news tell us something?
- Who writes corporate disclosures?
- What if we enforced a standard?

Things to know:

- Work on analysing corporate disclosures ranges from manual analysis up to using WordSmith. (concordance, wordlist, keywords count)
- Crowdsourcing is what some firms use to quickly build their databases

ANALYSING UK ANNUAL REPORT NARRATIVES

- Project background
- Before our work…
- Work so far… in progress…in the future…
- UK vs USA Filings (Current Research)
- Overview of our research tool
- Answering research questions
- Demo of research tool

- Questions

BACKGROUND & OBJECTIVES

- Part of an ESRC- and ICAEW-funded project examining the *Corporate Financial Information Environment (CFIE)*
  - Martin Walker, *Manchester Business School*
  - Steven Young, *Lancaster University Management School*
  - Paul Rayson, *Lancaster University School of Computing & Communications*
  - Mahmoud El-Haj, *Lancaster University School of Computing & Communications*
  - Vasiliki Athanasakou, *London School of Economics*

- Project seeks to analyse UK financial narratives, their association with financial statement information, and their informativeness for investors

- Automated, large sample analysis of UK annual report narratives represents a cornerstone of the project
  - Develop a tool for general use by academics

BEFORE…

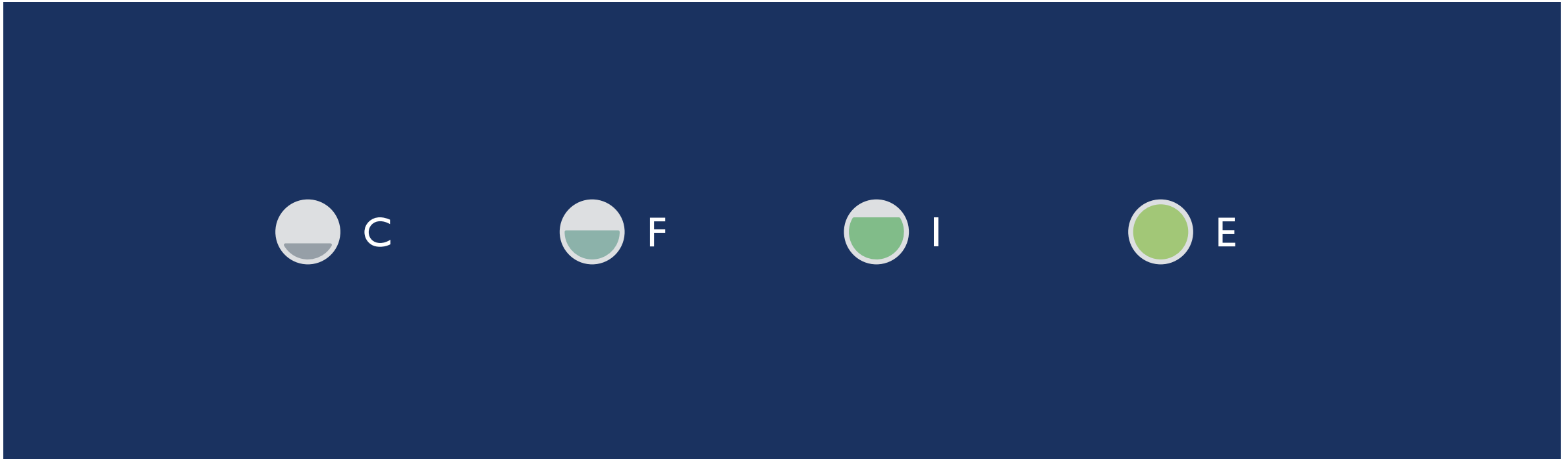
- Researchers worked on document level
- Section level analysis had to be done manually
- There was no clear relationship between documents
- Analysis didn't go beyond word level
- And therefore it wasn't possible to automate any cross sectional analysis

SO FAR… IN PROGRESS…IN THE FUTURE…

- So far:
  - NLP suit to aid researcher in quickly analysing financial disclosures that goes beyond simple word level analysis.
  - Built financial disclosures section-based (reference) corpus
  - Used machine learning to train a system to detect attribution and tone in financial sentences.
  - Used heuristic approaches to define Performance and Strategic sections.
- In progress:
  - Study the relationship and similarities between press releases and media articles using text reuse.
  - Use NLP and machine learning to detect strategic sections in annual reports
  - Use web as a corpus to harvest freely available financial documents.
  - Study text reuse in financial disclosures.
- Future
  - Work with Annual Reports in Chinese and some European languages
  - Using crowdsourcing to help build lexicons for each language

UK vs USA FILINGS

WHY'S USA LEADING?



CURRENT RESEARCH IS ON USA FILINGS!

- Majority of large sample analysis of annual report narratives has been conducted on US filings
- Usually 10-Ks (aka Annual Reports)
- those available via EDGAR (Free access to more than 20 million filings)
- Analysis of 10-K filings in EDGAR is relatively straightforward
  - Plain text files with consistent structure
  - Use HTML parser to identify section(s) and extract text

10-K ANNUAL FORM

Each 10-K contains 4 parts and 15 items

- **PART I**
- **ITEM 1.** Description of Business
- **ITEM 2.** Description of Properties
- **ITEM 3.** Legal Proceedings
- **ITEM 4.** Mine Safety Disclosures
- **PART II**
- **ITEM 5.** Market for Registrant's Common Equity….
- **ITEM 6.** Selected Financial Data
- **ITEM 7.** Management's Discussion and Analysis….
- **ITEM 8.** Financial Statements and Supplementary Data
- **ITEM 9.** Changes in and Disagreements ….
- **PART III**
- **ITEM 10.** Directors, Executive Officers and Corporate Governance
- **ITEM 11.** Executive Compensation
- **ITEM 12.** Security Ownership of Certain Beneficial Owners….
- **ITEM 13.** Certain Relationships and Related Transactions….
- **ITEM 14.** Principal Accounting Fees and Services
- **PART IV**
- **ITEM 15.** Exhibits, Financial Statement Schedules….

10-K ANNUAL (STARBUCKS VS. MCDONALD'S)

Starbucks Corporation

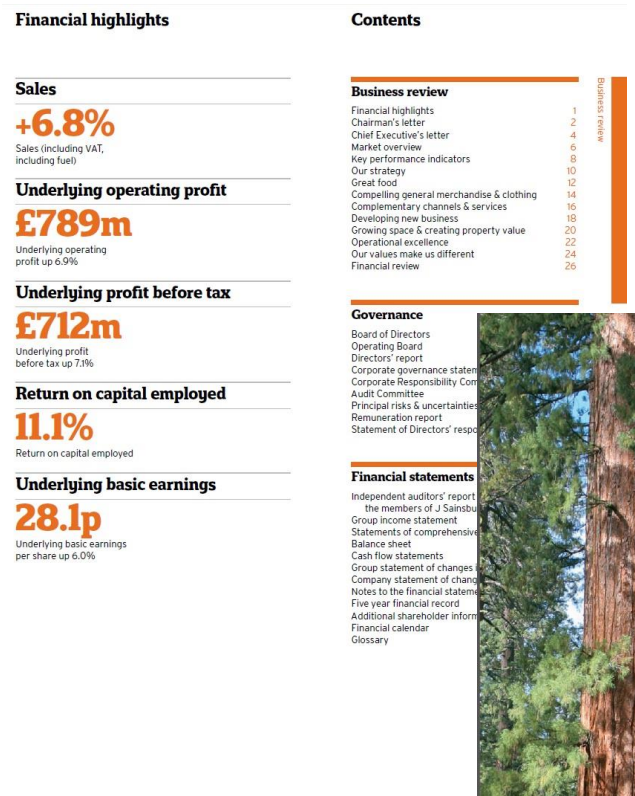
McDONALD'S CORPORATION

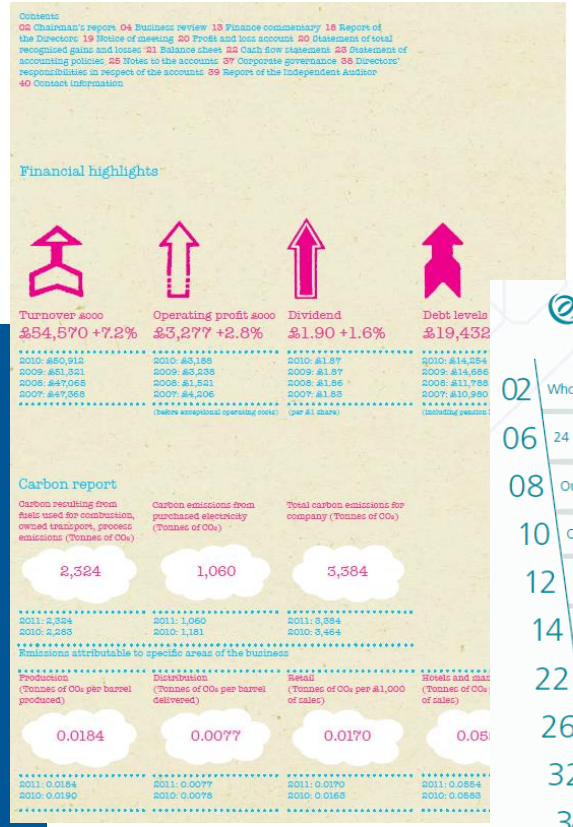
UK FILINGS

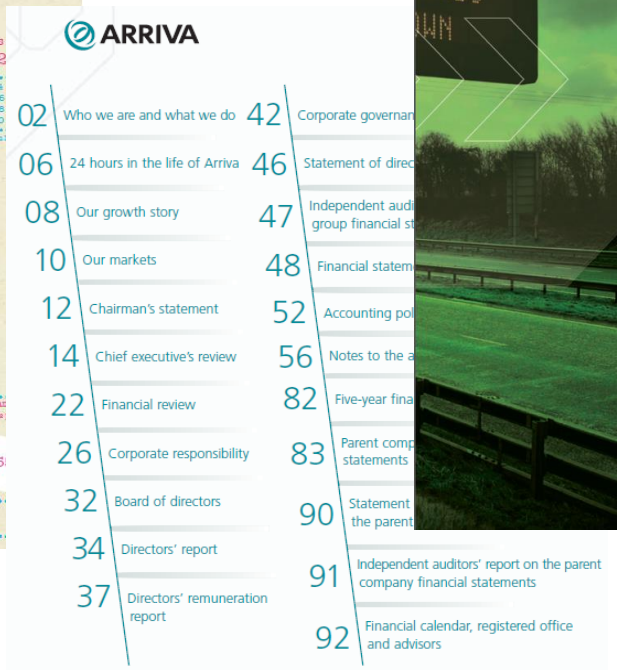
- Content and structure varies across firms.
- Management have more discretion over what, where, and how much information on topics such as risk, strategy, performance, etc. is reported.

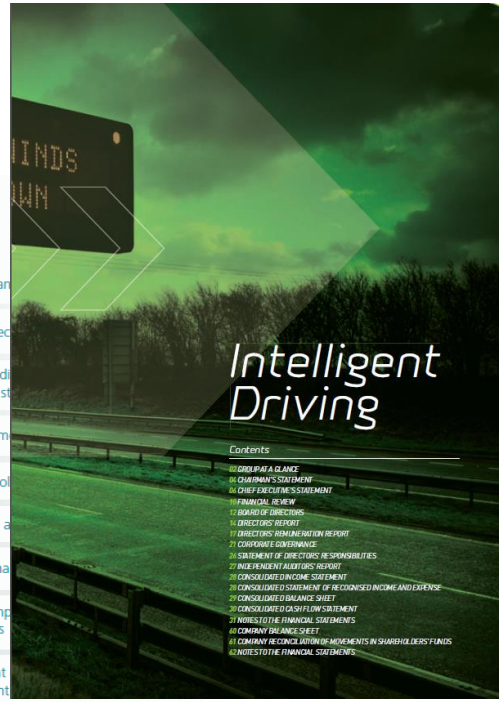
- UK annual reports pose more significant challenges to researchers
  - Normally supplied as *.pdf
  - No consistent template

UK ANNUAL REPORTS SAMPLE





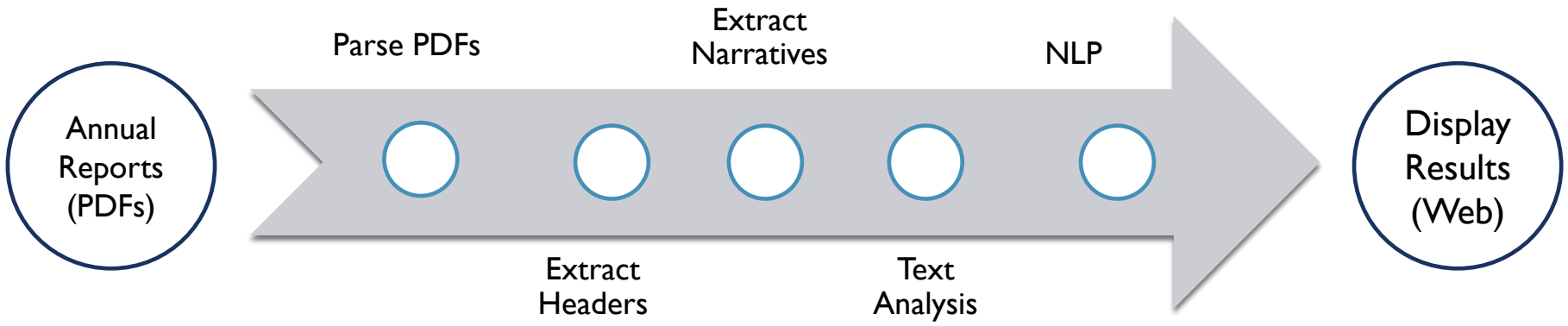




DATASET

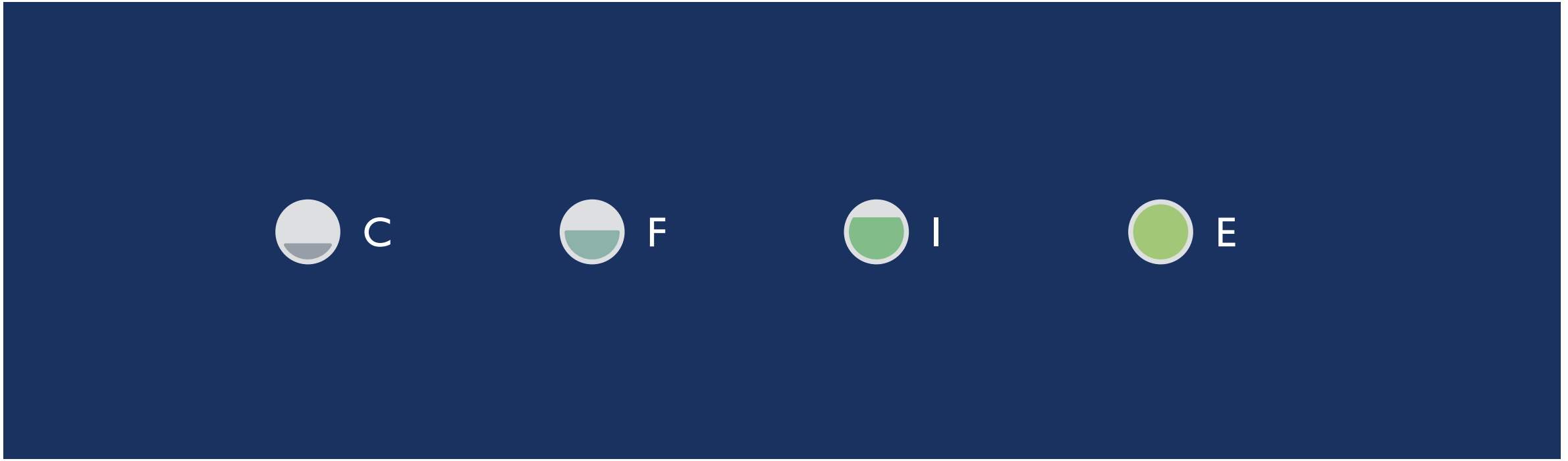
- >14,000 searchable financial annual reports
- of around 500 of the largest UK firms listed on the LSE
- between the years 2002 and 2014.
- Annual reports were automatically downloaded using a Perl script and some Java code.
- >150,000 media articles and press releases (US firms)

CFIE ANALYSIS PIPELINE



EXTRACTION PROCESS

WHAT ARE WE LOOKING TO EXTRACT?

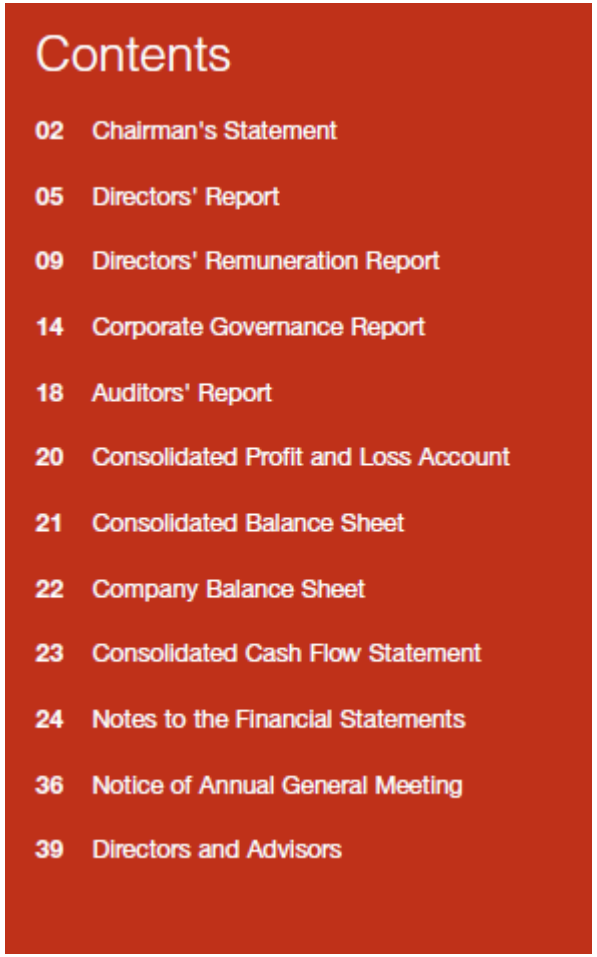


HEADERS AND THEIR SECTIONS

- Front End
  1. Chairman's statement
  2. CEO Review
  3. Corporate Government Report
  4. Directors Remuneration Report
  5. Directors Report and Business Review
  6. Directors Responsibilities Statement
  7. Directors Report
  8. Financial Review
  9. Key Performance Indicator
  10. Operational Review
  11. Highlights
- Back End
  - Financial statements (financial numbers)

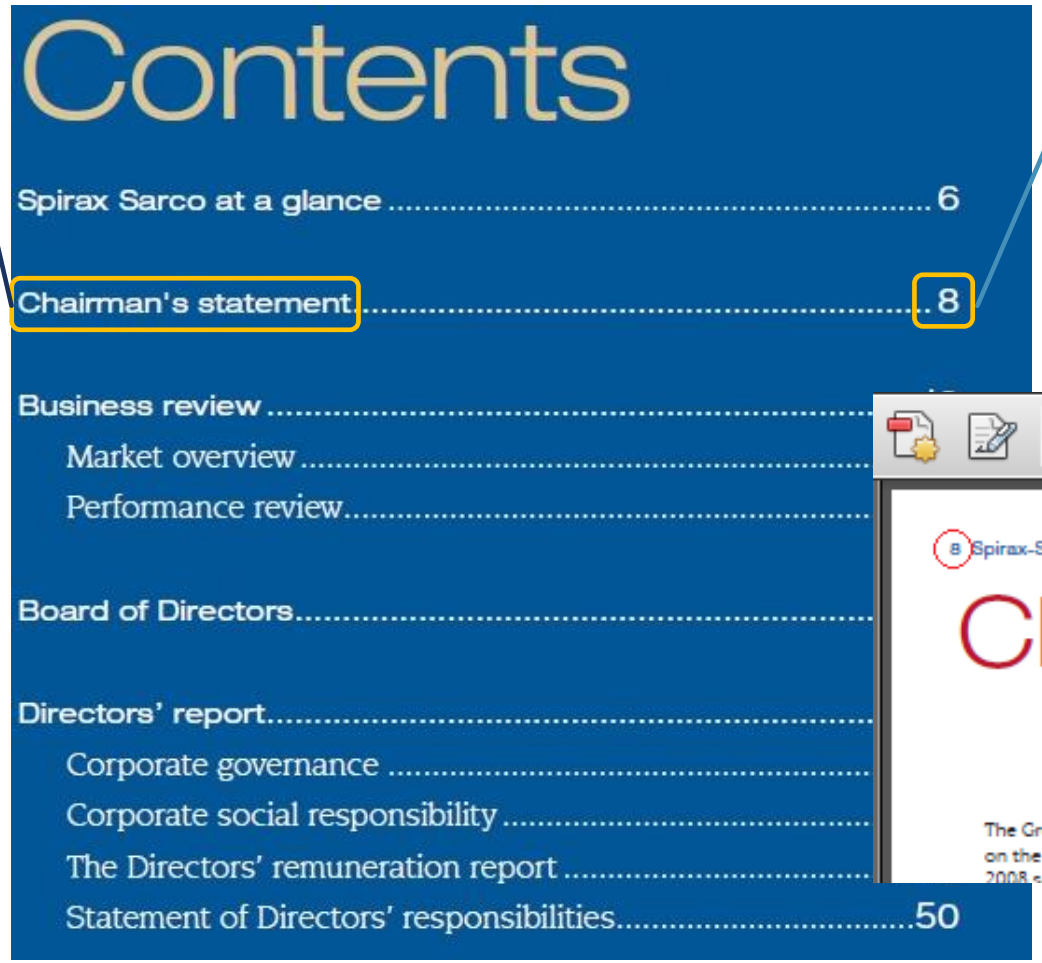
UK ANNUAL REPORT TOOL: EXTRACTION

- Use contents page to extract text by section from digital pdf
- Steps in extraction process:
  - Detect contents page
  - Parse contents page
  - Detect page numbering to determine section start/end
  - Add headers as bookmarks to pdf
  - Extract text for each section
- Analyse extracted text by section and for entire document



HOW?

Not consistent across ARs



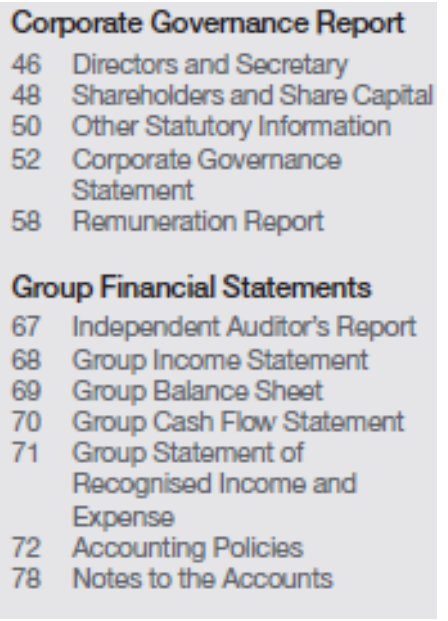
Doesn't always refer to the correct page

1) DETECTING THE CONTENTS PAGE

- Experts gold–standard
- highest matching score is the potential contents page
- Search by structure – e.g. *Chairman's Statement 13*.

2) PARSING THE CONTENTS PAGE

- Use regEx for parsing
- Use linguistic algorithms to avoid dates/addresses/figures (e.g. 77 million)
- Use synonyms and heuristic approaches for header's type (e.g. Chairman Statement)
- To tackle the problem of broken headers we concatenate sentences that end or begin with prepositions such as 'of', 'in' ...etc.
- The algorithm also concatenates sentences ending with singular or plural possessives, symbolic and textual connectors (e.g. 'and', 'or', '&'...etc), and sentences ending with hyphenations.



Corporate Governance Report

46 Directors and Secretary
48 Shareholders and Share Capital
50 Other Statutory Information
52 Corporate Governance Statement
58 Remuneration Report

Group Financial Statements

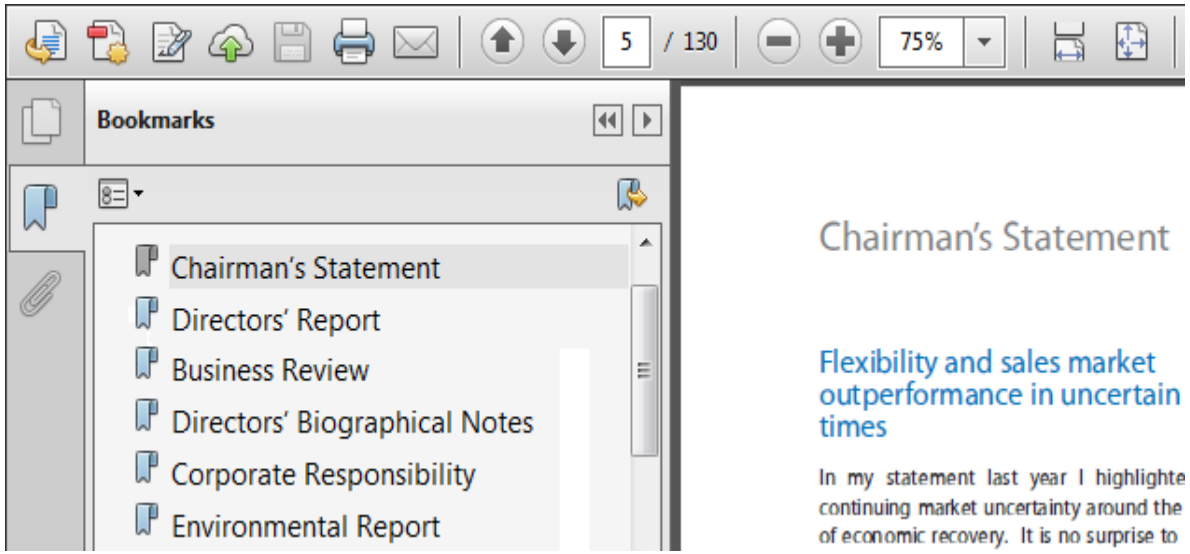
67 Independent Auditor's Report
68 Group Income Statement
69 Group Balance Sheet
70 Group Cash Flow Statement
71 Group Statement of Recognised Income and Expense
72 Accounting Policies
78 Notes to the Accounts

3) DETECTING PAGE NUMBERING

- The page numbers appearing on the contents page do not usually match with the actual page numbers in the pdf files.
- Created a simple page detection tool that crawls through all the numbers in the pdf pages and try to detect a pattern of consecutive number with an increment of 1 (e.g. 31, 32, 33). Comparing that to the actual pdf page number the tool then picks the difference with highest vote.
- Running this process we got an accuracy rate of 98%.
- Manually examining a sample of the 2% showed 1) encoding, 2) formatting and 3) design (booklet).

4) ADDING HEADERS AS BOOKMARKS

- Using the headers and their correct page numbers we implemented a tool to insert the extracted contents page headers as bookmarks (hyperlinks) to sample PDFs.



5) EXTRACTING HEADERS' NARRATIVES

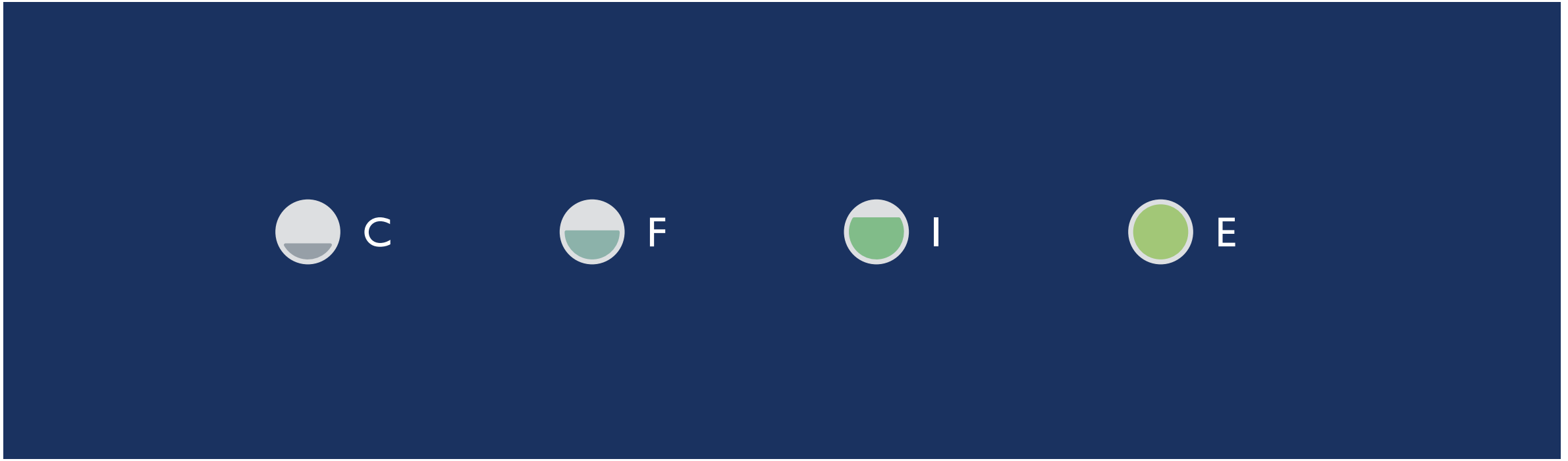
We get everything but mainly interested in front end:

1. Chairman's statement
2. CEO Review
3. Corporate Government Report
4. Directors Remuneration Report
5. Directors Report and Business Review
6. Directors Responsibilities Statement
7. Directors Report
8. Financial Review
9. Key Performance Indicator
10. Operational Review
11. Highlights

RESEARCH TOOL OVERVIEW

- In addition to performing text extraction, the tool provides a range of text analysis options:
  - Readability metrics
  - Word counts using pre-determined lists (e.g., forward looking, uncertainty, tone, etc.)
  - Word counts based on user-defined wordlists
  - Part of speech tagging
  - Semantic tagging
  - Comparison with reference corpus (word, parts of speech and semantic level)
  - Concordance and collocates
  - Word clouds
  - Search for word in context
  - …etc

ANSWERING RESEARCH QUESTIONS



Can we advance research on the lexical properties and narrative aspects of corporate disclosures using NLP?

- Yes
- Speed up processing time
- Provide extra level of analysis than just keyword and wordlist levels.
- Help relate profit/loss in firms to tone/attributing and other linguistic features.
- Help analyse management narratives and for example check number of times management shifts from singular to plural pronouns or using past and present verbs.

…etc

CAN WE PUBLISH WHAT'S ALREADY FREELY AVAILABLE?

- No for the files and Yes for the output/results
- Even though most of the financial disclosures are freely available we still cannot publish files collected and organised by other database companies.
- Solutions:
  - Use web as a corpus
  - Standardise data (firm codes, report layout, sections …etc)

ARE FIRMS HONEST WITH US?

- Companies will try to hide or downplay their losses – this can be sometimes automatically detected by measuring the tone and the use of forward looking statements (compared to previous reports).
- Analyst are usually behind uncovering these information but takes them a huge amount of time to do so (e.g. 90 reports in 6 months).

COULD THE NEWS TELL US SOMETHING?

- Part of the work we are conducting analyses press releases (by firms) and media articles (by news).
- The work studies the relationship between what a company reports and what media says about it.
- We collect media articles at a period following the release of a press release.

WHO WRITES CORPORATE DISCLOSURES?

- Some companies reuse their previous reports and add/edit/delete sections.
- It's hard to tell who writes an annual report - interviewing an expert in writing annual reports we found that:
  - Up to 20 people could participate in writing annual reports
  - Chairman usually don't write their own section but will read it and ask for edits.
  - They hire a company to do so.
- We used 3 text reuse methods for comparing and measuring text similarity and derivation in sets of texts.:
  - Word Error Rate (WER)
  - Cosin Similarity
  - Tesas (identifying text reuse based on text alignment)

WHAT IF WE ENFORCED A STANDARD?

- This will upset many database companies.
- But will benefit analyst, and researchers in the field of accounting and finance as well as investors.
- How?
  - Having a standard format for wiring annual reports will help in restricting what firms report
  - Help in better understanding of certain sections or where the company stands in the current market.
  - Until now there is not a single identifier to link all the databases available which makes it difficult to study for example annual reports and press releases in one go and that's what we provide researchers with.

UK ANNUAL REPORT TOOL: DEMO

- https://cfie.lancaster.ac.uk:8443/

QUESTIONS

CFIE UREL: http://ucrel.lancs.ac.uk/cfie