

Vertical Information Transmission in Organizations: Evidence from the Enron Corporation

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Abstract

Firms' production depends on effective information flows across the organisation, and hierarchies play a crucial role in shaping them. Nevertheless, there is little empirical evidence on how information moves across hierarchies. In this paper, I exploit a unique panel dataset of emails from the Enron Corporation to explain the role of vertical communication in information flows. I find that vertical communication was meant to either move information up the hierarchy or delegate tasks down, suggesting that subordinates were generally in charge of information acquisition, whereas superiors retained decision rights. In addition, emails are more precise when directed to superiors rather than when sent to subordinates, suggesting an uneven distribution of power in favour of superiors or effective incentives. This evidence supports the incentive-theory perspective on communication. However, an event study around the sudden resignation of the CEO shows that superiors gain a more important role in providing information in moments of crisis. This result suggests that higher-ranked roles hold more complex knowledge and help subordinates in challenging times, consistent with the knowledge-based view of hierarchies. Finally, I find that higher-ranked employees have broader languages, particularly when providing information, suggesting broader communication across the firm. Overall, the paper provides real-data evidence that incentive theories and team theories may complement each other in explaining the communication flows within firms.

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1 Introduction

Firms' production efficiency heavily depends on how information is transmitted within the firm. Business-relevant information may arrive at the firm through lower divisions or the leadership, but a much larger set of employees generally needs it to accomplish their tasks. Ineffective information sharing within the firm may create delays, errors, and lower revenues.¹ Hierarchies affect information flows by determining the allocation of formal decision rights and allowing for different roles in the management of information. A large theoretical literature has studied optimal organisational structures that minimise communication frictions, particularly on possibly different incentives across the communicating parties or exogenous constraints like cognitive limitations. What happens in practice? Due to the lack of data on firms' internal communication, empirical evidence has been scarce, as discussed by [Impink, Prat, and Sadun \(2020\)](#).

This paper aims to partly fill this gap by analysing information flows in the Enron corporation, a very large energy company. I built a unique dataset that merges Enron's emails with employees' roles and hierarchical relations, manually extracted from email attachments. Using large language models and text mining tools, I classify work-related emails based on whether they provide information, request information, or delegate tasks and based on their degree of specialisation.

I find that information was mostly acquired from subordinates and transmitted up the hierarchy, suggesting that superiors retained decision rights. In addition, the information provided to superiors had higher precision compared to that provided to subordinates, implying that centralisation of decision-making did not imply lower communication quality. These facts support an incentive-theory-based view of within-firm communication. However, the intensity of information provision to subordinates and its quality increased right after the resignation of CEO Jeff Skilling. This result suggests more complex knowledge at higher levels of the hierarchy, as predicted by theories of knowledge-based hierarchies ([Garicano 2000](#)).

The Enron Corporation was a large American energy company which suddenly fell into bankruptcy in December 2001. The case created a scandal and originated an investigation by the Federal Energy Regulatory Commission, which then released emails from the company to the public in an attempt to clarify the case. The email data formed the Enron Corpus, which, to my knowledge, is the only legally public database of emails of a large corporation.² In this paper, I use the version of the Corpus elaborated by [Agarwal et al. \(2012\)](#) for email bodies. I then used the raw version of the Corpus to extract email attachments that contained information on the hierarchy, mostly divisions' hierarchical trees sent following organisational changes.

The merge of email text data with information on the hierarchical position of email

¹[Sandvik, Saouma, Seegert, and Stanton \(2020\)](#) show that better information flows increase productivity.

²The Enron Corpus has been extensively studied in Computer Science and Computational Linguistics, e.g. [Klimt and Yang \(2004\)](#); [Bekkerman, McCallum, and Huang \(2004\)](#); [McCallum, Wang, and Corrada-Emmanuel \(2007\)](#); [Agarwal et al. \(2012\)](#). In other fields, the use of the corpus is scarce. An exception is [Aven \(2015\)](#).

senders led to a panel dataset of 1557 employees and 3 years (1999-2001). This final dataset excludes non-work related emails, and those sent by employees in administrative roles, which are not exactly comparable to the others.³ To capture employees' hierarchical level, I use two alternative measures. First, I compute the hierarchical distance from Kenneth Lay, who held the position of CEO for the majority of the time. The measure of distance corresponds to the number of superiors the employee has to get to Lay and is available only for individuals whose hierarchical position can be traced to him. Second, I group employees' roles into categories from the most managerial to the most specialised. These measures vary over time for some individuals because of organisational changes or promotions, which create additional variation.

I then compute textual measures to capture the degree of language specialisation at individual and email levels. The individual measure of specialisation captures how diverse and broad an employee's language is and relies on the words used in all employee's emails. I adapt the Herfindahl–Hirschman index (HHI) to the context of language to capture the degree of language concentration around a few words. The measure takes higher values if the employee uses a few words very frequently, and vice-versa is low if the employee uses a larger set of words with homogeneous frequency. Concerning email-level specialisation, I consider two measures. First, I rely on large language models and use OpenAI's GPT 3.5 algorithm to classify emails on a scale from 1 (very broad) to 5 (very technical).⁴ Second, I compute the average number of words' meanings for each email, as appearing in the English dictionary. I interpret these measures as proxies for quality, as more technical content is generally more precise and informative than broader content.

Finally, I identify the nature of emails' content by classifying it into three categories: *provides information*, *requests information*, and *requests some service or delegate tasks*. I achieve that using LLMs again.

Who acquires information in firms, and how does information move across the hierarchy? One strand of the literature relies on contract theory and studies cases where the superior and the subordinate do not share the same incentives. [Aghion and Tirole \(1997\)](#) suggests that informed subordinates communicate information to their superior (who retains decision rights) if communication costs are low and incentives close enough. Nevertheless, the superior may prefer to delegate decision rights to the subordinate to incentivise effort in information acquisition. On the contrary, they predict less communication if their objectives are too different. Indeed, in this case, superiors want to retain decision rights to prevent subordinates from making decisions that are not favourable to them. At the same time, subordinates may not want to communicate their information for similar reasons. [Dessein \(2002\)](#) shows that if incentives are relatively close, superiors may prefer to delegate decision rights to subordinates to avoid the risk of noisy communication. These models assume that subordinates are free to leave the firm and cannot be perfectly controlled. As a consequence, holding information gives them contractual

³ Assistants and secretaries support the work of other employees by definition of their role. Their communication depends more strictly on their labour contract rather than the organisational design.

⁴ The use of LLMs for classification is becoming more common with the improved quality of the algorithms. For example, [Arold, Ash, MacLeod, and Naidu \(2024\)](#) use LLMs to determine whether certain worker rights clauses are more pro-workers than others.

power. However, superiors can implement career incentives or other devices to make subordinates' preferences closer to theirs.

A second strand of the literature builds on team theory, assuming that subordinates and superiors share the same incentives. This literature focuses on other frictions, namely cognitive boundaries that either prevent employees from dealing with all possible problems (Garicano 2000) or limit language capabilities, such that the set of signals is smaller than the set of events that an employee may want to communicate (Crémer, Garicano, and Prat 2007). The former paper suggests that hierarchies allow for the specialisation of knowledge so that subordinates mostly deal with routine problems while superiors take care of rare and complex issues. The latter paper instead derives conditions for which subordinates adopt precise languages specific to their division, preventing them from communicating with other divisions. In these cases, superiors may act as translators by learning each division's language and transmitting information across them.

I find that in Enron, vertical communication mostly moved information up the hierarchy. First, emails directed to subordinates are more likely to request information than emails directed to superiors, which tend instead to provide information. This fact is consistent across hierarchical levels overall. Delegation is relatively less frequent and more likely to happen towards subordinates. Second, messages from subordinates to superiors are more precise than in the opposite direction, particularly regarding the provision of information. In light of the theory, this evidence suggests that, even if information was mostly acquired from lower hierarchical levels, superiors retained decision rights, and incentive problems were not strong enough to prevent or make communication too noisy. Many reasons may explain the relatively scarce delegation. Possibly, superiors were already sufficiently informed and did not rely only on subordinates' information. Their decision-making was then sufficiently correct, even with noisy communication. Alternatively, contractual agreements and incentive designs successfully aligned subordinates' incentives to those of superiors, and the latter did not internalise communication costs. Finally, experimental evidence may suggest that superiors had a preference to retain decision rights even if that was not efficient or in their best interest (Fehr, Holger, and Wilkening 2013).

Although this evidence suggests stronger bargaining power and decision-making at higher ranks, additional results show that superiors gained more important roles in providing information to subordinates in moments of instability. I carried out an event study on the sudden resignation of the CEO, Jeff Skilling, which led to large media attention and increased uncertainty, particularly at lower hierarchical levels of the company, which were likely unaware of Skilling's intention. I show that right after the resignation, conditional on writing to subordinates, superiors were much more likely to provide information rather than request it. This finding supports the theory on *knowledge-based hierarchies* (Garicano 2000, Garicano and Wu 2012), which suggests that higher roles in the hierarchy tend to deal with more complex and rare events. In a less stable environment, superiors are more likely to acquire information and support decisions taken by lower ranks. This interpretation is supported by the fact that information provided to subordinates became more precise after the resignation.

Finally, I provide supportive evidence that higher-ranked employees communicate on a wider range of topics, possibly allowing for synergies across specialised divisions. Indeed, higher hierarchical levels have a more diverse and less specialised language when providing information.

This paper complements the existing empirical evidence on vertical communication across the hierarchy.⁵ [Liberti and Mian \(2009\)](#) provide evidence of another environment (a financial institution) where lower-ranked employees were in charge of collecting information and communicating it, whereas upper-ranks retained decision rights. However, they only observe communication for loan-approval decisions. [Josephs, Peng, and Crawford \(2024\)](#) find a similar pattern using email data from Microsoft. They show that communication tends to be directed towards superiors rather than subordinates. Their analysis relies on email frequencies only, so they cannot discriminate between emails that ask for information and emails that provide it.⁶ [Reitzig and Maciejovsky \(2015\)](#) study subordinates' incentives to provide information to superiors and find evidence that 1) the longer the sequence of superiors above a middle manager, the less likely she would be willing to provide information up the hierarchy, and 2) subordinates are less likely to provide information to superiors if they believe to not have full control over the outcome. [Espinosa and Stanton \(2023\)](#) find a reduction in communication to superiors once subordinates receive training, which they interpret as a reduction in the requests for help. Finally, [Hinds and Kiesler \(1995\)](#) provides empirical evidence that employees with technical tasks are more likely to communicate laterally (i.e. horizontally) compared to less technical roles.

This paper contributes as well to the empirical literature on decision-making in firms ([Joseph and Gaba 2020](#)). Indeed, information flows bring information to decision-makers, who tend to be at the top of the hierarchy under centralisation and at the organisation's periphery under decentralisation. [Bloom, Garicano, Sadun, and Van Reenen \(2014\)](#) show that adopting technologies that reduce communication costs leads to more decentralisation, whereas adopting information technologies that support productivity leads to more decentralisation. [Liberti \(2018\)](#) show that delegating decision rights creates incentives to acquire and use soft information, whereas [Katayama, Meagher, and Wait \(2018\)](#) report survey evidence that decision-making is often shared across the hierarchy.

Finally, the paper contributes to the study of the effect of uncertainty on firms' internal communication. [Srivastava \(2015\)](#) shows that at times of ambiguity, workers decrease communication with formal connections but increase it with their informal network. [Impink, Prat, and Sadun \(2024\)](#) also study the effect of CEO turnovers and show that communication first drops and later recovers mostly due to increased vertical communication. Finally, [Vuori and Huy \(2016\)](#) interviewed Nokia's employees during market challenges and found that middle managers were less likely to communicate negative information to superiors.

⁵[Malenko \(2024\)](#) and [Joseph and Gaba \(2020\)](#) provide a more general literature review of theoretical and empirical research on communication in organisations.

⁶To my knowledge, [Srivastava, Goldberg, Manian, and Potts \(2018\)](#) is the only previous work that looks at email content, rather than email frequencies only. However, they focus on a different question and study how changes in employees' cultural fit with the firm are associated with career progressions.

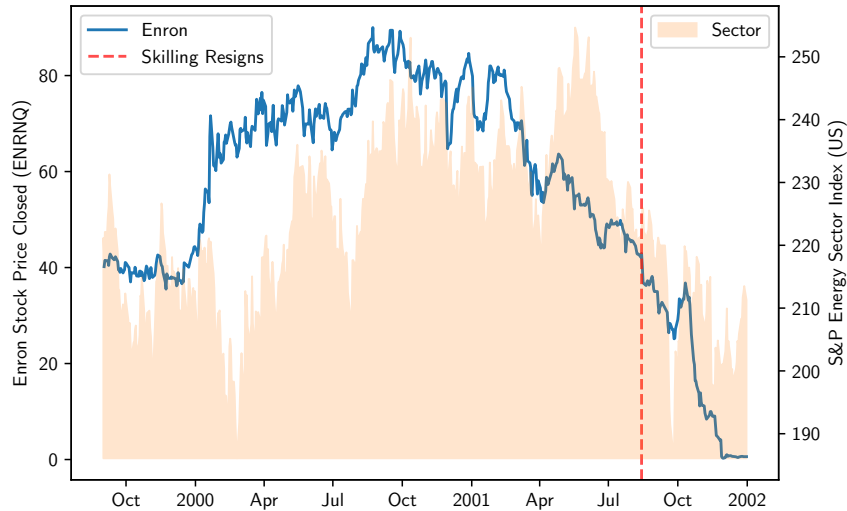
The rest of this paper is organised as follows: section 2 provides details about the Enron Corporation, section 3 describes the collection and construction of the data, section 4 presents the empirical evidence, section 5 discusses the interpretation of the results in light of theoretical frameworks, and section 6 concludes.

2 The Enron Corporation

The Enron Corporation used to be an energy company based in Houston, Texas (United States). It was founded in 1985 after the merger of Houston Natural Gas and Omaha-based Inter North. Kenneth Lay, CEO of Houston Natural Gas, became CEO and Chairman of Enron. Between February 12th, 2001 and August 14th, 2001, Kenneth Lay left the CEO role to Jeffrey Skilling while preserving the role of Chairman. He then took back the CEO role until the company's bankruptcy, on December 2nd, 2001.

Initially, Enron was a traditional energy company that owned the second-largest pipeline network in the United States. It later expanded by offering financial products, in particular in the energy market, and online trading. Enron's stated revenue grew massively, with a total net income of \$ 979 million in 2000, increasing from \$ 584 million in 1996.⁷ In 2000 Enron got ranked 22nd in the Fortune's 100 best companies. Nevertheless, Enron incurred important losses in 2001, which led to bankruptcy. Figure 1 reports the evolution of the stock price, which describes the rise and fall of Enron's value.

⁷Source: Enron Annual Report 2000.



Daily Enron’s stock price closed (left axis) compared to S&P Energy Sector Index (right axis). Although variations are correlated, it is possible to see how Enron’s stock price fell until the bankruptcy, in December 2001. The resignation of CEO Jeff Skilling corresponds to a substantial jump in the stock market valuation.

Figure 1: Enron Stock Price and Energy Sector Index

3 Data

This paper uses data constructed out of the Enron email corpus, originally made publicly accessible by the Federal Energy Regulatory Commission (FERC) after the Enron Corporation filed for bankruptcy.⁸ The original dataset contained 1,361,403 emails from 158 mailboxes belonging to 149 employees of the company (Yeh and Harnly 2006).⁹ From the Enron corpus, I extract and merge email text data and information on senders’ hierarchical roles and positions.

The email text data I use is the one processed and analysed by Agarwal et al. (2012) (AOHR hereafter), which includes 276,279 emails. I then extract information about employees’ roles, divisions, and positions in the hierarchy from emails’ bodies and attachments. Indeed, several emails reported organizational announcements or promotions, which included the list of the affected employees and their respective new roles, and attachments with the new organizational charts, which I digitized manually.¹⁰ I assume

⁸<https://www.cs.cmu.edu/~enron/>.

⁹Researchers have been cleaning this dataset, erasing sensitive and personal information. As a consequence, the version available nowadays is significantly smaller. Klimt and Yang (2004) report 619,446 emails in their version. Yeh and Harnly (2006) report that their cleaned dataset included 269,257 emails.

¹⁰Emails attachments are available in the complete version of the dataset, originally downloaded from <http://www.edrm.net/resources/data-sets/edrm-enron-email-data-set>. To recover the latter, I used string matching on the attachments’ content, subject title, and file name. This procedure led to the selection of more than 400 .pdf or .ppt format files, which I screened and digitised manually. Figures 7

employees had the role specified in the email up to the email date. Some employees appeared in multiple documents, creating some time variation through promotions and changes in the hierarchical structure.

The merge of the email bodies with senders' hierarchical positions led to a (sparse) panel dataset with 128,291 emails sent by 1557 individuals. Following additional cleaning, as later described, the data include 82,173 emails sent by 1130 distinct employees between September 1999 to June 2002.¹¹ 132 of those employees are owners of mailboxes published by the FERC and, as a consequence, have a larger weight in the sample. Indeed, they have sent 68.65% of emails in the dataset, and have received 43.55% of them. Although the list includes most of the top management, the roles of mailbox owners are quite diverse.¹²

3.1 Selection of Informative Emails

To focus on communication that is relevant for production, I identify emails that involve the transmission of work-related information or that delegate tasks. To accomplish this categorization, the paper exploits large language models and their ability to summarize text. In particular, I prompt OpenAI's GPT 3.5 Turbo algorithm to assign one of the following categories to each email: 1) *provides information*; 2) *requests information*; 3) *requests some service or delegate tasks*; 4) *provides acknowledgement*; 5) *is non-work related*; 6) *is not meaningful*. I then retain only emails assigned to the first three categories.¹³

3.2 Selection of Hierarchy-Relevant Employees

Employees in administrative assistant roles differ from other workers as they are specifically hired to support the work of particular, generally high-ranked individuals. This fact has two main consequences. First, their communication patterns are more deterministically induced by their roles, suggesting a more mechanical relationship between their roles and the characteristics of the emails they send. Second, their location in the hierarchy structure is not comparable to other roles. For example, an administrative assistant to the CEO directly responds to the highest-ranked employee, but this is not comparable to a division director who also responds to the CEO. For these reasons, I exclude from the analysis emails sent by roles such as Administrative Assistant, Senior Administrative Assistant, or Administrative Coordinator.

and 8 in the appendix provide, respectively, an example email containing an organizational announcement and an example of an attachment with the hierarchical tree for a specific division.

¹¹The merge of the hierarchy data and the email data relied on matching the employee names appearing in the organisational charts with the email senders' names extracted by AOHR. The (probably automatic) extraction of the latter sometimes led to the identification of multiple names for the same sender. I have allocated the emails of those senders to all employees with the corresponding names. As a result, the same email may appear multiple times in the panel dataset.

¹²Table 3 in the appendix provides the list of roles for the 132 employees whose mailbox is part of the corpora.

¹³Section A.1 in the appendix provides details on the implementation of the categorisation.

3.3 Text-based Measures of Language Specialisations

A more specialised language, in the spirit of [Cr mer et al. \(2007\)](#), is a language that uses mostly precise and technical words which refer to events faced frequently. In a context where a division focuses on a specific field and set of problems, we can expect that the specialised language would often use a relatively small set of words and rarely other words.

3.3.1 Individual-level measure

To measure the employees’ overall degree of language specialisation, I adapted the Herfindahl-Hirschman Index (HHI) to the context of language.¹⁴ This index was originally developed to measure market concentration as a function of firms’ market shares. By replacing market shares with words’ relative frequency in an employee’s language, the index captures the degree to which the employee uses predominantly certain words rather than using all words with the same probability. In practice, let W_i be the set of words w used in all emails sent by employee i . Let also f_w be the frequency of word w in W_i , and V_i be the set of unique words in W_i . The degree of language specialisation for employee i is then:

$$C_i = \sum_{w \in V_i} \left(\frac{f_w}{\#W_i} \right)^2, \quad (1)$$

where $\#W$ is the cardinality of W . To ensure that different declinations of the same word are not considered different words, I extract and use only word roots using the *Porter Stemmer*.

The advantage of this measure is its simplicity and interpretability. Nevertheless, it depends on the sample size, as a larger sample leads to a larger vocabulary V . Indeed, it has been shown that there exists a concave relationship between the number of words observed in the sample and the vocabulary size.¹⁵ It follows that, by observing different sample sizes for each employee, the measure may not be comparable across them as relative word frequencies depend on the vocabulary size ([Baayen 2001](#), [Sampson 2001](#)). To address this concern, I compute relative word frequencies using the Good-Turing correction ([Good 1953](#)) with the method described by [Gale and Sampson \(1995\)](#).¹⁶

3.3.2 Message-level measures

The degree of language specialisation of a specific email captures how technical the terms used are. Technical terms differ from general ones as they are more likely to have specific

¹⁴[McCannon, Hall, and Zhou \(2023\)](#) use a similar approach to identify topic concentration in teachers’ contracts. [Hoberg and Phillips \(2018\)](#) use instead the average cosine similarity across word pairs.

¹⁵The intuition is that when the sample of words is small, increasing the sample size would like to add new words. On the contrary, when the sample is large, increasing the sample is likely to add words already included in the vocabulary.

¹⁶Details on the method used are in section [A.2](#) in the appendix.

meanings and unique interpretations. It follows that more specialised messages are also clearer and more informative. To capture such specialisation, I adopt two approaches which do not rely on word frequencies, as is the case for the HHI index. Indeed, with short texts, usually the case for emails, statistical measures based on word frequencies are less informative due to the small number of words and produce little variation.

The first method categorises emails using a large language model (LLM), in particular OpenAI’s GPT 3.5 Turbo. To achieve that, I prompt the algorithm to categorise every email by *degree of language specialization from 1 to 5 where 1 is a very broad language and 5 is a very technical language*.¹⁷ The second method instead measures directly the number of possible meanings that the terms appearing in the text can have. More precisely, I browse an English dictionary and count the possible meanings for every term in the email (excluding *stopwords* - uninformative terms). I then take the average across words, obtaining the average number of meanings of the words in the message.

I consider these measures proxies for quality. Indeed, more technical content is more precise and informative than broader messages.

3.4 Identification of Hierarchical Levels

Hierarchical levels allow to rank employees based on the advancement of their career. Higher hierarchical levels identify roles with more managerial tasks and larger responsibilities. On the contrary, lower levels represent more specialised and technical roles, up to entry-level roles.

In this paper, I construct hierarchical levels using two approaches, one based on role names and one based on employees’ hierarchical distance from Kenneth Lay, arguably the company’s most prominent employee. The role-based method groups and orders roles by common sense. It led to the identification of 6 groups: the first includes *President*, *Chairman*, and C-Suit roles; the second includes top-management roles such as *Vice President* and *Senior Director*; the third includes higher-management roles such as *Director* and *General Counsel*; the fourth includes lower-management roles such as *Manager*, *Senior Counsel*, and *Supervisor*; the fifth includes advanced technical roles such as *Analyst*, *Specialist*, *Counsel*, and *Attorney*; finally the sixth includes entry-level roles such as *Staff*, *Associate*, *Clerk*, and *Consultant*.¹⁸ The advantage of this method is that role names are directly informative of the degree of managerial responsibilities and provide a reliable way to categorise employees based on the generality of the tasks they are involved with. The drawback is that role names do not necessarily map to a specific degree of importance and influence within the company. For instance, a *Senior Director* in the North-America division may respond directly to the top management, while a *Senior Director* of a subsidiary may have very limited contact with the CEO. The second approach to categorise hierarchical levels addresses this issue and relies on employees’ hierarchical distance from Kenneth Lay, who kept the CEO role for the majority of Enron’s existence. Under this method, I identify 7 levels, where level 1 corresponds

¹⁷Details of the procedure and example emails with labels are in section A.1 of the appendix.

¹⁸Table 2 in the appendix reports the full list of role names assigned to each hierarchical level.

to employees who directly respond to Kenneth Lay, level 2 identifies employees whose superior responds to Kenneth Lay, and so on.

It is relevant to note that statistics change based on the method used because 1) the two methods capture slightly different information, and 2) the resulting hierarchical level depends on data availability. The role-based category is missing for employees for whom I do not observe their roles. Similarly, The distance-base measure relies on being able to trace the employee’s hierarchy up to Lay.

Hierarchical levels are not necessarily fixed across time for each employee. Indeed, they may change if employees change roles or move across the hierarchy (because of promotions or organisational changes).

4 Empirical Evidence

4.1 Vertical Communication

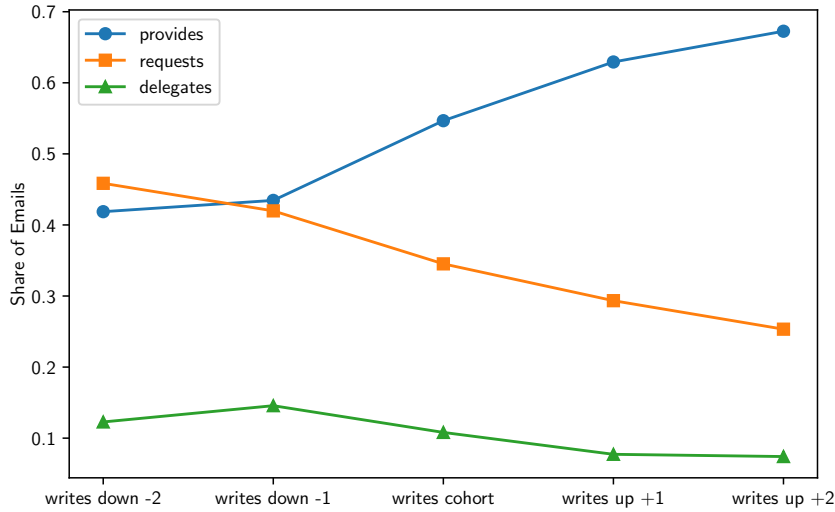
Descriptive statistics suggest that vertical communication was meant to move information up the hierarchy or delegate tasks. Figure 2 reports the share of emails that provide information, request information, or delegate tasks, out of all emails directed to a certain hierarchical level relative to the sender.¹⁹ Two facts emerge from the figure. First, emails directed to superiors are more likely to provide, rather than request, information compared to those directed to subordinates. Indeed, if the superior of the sender is in the recipient list, about 67% of emails provides information. This number drops to about 42% if the recipient list includes the subordinate of the subordinate of the sender. On the contrary, the share of emails requesting information follows a reversed pattern, with emails directed to subordinates being less likely to request information than emails sent to superiors.²⁰ Second, emails are more likely to delegate tasks if they are sent to subordinates. These facts suggest that vertical communication mostly moved information towards superiors or delegated tasks towards subordinates. They support the hypothesis that subordinates were in charge of information acquisition, whereas superiors held decision rights ex-ante.

4.2 Message Specialisation

Employees write more precise messages when they provide information. Although this is consistent across the hierarchical direction of the email, there is heterogeneity, with emails being more precise when directed to superiors than when directed to subordinates. Figure 3 reports the average message specialisation of emails by content and hierarchical direction. The upper panel uses the LLM-based measure of specialisation, where email’

¹⁹Note that an email directed to a certain hierarchical level implies that at least one of the recipients is at the specified hierarchical level. It does not exclude that the recipient list also includes employees at other levels.

²⁰This fact is particularly strong for top-ranked employees, but overall holds at different hierarchical levels, as shown in figure 9 in the appendix.



Share of emails that provide information (i.e. *provides*), request information (i.e. *requests*), or delegate tasks (i.e. *delegates*), conditional on the recipient(s) including the superior of the superior of the sender (*writes down +2*), the superior of the sender (*writes down +1*), someone in the same hierarchical level of the sender (*writes cohort*), the subordinate of the sender (*writes down -1*), or the subordinate of the subordinate of the sender (*writes down -2*).

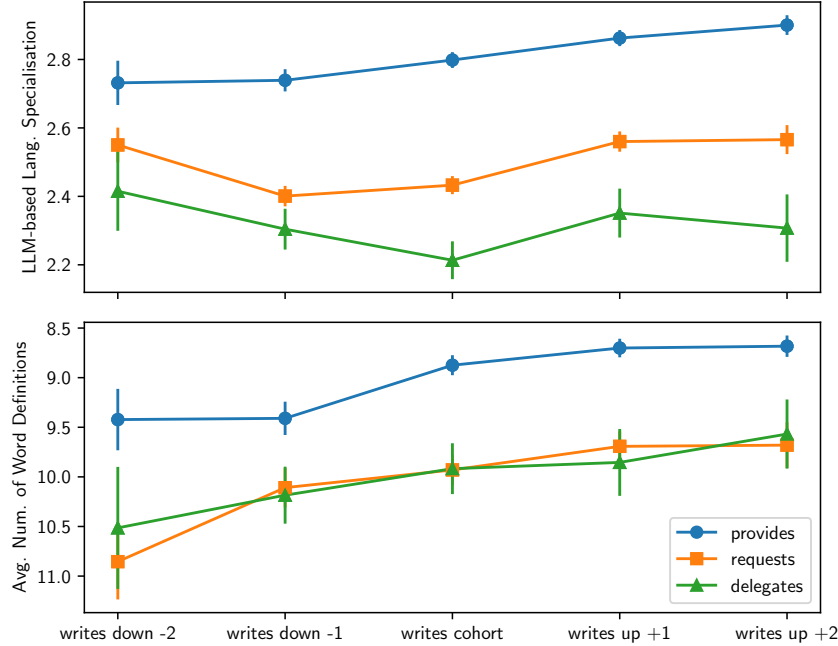
Figure 2: Shares of Emails by Content

language is rated from 1 to 5, where 1 corresponds to “very broad” and 5 “very technical”. The lower panel presents statistics where message specialisation is measured as the average number of meanings that the words used have in an English dictionary.²¹ In both panels, statistics show that messages use more technical language when they are directed to superiors compared to when they are sent to subordinates. This pattern is consistent for providing and requesting information but particularly marked for providing information. A more technical language is a language that is less likely to confuse or be misunderstood. In other words, messages written to superiors are more precise and clear than those written to subordinates.

4.3 The Effect of Jeff Skilling’s Resignation on Vertical Communication

CEO turnovers may create uncertainty for the firm’s employees for several reasons, including changes in firm strategy, new organisational changes, and more volatile capital markets. Such changes may impact intra-firm information flows and communication, as studied by [Impink et al. \(2024\)](#).

²¹Note that, according to the latter measure, a larger number identifies broader language, which is the opposite compared to the LLM’s categorisation. To help the readability of the graph, the y-axis of the right panel is reversed.



Average message-level degree of language specialisation measured with LLM’s categorisation (above) or with the average number of words’ meaning (below, inverted y-axis to simplify the interpretation). Averages are for given content type, conditional on the recipient(s) including the superior of the superior of the sender (*writes down +2*), the superior of the sender (*writes down +1*), someone in the same hierarchical level of the sender (*writes cohort*), the subordinate of the sender (*writes down -1*), or the subordinate of the subordinate of the sender (*writes down -2*).

Figure 3: Message-Level Degree of Language Specialisation

This section studies the sudden resignation of Jeff Skilling from the CEO role, focusing in particular on the communication behaviour of superiors towards their subordinates. For the analysis, I consider only emails where at least one recipient is a subordinate of the sender, and I exclude emails sent by either Jeff Skilling or Ken Lay, who took over as CEO. In addition, I constrain the sample to 4 months, 2 months before and 2 months after Skilling’s resignation. I estimate the following model:

$$C_i = \alpha_{j(i)} + \beta_{t(i)-\bar{t}} + \varepsilon_i,$$

where i indexes emails, $j(i)$ the sender of email i , and $t(i)$ the week when the email i was sent. I define \bar{t} the week which includes the date of the resignation of Skilling (i.e. August 14th, 2001), so that time fixed effects are indexed relative to the resignation week. The $\{\hat{\alpha}_j\}$ estimates capture sender fixed effect. The dependent variable C_i represents an indicator variable for the content of the email i , where the content can be the provision of information, the request of information, or the delegation of tasks. In particular, I estimate models where the dependent variable is either C_i^p or C_i^r , with the former being

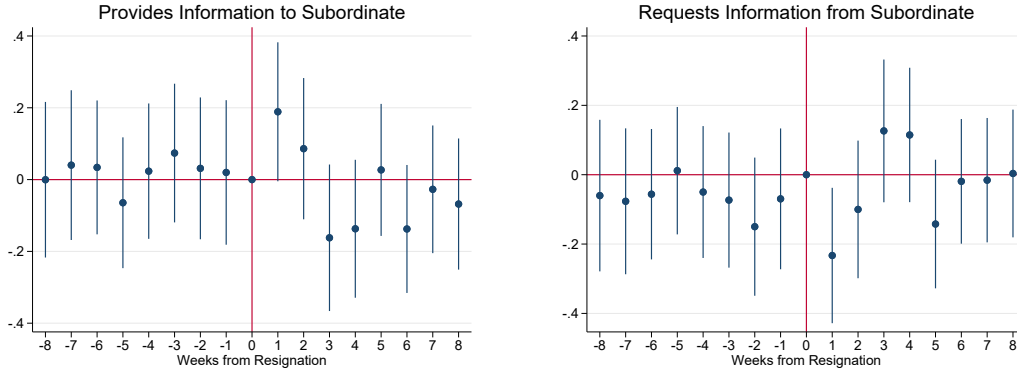


Figure 4: The Impact of Skilling's Resignation on Emails to Subordinates' Content

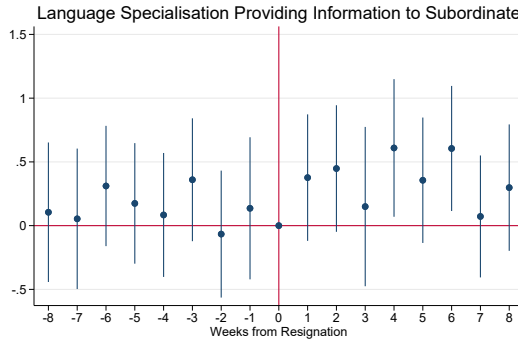


Figure 5: The Impact of Skilling's Resignation on Emails to Subordinates' Precision

a dummy equal to one if the email provides information and the latter being a dummy equal to one if the email requests information.

Figure 4 reports estimates of the week fixed effects ($\{\hat{\beta}_t\}$) with C_i^p (left panel) or C_i^r (right panel) as dependent variable. It is possible to see that in the week right after the resignation emails written to subordinates are statistically more likely to provide information and less likely to request it.²²

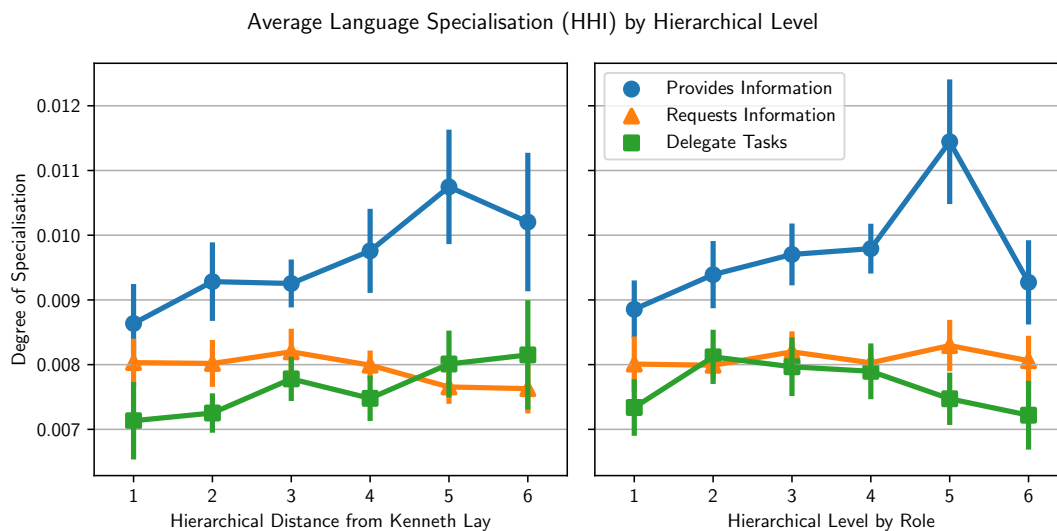
Figure 5 provides estimates for the same model but with message specialisation as the dependent variable, and the sample is constrained to only emails that provide information. Whereas the instantaneous effect is less evident, it shows that the provision of information to subordinates increases in precision in the weeks following the resignation.

4.4 Language Specialisation

Higher-ranked employees use broader languages compared to lower-ranked employees when they provide information. Nevertheless, the degree of language specialisation when

²²Note that, from previous results, emails directed to subordinates tend to ask for information rather than provide it, implying a reverse on the general trend.

requesting information or delegating tasks is more homogeneous across hierarchical levels. Figure 6 reports each hierarchical level’s average employee-level language specialisation, measured through the HHI-based formula. The left graph uses the distance-based hierarchical levels, while the right graph uses the role-based measure.



Average employee-level language specialisation by hierarchical level. The language specialisation for emails that provide information is measured with the HHI formula (eq. 1) where the set of all words considered (W) is the set of all words appearing in employee’s emails that provide information. Similarly, the measure for the other types of content limits the set of words to those used in emails with that content.

Figure 6: Individual-level Degree of language Specialisation

5 Conceptual frameworks

Alternative theories of within-firm communication have focused on different rationales for the transmission of information across the hierarchy, deriving possibly contrasting implications. In this paper, I discuss two approaches developed in Organizational Economics. The first builds on *incentive theory* and focuses on the optimal design of incentive contracts. The second, based on *team theory* (Marschak and Radner 1972), abstracts from incentive problems and focuses on constraints on communication that are exogenous to the communicating parties.

The literature on incentive theory, which largely builds on the work by Crawford and Sobel (1982), discusses environments where a *principal* retains decision rights but does not hold the relevant information for the decisions, which is instead collected by an *agent*. In this context, the principal either requests the agent to communicate their information, or delegate them the decision rights. The outcome depends on how much information the principal already has and how much the agent and principal’s preferences differ. If

the agent has sufficiently close preferences to the principal, delegation may be optimal because it incentivises the agent to collect better information (Aghion and Tirole 1997) or because it prevents noisy communication (Dessein 2002). Otherwise, communication occurs, but possibly partially, as the agents do not expect the principal to choose their preferred action and are not incentivised to put in effort.

Through the lenses of this literature, firms' hierarchies allow the allocation of decision rights and the creation of optimal incentives to acquire and communicate information.

On the contrary, the team theoretic literature assumes that employees' incentives are perfectly aligned, meaning that employees share the same preferences and objectives. However, limited cognitive abilities induce costs in information acquisition, information processing, and communication. In this setting, hierarchies allow for the specialisation of knowledge across the organisation, so that not everyone needs to learn and process all the information. In this way, the firm can reduce costs in information acquisition but increase communication costs, as decision-makers need to seek information from others. Starting from this trade-off, Bolton and Dewatripont (1994) find that an optimal organization would involve subordinates processing specialised information and communicating it to their superior. The latter would take the decision (by integrating information from other subordinates as well) or add additional information and communicate up as well to their superior. Superiors delegate decisions to subordinates if they are overloaded. To reach these results, a crucial aspect is that decision-making requires multiple pieces of specialised information. Consequently, centralising decisions at higher hierarchical levels reduces communication costs, as employees only need to communicate their information to a single person. Garicano (2000) and Garicano and Wu (2012) focus on the same specialisation-communication trade-off, but reach different conclusions as they think of specialisation in terms of type of problems. Therefore, in their framework, employees know how to solve only specific problems and need to seek help otherwise. Communication is then meant to reach the person with the relevant knowledge, rather than aggregate knowledge from multiple people, and communication costs are higher if the problems that require communication occur more frequently. In this context, they find optimal an organisation of the firm through *knowledge-based hierarchies*, where lower-ranked employees, who take care of production, know necessary to address routine tasks and simple problems. On the contrary, knowledge related to more exceptional and complex issues resides at higher hierarchical levels. It follows that vertical communication involves either asking for help from superiors or providing solutions to subordinates.

Crémer et al. (2007) study the specialisation-communication trade-off from a language perspective. Because of language limitations, employees can communicate a small set of problems very precisely, or a larger set more vaguely. If divisions adopt a language more specialised to the specific set of problems they face, they reduce communication costs internally but increase costs when communicating with other divisions. In this context, higher roles in the hierarchy may adopt the role of *translators* by learning different specialised languages and transferring information across divisions. In this way, the paper shows how hierarchies can facilitate information flows and predicts that higher-ranked employees use richer language. However, it does not directly imply the direction

of vertical communication.²³

6 Discussion and Conclusion

Firms continuously face the challenge of defining their internal organisations and hierarchical structure. One key reason why such decisions are pivotal for firms' success is that they affect information flows and communication, heavily affecting, as a consequence, the efficiency of production. The importance of such decisions grows with the firm size, as large firms need to address more severe communication frictions.

This paper provides evidence on how information flows occur in a large multinational company and identifies critical aspects. First, vertical communication was mostly meant to provide information to superiors and ask for information from subordinates. Delegation was less frequent and generally implemented by superiors towards subordinates. These facts suggest that Enron kept decision-making centralised at higher-ranked employees even though subordinates were generally in charge of information acquisition. In addition, the provision of information was of higher quality when directed to superiors rather than subordinates. Under the incentive theory view, these facts suggest that subordinates were sufficiently aligned with their superiors' preferences, and communication costs were relatively low. They also suggest that bargaining power was mostly in the hands of higher-ranked employees, and holding information was insufficient to give power to subordinates. Enron's renowned corporate culture, which imposed intense competition among employees, may have played a role in aligning subordinates' incentives with superiors.²⁴ Alternatively, these facts align with [Bolton and Dewatripont \(1994\)](#)' theory that predicts the centralisation of decision-making to avoid multiple transfers of the same piece of information. However, the theory is not consistent with a lower-quality provision of information to subordinates. The second piece of evidence shows that superiors' communication with subordinates shifted to providing information right after Skilling's resignation. This result suggests that higher-ranked employees would still have easier and better access to complex information necessary to deal with uncertain environments. This aligns with [Garicano \(2000\)](#)'s theory of knowledge hierarchies.

Overall, the paper shows that organisational theories are complementary in explaining the real-world dynamics of within-firm communication. It identifies two key roles of hierarchies in information flows. On the one hand, they are fundamental tools for allocating decision rights across the firm and creating incentives for communication. On the other hand, they allow employees to specialise in the acquisition and management of different knowledge, so as to minimise information acquisition costs.

²³[Dessein and Santos \(2006\)](#) also study the specialisation-communication trade-off in a team theoretic framework. In their model, organisations decide workers' specialisation (i.e. how many tasks to assign them) and how much they should adapt to local information rather than keep a pre-specified plan. More task specialisation requires more communication if workers adapt their tasks to local knowledge but not if workers follow a perfectly predictable pre-specified plan. The paper does not derive direct implications for vertical communication.

²⁴For example, employees ranked last in superiors' performance reviews were dismissed.

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Appendix A Details

A.1 Details on Categorising with OpenAI’s Algorithm

The categorization of the emails with OpenAI’s algorithm aimed to label emails on two dimensions. First, it categorised emails based on what type of information the email contained. Second, it categorised emails on the degree of specialisation of the language used. For each email, I prompted OpenAI’s GPT 3.5 Turbo model in the following way:

System prompt:

You will be presented with emails of Enron Corporation employees and your job is to categorize each email based on its content and the degree of language

model	gpt-3.5-turbo-0125
temperature	0.1
response_format	{"type": "json_object"}
seed	100

Table 1: Model and parameters fed into OpenAI’s API.

specialization.

You will output ONLY a json object containing the following information:

```
{
  content: string // name of the category on the type of content. Choose only
  from the following list: 1) provides information; 2) requests information; 3)
  requests some service or delegate tasks; 4) provides acknowledgement; 5) is
  non-work related; 6) is not meaningful.
  language: int // Degree of language specialization from 1 to 5 where 1 is a
  very broad language and 5 is a very technical language.
}
```

User prompt:

[*email’s body*]

Table 1 reports the exact model used and the parameters fed to the algorithm. The remaining parameters are left as the defaults. Note that the very low value for the *temperature* parameter is meant to reduce the “creativity” of the model, to ensure consistency in the outputs. In addition, the seed value is meant to allow the replication of the output (even though, as of July 2024, it does not guarantee an exact replication of the output, according to notes from OpenAI).

The output was substantially consistent to the requested format and contained the relevant information. Out of 128291 emails analysed, the algorithm failed to provide an output for 13 emails, and for 6 emails it provided an output not consistent with the instructions. Out of the 128272 emails with a correctly-formatted output, 2519 were assigned to a content category not included in the list of options provided in the instructions. Nevertheless, 2502 of those were assigned to “non-work related” instead of being assigned to “is non-work related”, an error that has been easily fixed. Finally, out of the 128272 emails with a correctly-formatted output, only one email was assigned to a language category which was not provided in the instructions.

The following list provides examples of emails (purely randomly selected) for every possible pair of categories:

1. Content category *provides information*; Language category *1*:

FYI.

Forwarded by Kay Mann/Corp/Enron on 07/11/2000

04:30

PM
From: Gregg Penman
To: Kay Mann/Corp/Enron@Enron
cc:
Subject:

07/11/2000 04:10 PM

2. Content category *provides information*; Language category *2*:

Hi Wilson,
I spoke with David Hunt, and he has no problem with you representing Enron Power Marketing in the proposed transaction with Clarksdale and Yazoo City.
Please let me know if you have any other potential conflicts.
Thanks,
Kay Mann

3. Content category *provides information*; Language category *3*:

Jim—
As I mentioned in a voice message to you, your current list appears to capture our interests in power generation facilities located in Texas. We questioned EWS Tax Planning, EWS Accounting, and EWS-Power Originations, to determine if anyone was aware of other Texas power generation projects.
There are LLC's/LLC structures set up for additional development, but none of them have financials. The first is Newton Development/Lone Star Development. It appears this structure was created to acquire land purchase options for Texas power plant development sites, and to develop an electric power facility in Newton County, Texas. The second is Montague Development, LLC. It appears that this entity was created to acquire land for and/or develop a coal fired generation facility in Brownsville. I understand there are approximately 140k of costs accumulated on Enron North America Corp. for Montague, but apparently there are no agreements in place.

Let me know if you need anything else.

——Original Message——

From: Steffes, James D.
Sent: Wednesday, November 14, 2001 11:59 AM
To: Rice, Greek
Subject: List of Assets in ERCOT
Greek —
Here is our current list.
Thanks,
Jim

4. Content category *provides information*; Language category *4*:

I spoke with Steve Saye at WIC today and he said that they interpret the tariff to read that a release done at the full negotiated contract rate is the same as the maximum rate. Therefore we can release at the \$.12 rate. He also stated that he would begin the approval process with the banks for the release but thought that there would be no problem with Huber's credit. He did state that the bank approval timing was out of his control but he would try to expedite it. In addition, he felt that the best way to do the release was to do it with the first bidder meeting minimum terms and have Huber ready to take it. He said that it would not have to be noticed ahead of time so no one would know that it was going to hit the board. My question is, can we get the contract with Huber signed prior to receiving the bank approval for the WIC price?

5. Content category *provides information*; Language category **5**:

NGI's Daily Gas Price Index

Breaking News : posted Oct 24, 12:00 PM

FERC Approves Transco's Leidy Project, Petal Expansion, New ANR Lateral

The Federal Energy Regulatory Commission issued draft orders Wednesday for Transcontinental Gas Pipe Line's Leidy East expansion in Pennsylvania, a pipeline and deliverability expansion at Petal Gas Storage in Mississippi and a new ANR lateral to serve to 1,050 MW Badger power plant in Kenosha, WI.

Transco's \$98 million Leidy East pipe expansion project would make up for the failed Phase III portion of its MarketLink expansion. The Leidy East project will provide up to 130,000 Dth/d of transportation from Leidy, PA, to northeastern markets in New Jersey, New York, and Pennsylvania. The expansion consists of six pipeline loop segments that amount to 26 miles of 42-inch diameter pipe, and about 5 miles of 30-inch diameter, mostly in Western PA. The project also would add 3,400 hp of compression in Pennsylvania and New Jersey.

Williams said this summer that it expects the Leidy East facilities to be in service by November 2002 (see Daily GPI, June 20 <<http://intelligencepress.com/subscribers/daily/news/d20010620e.html>>).

The Williams subsidiary said Aquila Energy Marketing, PECO Energy Co., Reliant Energy Services and Williams Energy Marketing are all customers.

Petal Gas Storage LLC's new pipeline would extend 59 miles to a connection with Southern Natural at a compressor station near Enterprise, MS. The \$94 million project also includes a new 9,000

horsepower compressor station.
ANR Pipeline's lateral will carry about 210 MMcf/d of gas to Badger
Generating Co's proposed power plant in Wisconsin. The 13-mile
long pipeline would cost \$19.5 million and should be in service
during the summer of 2003.

6. Content category *requests information*; Language category *1*:

I would like to take the remaining work days in the week of July 2-6.

7. Content category *requests information*; Language category *2*:

Gloria ,
Is there any way you could copy and send overnight to me the CIG
invoices for the 33175000 contract from May, 2000 through January ,
2001?
I am helping Darla and Megan reconcile the Citizens account. It is
changing over to Kinder Morgan effective Dec. 1 and we need to
reconcile this account rather quickly.
I printed all other invoices on the Internet from CIG's website but
they only go back 9 months.
Let me know if this is possible or where else I might find these.
Thanks,
Theresa

8. Content category *requests information*; Language category *3*:

Am I the only one who doesn't understand this answer? DF
----- Forwarded by Drew Fossum/ET&S/Enron on
09/21/2000
10:25 AM -----
Elaine Concklin
09/20/2000 06:04 PM
To: Dave Neubauer/ET&S/Enron@ENRON, Steve Gilbert/ET&S/Enron@ENRON,
Mike
McGowan/ET&S/Enron@ENRON, Drew Fossum/ET&S/Enron@ENRON, Steven
Harris/ET&S/Enron@ENRON, Lindy Donoho/ET&S/Enron@ENRON
cc: Vera Apodaca/ET&S/Enron@ENRON, Henry Baker/ET&S/Enron@ENRON,
Sophie
Patel/ET&S/Enron@ENRON
Subject: Re: 2000 3CE GPG Overview
FYI - regarding your question this afternoon.
Everyone be sure to dream up some creative ways to improve earnings .
. . . We
need revisions by Friday morning.
Thanks! Elaine
----- Forwarded by Elaine Concklin/ET&S/Enron on
09/20/2000
05:58 PM -----
Tracy Geaccone

09/20/2000 05:54 PM

To: Elaine Concklin/ET&S/Enron@ENRON

cc:

Subject: Re: 2000 3CE GPG Overview

\$2.5MM SAP accrual which I will use to offset the increase in the Corp charges for this year instead of charging to the pipelines.

\$5.0 –\$6.0MM I hope to be able to carry over to next year. It depends on the

\$ some costs really come in at. We did some things in the second quarter to

hold income back. I can't really reverse this year. If our GPG target does

go up to \$401MM, I will have a \$35 MM hole at my level.

I wrote off business development projects and some other things.

The inventory deal is still up in the air. Rod will know more tomorrow.

At this point in time, even if it happens higher, we will still have a hole.

Maybe they can try the structured products???

Tracy

Elaine Concklin

09/20/2000 04:10 PM

To: Tracy Geaccone/GPGFIN/Enron@ENRON

cc:

Subject: 2000 3CE GPG Overview

Tracy,

Can you tell me what the (\$10.2) for Enron Pipeline Company is in the 3CE

(primarily in Q1 & Q2)? That seems to be creating the remaining GPG hole for

the year.

Our officers had been counting on having more reserves to carry into 2001 to

help fill the NNG and TW gaps. I also heard from Bob that the inventory deal

may still be viable at a higher amount – more like \$20MM. Do you have any

updates on that?

Thanks, Elaine

9. Content category *requests information*; Language category 4:

The commission has issued a new rulemaking, R. 00–02–003, to address CEQA

review for CLECs.

Parties should file their responses to the following questions no later than

March 15, 2000.

1. Is the Commission's existing practice for authorizing new CLECs adequate

to comply with CEQA and to protect California's environmental resources?

2. Is the Commission's existing policy of allowing incumbent local exchange carriers and cellular carriers to construct new facilities without environmental review in compliance with CEQA? Does it promote adequate protection of California's environmental resources?
3. Do local authorities and other government agencies have adequate opportunities to protect local environmental resources under the current set of Commission practices and policies regarding incumbent local exchange carriers and CLECs? If not, how should this circumstance be remedied?
4. Does the Commission's existing practice for authorizing new CLECs create a competitive advantage or disadvantage for certain carriers? If so, how might those disparities be eliminated or reduced?
5. Is the Commission's existing practice for authorizing new long distance carriers adequate to comply with CEQA and to protect California's environmental resources?
6. Is the Commission's existing policy of allowing incumbent long distance carriers to construct new facilities without environmental review in compliance with CEQA? Does it promote adequate protection of California's environmental resources?
7. Do local authorities and other government agencies have adequate opportunities to protect local environmental resources under the current set of Commission practices and policies regarding long distance carriers? If not, how should this circumstance be remedied?
8. Does the Commission's existing practice for authorizing new long distance carriers create a competitive advantage or disadvantage for certain carriers? If so, how might those disparities be eliminated or reduced? Are we interested in this proceeding? Attached is a copy of the rulemaking.

10. Content category *requests information*; Language category **5**:

I have one principal concern in respect of one of the three structures called the "Commodity Transit Trade" structure. The concern relates to the passing of title to the metal forming the subject-matter of the contract. Under this structure, MCC sells metal to the counterparty ("Counterparty") on a spot basis with payment deferred (Contract 1). Counterparty simultaneously sells

back the metal to MCC, also on a spot basis, but not on deferred payment terms (the spot payment received Counterparty therefore constitutes the finance) – Contract 2.

The concern is that, as the transaction has been explained to us, there may be a delay of two or three days between (i) legal title to the metal passing to Counterparty under Contract 1 and (ii) legal title passing back again to MCC under Contract 2. There is therefore a risk that an event could occur in the interim which prevents title passing back to MCC. The most likely event would be the insolvency of the counterparty, but other events (eg supervening illegality due to the imposition of sanctions) are conceivable. More specifically, a liquidator of Counterparty could seek to disclaim (or set aside) Contract 2 if the market price of metal has increased during the interim.

Consequences

The consequences stem from the fact that the metal forming the subject matter of these financings will typically be on the high seas bound for a third party (ie not counterparty). MCC will have a contractual obligation to transfer good title to the metal to that third party. If title to the metal remains vested in Counterparty then Enron cannot fulfil this obligation to the third party. Conversely, if MCC completes the sale to the third party, MCC cannot be said to have passed good title to Counterparty under Contract 1 above. In other words, MCC could be sued for breach of contract for failure to transfer good title to Counterparty or the third party, on the basis that it has sold the same goods twice.

The likely downside is that Enron could be forced to perform both to counterparty and to the third party at a loss (or to perform to one and pay market damages to the other). However, there is a remote possibility that punitive damages could also be awarded against MCC on the basis that it has sold the same goods twice, or possibly on the basis that the transactions are not "genuine" sales of goods, but a sham (this danger should not be exaggerated and is mitigated by the choice of English law as the

governing law of the contract).

A further consequence would of course be that the financing itself would not be capable of being completed, with the attendant loss of fees/commissions etc, but this is probably a minor consideration.

Mitigants?

There are possible mitigants of the risk highlighted above, as follows :

Cross default – Contracts 1 and 2 will include cross default language to the effect that if Counterparty does not execute Contract 2, Contract 1 is cancelled. Care should be taken to ensure that this language is wide enough to cover all circumstances (eg if Counterparty has "executed" but not performed Contract 2, would the cross default apply?). More significantly, even if the cross default language works contractually, it may be overridden by the bankruptcy laws of the Counterparty, as invoked by Counterparty's liquidator. In other words, the liquidator may be able to "cherry pick" Contract 1 while renouncing Contract 2. This could be checked on a jurisdictional basis, if considered appropriate.

As mentioned, English law, as the governing law of the contracts, may mitigate the risk described above to some degree, but local insolvency law in the country of Counterparty could override the parties' choice of English law.

Probability – As a matter of crude probability, it may be regarded as fairly unlikely that, within a narrow window of a few days or so (i) a Counterparty goes bankrupt (ii) in a rising market and (iii) its liquidator takes the point and insists on performance of Contract 1 while renouncing Contract, particularly in light of the fact that Counterparty does not have possession of the metal and possession would be difficult to obtain. This may be why the issue appears not to have arisen under past transactions. It is however no assurance that these circumstances will not arise in the future.

Conclusion

There is a real risk of loss to MCC should the Counterparty go bankrupt after Contact 1 above, but before performance of Contract 2. This risk is most acute in a rising market and is relatively unlikely to materialise in a

given case. If it does materialise, it is hard to assess definitively the possible loss involved, but this would be likely to be, at a minimum, the difference between the then prevailing market price and the price of the metal under Contract 1.

Please (anyone) let me know if you would like to discuss this before we move to a formal DASH.

Thanks

Paul

Olivier Herbelot

01/09/2000 15:00

To: Paul Simons/LON/ECT@ECT

cc:

Subject: Re: Metal Trade Finance

Paul: Did you have any big concerns from your point of view after this morning's meeting? Olivier

11. Content category *requests some service or delegate tasks*; Language category **1**:

Tana — please delete this entry from Lotus Notes as it is a duplicate entry. Thanks

Click on this link to view the document in the Financial Trading Agreements database—>

12. Content category *requests some service or delegate tasks*; Language category **2**:

Shirley:

Could you please organize interviews for Mr. Ball with the usual Research

suspects, including Alex Huang and Tanya Tamerchenko?

Mr. Ball's phone numbers are on his enclosed resume. Thanks.

Grant.

Vince:

I talked to this guy briefly. I think he is desperate to get out of Unocal

before they downsize him out of a job.

He has a decent resume and the attached comment from Don Winslow is interesting.

Grant.

13. Content category *requests some service or delegate tasks*; Language category **3**:

Kate,
EPE will be lending us a schedule for Tuesday, 25 mws at \$4 at PV. The schedule will be on peak. Similar to today. Please work with the preschedulers to get the sheet correct (Friday's sheet for Monday had a duplicate 10 mw schedule in it).
Let me know if you have questions.
Thanks,
Bill

14. Content category *requests some service or delegate tasks*; Language category **4**:

After our recent Re-start meeting and the associated planning, there has been significant e-mail activity about what appears to be different points of contact into the different Pools and Transmission Providers.

I would recommend that Netco anoint a Primary Point of Contact with each Pool and Transmission Provider and that person have the resources of Legal, Govt Affairs, Commercial, Credit, etc. The Primary Point of Contact would initiate and lead all discussions with the counterparty to expedite the agreement.

For the Pools, I think that Govt Affairs should be the Primary Point of Contact.

ISO-NE	=	Christi Nicolay
NY-ISO	=	Christi Nicolay
PJM	=	Jim Steffes
ERCOT	=	Charles Yeung
MISO	=	Sarah Novosel
SPP	=	Christi Nicolay
CAISO	=	Alan Connes (although Steve Hall is already working on this and should not be displaced).

For the individual Transmission Providers, I think that the Real-Time Desk/Logistics should be the Primary Point of Contact.

Does anyone see any issues with this proposal? I am concerned that Netco may be taking multiple positions with the same provider and that could lead to delay.

Thanks.

15. Content category *requests some service or delegate tasks*; Language category **5**:

John, Milly has asked me to move the share certificates for Impact Energy to Enron Canada's control. These shares currently reside in a Morgan Stanley account controlled by ENA. As you may recall Enron Canada bought and paid for these shares and special warrants. Enron Canada directly owns 1,595,455 shares valued at USD\$1.6 million and indirectly owns 1,300,000 shares (through JEDI) which Enron Canada beneficially owns 50% worth USD\$650,000. These securities are worth USD\$2.25 million to Enron Canada and I believe represent the only significant non trading asset in Enron

Canada. Enron Canada proposes to move all the certificates to the control of the legal group of Enron Canada. The logic is simple, Enron Canada has a fiduciary duty to its shareholders and creditors to control its assets and if they need to be disposed we are in the best position to realize full value for the securities. Please advise if you have any problems with this proposal, otherwise I will make it happen on monday November 26, 2001.

Thanks John

16. Content category *provides acknowledgement*; Language category 1:

Rob, no hi or goodbye – you are losing your Canadian politeness :)
On a serious note, you are doing the right thing for the company and for Barry's career. This will be a good opportunity for him to get to the next level if he makes it happen.
As you are aware, I will aggressively support you and the Toronto initiative.
Let me know.
Regards
Delainey

----- Forwarded by David W Delainey/HOU/ECT on
10/03/2000

01:24 PM -----

Rob Milnthorp

10/02/2000 09:22 AM

To: David W Delainey/HOU/ECT@ECT, John J Lavorato/Corp/Enron@Enron

cc:

Subject: Barry Tycholiz

Barry's yours December 15th.

17. Content category *provides acknowledgement*; Language category 2:

Thanks very much for your comments. I too applaud the groups' efforts on the new request system ! This is the kind of improvement in our processes that

we should all be seeking on a regular basis. It's nice to know this one hit

the mark and adds value to our customers' processes as well.

Kim S Theriot 03/03/2000 09:55 AM

To: Mary Solmonson/HOU/ECT@ECT

cc: Bernice Rodriguez/HOU/ECT@ECT, Samuel Schott/HOU/ECT@ECT, Mary G Gosnell/HOU/ECT@ECT

Subject: New Global Counterparty Change Request System

Just wanted to drop you a note to let you know how pleased we are with the

New Global Counterparty Change Request system. I had the opportunity to use

it yesterday. It is very easy to use and very user friendly! Also it
is
very efficient, since we no longer have to remember who handles what
party of
the alphabet. We love the fact that we can work on a request and save
it as
a draft before finalizing it. Also like the ability to view our own
request
so that we can view the status.
Overall, your group has done a great job on this project!
Kim Theriot

18. Content category *provides acknowledgement*; Language category 3:

Jim:
Your words of encouragement are greatly appreciated. I've certainly
had some
troubles this quarter. I do appreciate your offer but I don't want to
take
away from the amazing year you've had so far. Maybe you should come
trade
this ...
John
Jim Schwieger
12/06/2000 05:42 PM
To: John Arnold/HOU/ECT@ECT
cc:
Subject: For What It's Worth.
Through the year's (Sounds like I'm really old) I have learned that the
really
great individuals come down on themselves for circumstances beyond
their
control when in fact their performance is far beyond what anyone else
could
have done. I believe you are one of those individuals. I appreciate
what
you have done with EOL and the burden you have had to take on. This
especially hits home when I see what has happened to you P/L the last
3
months. You are expected to carry the world without having any NYMEX
liquidity to cover your risk. I would like to offer to transfer \$30
million
out of the Storage Book to the Price Book. Without you and EOL I
could never
have done what I've done.
Thanks,
Jim Schwieger

19. Content category *provides acknowledgement*; Language category 4:

Edward, you are very welcome and I appreciate all the efforts to
ensure the

transition works and we get the accounting treatment we want on Garden State.

Regards
Delainey

----- Forwarded by David W Delainey/HOU/ECT on

08/01/2000

06:15 PM -----

Enron North America Corp.

From: Edward Ondarza

08/01/2000 05:11 PM

To: David W Delainey/HOU/ECT@ECT

cc:

Subject:

Dave,

Congratulations on your appointment to CEO – what's next?

I am working with Bryan and Ray on the transition, everything seems to be

going along smoothly. Bryan is comfortable with me moving as soon as EBS has

physical space for me as long as I am available to him by phone. I expect to

move next week.

I am working on a scheme with Wes on marking the swaps on Garden State without fair valuing the asset. Citibank and National Bank of Canada are

interested, and the trade should improve the economics as a result of trading

with a strong credit (bank) as opposed to a stand alone operation (Garden

State). I should have more feedback by the end of the week.

Thank you for your support on my move to EBS. I have really enjoyed working

with you and appreciate what you have done for me. Working with you, Greg

and Rodney has really improved my management, finance and structuring skills

that I expect to apply at EBS.

Call me if there is anything I can ever do to support you. I look forward

to working with you again.

Thanks for being a terrific boss and good friend.

Regards,

Edward

20. Content category *provides acknowledgement*; Language category **5**:

Looks correct to me Dawnie.

PL

21. Content category *is non-work related*; Language category **1**:

that game was great. i was so impressed with griese & gary & the whole

office. the defense is a major concern. i am torn between being impressed with what they did on the road in a hostile environment or being freaked out b/c of that defense. st. louis had a good defense last year. i hope their defense is still good b/c that would say a lot about our offense.

22. Content category *is non-work related*; Language category *2*:

Cooper is doing fine he is still breathing according to him

-----Original Message-----

From: Postlethwaite, John

Sent: Wednesday, January 16, 2002 10:32 AM

To: Zufferli, John

Subject: RE: How are things

Things are going well here. We have been working on cleaning up Dec. I cautiously optimistic about UBS. I think the fact that they put no money up front could make things difficult with the creditors. I am not sure if they will accept the fact that will only get money from profits that we make. There are no guarantees that we will be profitable.

Yeah, the last few weeks are hard. I am sure she is at the point she just wants it over with. Are you ready for your life to get flipped around. It's a lot of fun but difficult for the first 2 months. After that it get's easier as you go.

So I assume you are riding it out with UBS? Not sure how I feel about the situation. Could be just the fear of the unknown.

How is Cooper doing?

John

-----Original Message-----

From: Zufferli, John

Sent: Wednesday, January 16, 2002 9:19 AM

To: Postlethwaite, John

Subject: RE: How are things

things are going well, hectic but more steady now that we are bought by UBS, at least steady in mind

jess is doing well, just 6 weeks left, she is getting to the uncomfortable phase now

how are you doing in portland?

-----Original Message-----

From: Postlethwaite, John

Sent: Tuesday, January 15, 2002 3:57 PM

To: Zufferli, John

Subject: How are things

John, thought I would drop a line and see how things are going. Not much to report here, just waiting to see what the fall out from the sale will be. How is Jessica and baby to be doing?

John

23. Content category *is non-work related*; Language category *3*:

Poetry Analysis/ Discussion

Tulips

The tulips are too excitable, it is winter here.
Look how white everything is, how quiet, how snowed-in.
I am learning peacefulness, lying by myself quietly
As the light lies on these white walls, this bed, these hands.
I am nobody; I have nothing to do with explosions.
I have given my name and my day-clothes up to the nurses
And my history to the anesthetist and my body to surgeons.
They have propped my head between the pillow and the sheet-cuff
Like an eye between two white lids that will not shut.
Stupid pupil, it has to take everything in.
The nurses pass and pass, they are no trouble,
They pass the way gulls pass inland in their white caps,
Doing things with their hands, one just the same as another,
So it is impossible to tell how many there are.
My body is a pebble to them, they tend it as water
Tends to the pebbles it must run over, smoothing them gently.
They bring me numbness in their bright needles, they bring me sleep
Now I have lost myself I am sick of baggage
My patent leather overnight case like a black pillbox,
My husband and child smiling out of the family photo;
Their smiles catch onto my skin, little smiling hooks.
I have let things slip, a thirty-year-old cargo boat
Stubbornly hanging on to my name and address.
They have swabbed me clear of my loving associations.
Scared and bare on the green plastic-pillowed trolley
I watched my teaset, my bureaus of linen, my books
Sink out of sight, and the water went over my head.
I am a nun now, I have never been so pure.
I didn't want any flowers, I only wanted
To lie with my hands turned up and be utterly empty.
How free it is, you have no idea how free –
The peacefulness is so big it dazes you,
And it asks nothing, a name tag, a few trinkets.
It is what the dead close on, finally; I imagine them
Shutting their mouths on it, like a Communion tablet.
The tulips are too red in the first place, they hurt me.
Even through the gift paper I could hear them breathe
Lightly, through their white swaddlings, like an awful baby.
Their redness talks to my wound, it corresponds.
They are subtle: they seem to float, though they weigh me down
Upsetting me with their sudden tongues and their color,
A dozen red lead sinkers round my neck.
Nobody watched me before, now I am watched.
The tulips turn to me, and the window behind me
Where once a day the light slowly widens and slowly thins,
And I see myself, flat, ridiculous, a cut-paper shadow
Between the eye of the sun and the eyes of the tulips,
And I have no face, I have wanted to efface myself
The vivid tulips eat my oxygen.
Before they came the air was calm enough,
Coming and going, breath by breath, without any fuss.

Then the tulips filled it up like a loud noise.
Now the air snags and eddies round them the way a river
Snags and eddies round a sunken rust-red engine.
They concentrate my attention, that was happy
Playing and resting without committing itself.
The walls, also, seem to be warming themselves.
The tulips should be behind bars like dangerous animals;
They are opening like the mouth of some great African cat,
And I am aware of my heart: it opens and closes
Its bowl of red blooms out of sheer love of me.
The water I taste is warm and salt, like the sea,
And comes from a country far away as health.

24. Content category *is non-work related*; Language category **5**:

ENE – 77!

25. Content category *is not meaningful*; Language category **1**:

position on what?

26. Content category *is not meaningful*; Language category **2**:

fill me in. how can i eavesdrop??
To: John Arnold/HOU/ECT@ECT
cc:
Subject: Re: NG YEAR ENd Quiz
I belong to a natgas discussion group on the internet. This is from
one of
the guys. Basically they are a bunch of gastraders from various firms
(a lot
of producers, some industrials, some small shops and few i—banker
types) I
found the test to be mildly amusing. And since I had no idea what '
club no
minors' was— i was hoping for some insight from you guys. Fortunately
, the
lovely Ms. Shipos was able to fill me in.
Anyway, while occasionally garbage, the discussions do provide insight
on
what others are thinking of production, storage and other such matters
. And
when I was a marketer, I found a few leads. Finally, since a lot of
the
information revolves around gossip about a particular 'super trader'
at the
big ENE, i find it amusing that one of the most reserved and modest
individuals I know is so talked about on the internet.
JF

27. Content category *is not meaningful*; Language category 3:

5.215 by 5.225, I bought 5.235, thought it was going up

28. Content category *is not meaningful*; Language category 4:

LA TECH #4
Maryland #3
Hawaii #2
Eastern Michigan #1

29. Content category *is not meaningful*; Language category 5:

Tori Fiedler 5
Jason Patton 0

A.2 Details on the Implementation of the Good-Turing Correction

To correct the measure of word relative frequency, I use a method based on the work of [Good \(1953\)](#) (*Good-Turing estimation*) and proposed in its specific version by [Gale and Sampson \(1995\)](#), [Sampson \(2001\)](#) (chapter 7).²⁵

Let $V(m, N)$ be the number of unique words that appear m times in the sample of N words. In other words, $V(m, N)$ is the frequency of word-frequency m . In addition, let $f(i, N)$ be the number of times that word i is observed in the sample of N words, and $p(i, N) = \frac{f(i, N)}{N}$ the relative frequency of word i . $p(i, N)$ is a biased measure of the relative frequency in the population (i.e. in the whole language), because some words of the population may not be observed in the sample of N words.

Assume that word i appears m times in the sample of N words, i.e. $f(i, N) = m$. The Good-Turing correction for the measure m , m^* , would then be:

$$m^* = (m + 1) \frac{\mathbb{E}[V(m + 1, N)]}{\mathbb{E}[V(m, N)]}$$

For the empirical computation of m^* , [Sampson \(2001\)](#) (chapter 7) provide a detailed step-by-step procedure, and I remind the reader to that reference for all the details. In short, for lower values of m , m^* will be computed as:

$$m_1^* = (m + 1) \frac{V(m + 1, N)}{V(m, N)}$$

that is, using the observed values of $V(m + 1, N)$ and $V(m, N)$ as measured in the sample of N words. For higher values of m instead, m^* will be computed as:

$$m_2^* = (m + 1) \frac{S(V(m + 1, N))}{S(V(m, N))}$$

where $S(V(m, N))$ is estimated with the following steps:

²⁵An explanation of the Good-Turing estimates is also available in [Baayen \(2001\)](#), page 57-61

1. Let m be a specific value for word frequencies, while \tilde{m} be any possible value of word frequencies. Using the sample of N words, compute a smoothed version of $\{V(\tilde{m}, N)\}_{\tilde{m}}$ that takes into account the fact that, in the sample, $V(m, N)$ is not observed for all \tilde{m} :

$$Z(m, N) = \frac{2V(m, N)}{m^{post} - m^{pre}}$$

where, after ordering the set of all \tilde{m} , m^{pre} is the value just preceding m , and m^{post} is the value just following m .

2. Estimate via OLS the following model:

$$\log(Z(\tilde{m}, N)) = \beta_1 + \beta_2 \log(\tilde{m}) + u.$$

In multiple applications, it has been shown that the scatterplot of $\log(Z(\tilde{m}, N))$ and $\log(\tilde{m})$ is approximately linear, so a linear model is appropriate.

3. Finally:

$$S(V(m, N)) = \exp(\hat{\beta}_0 + \hat{\beta}_1 \log(m))$$

The Good-Turing corrected estimate of m is then given by:

$$m^* = \begin{cases} m_1^* & \text{if } |m_1^* - m_2^*| > 1.96 \sqrt{(m+1)^2 \frac{V(m+1, N)}{V(m, N)^2} \left(1 + \frac{V(m+1, N)}{V(m, N)}\right)} \\ & \text{and if that inequality holds for any } \tilde{m} < m \\ m_2^* & \text{otherwise} \end{cases}$$

Once obtained the Good-Turing corrected measure of word frequency m^* , we can compute the corrected measure of relative frequency as:

$$p^* = (1 - P_0) \frac{m^*}{N'} \quad (2)$$

where $P_0 = \frac{V(1, N)}{N}$ is the estimated total probability of all unseen words (i.e., words not appearing in the sample), and $N' = \sum_{\tilde{m}} V(\tilde{m}, N) \tilde{m}^*$.

To summarize, consider a word i which appears m times in a sample of N words. If we estimate the probability of observing word i with the ratio $\frac{m}{N}$, we would put zero weight on any word that does not appear in the sample, an error which is larger for smaller sample sizes. To correct for this problem, this paper uses equation 2, which is a version of the Good-Turing correction, to estimate the probability of a word that appears m times in the sample.

A.3 Details on the Extraction of Information on the Hierarchy

A.4 Details on the Construction of Hierarchical Levels based on Roles

A.5 Additional Tables and Figures

Oggetto: EGM Operations & Accounting Organizational Changes
Mittente: "Brent Price - CAO VP-Operations@ENRON" <IMCEANOTES-
Brent+20Price+20-+20CAO+20VP-Operations+40ENRON@ENRON.com>
Data: 31/10/2001 19:44
A: "Enron Wholesale Services All@ENRON" <IMCEANOTES-
Enron+20Wholesale+20Services+20All+40ENRON@ENRON.com>

I am pleased to announce the following organizational changes within EGM Operations & Accounting effective immediately:

Todd Hall will be relocating to London and will assume responsibility for all EGM operational activities in London including Risk Management, Confirmations, Coordination & Settlements and Trade Accounting. Todd will be working closely with the EGM business unit heads in London to ensure their businesses are being supported in an effective and efficient manner.

Cindy Horn will assume the role of EGM IT & Remote Office Controller. She will be responsible for the oversight and coordination of all IT projects affecting the Operations group. Her duties will include monitoring and reporting project timelines and expenses and ensuring IT is being utilized in the most cost-effective manner within Operations. Cindy will also manage the operational activities of the Singapore and Tokyo offices and coordinate with the Sydney office in regards to EGM operations.

Michelle Bruce will assume responsibility for Risk Management in the Houston office for Crude & Products, Coal and Weather. She will also continue to manage the Confirmation, Coordination & Settlements and Trade Accounting functions in Houston.

Please join me in congratulating these individuals on their new assignments.

EDRM Enron Email Data Set has been produced in EML, PST and NSF format by ZL Technologies, Inc. This Data Set is licensed under a Creative Commons Attribution 3.0 United States License (<http://creativecommons.org/licenses/by/3.0/us/>). To provide attribution, please cite to "ZL Technologies, Inc. (<http://www.zl11.com>)."

Figure 7: Example of email containing organizational information. It includes author's hand-written emphasis on employees' names.

West Power Trading

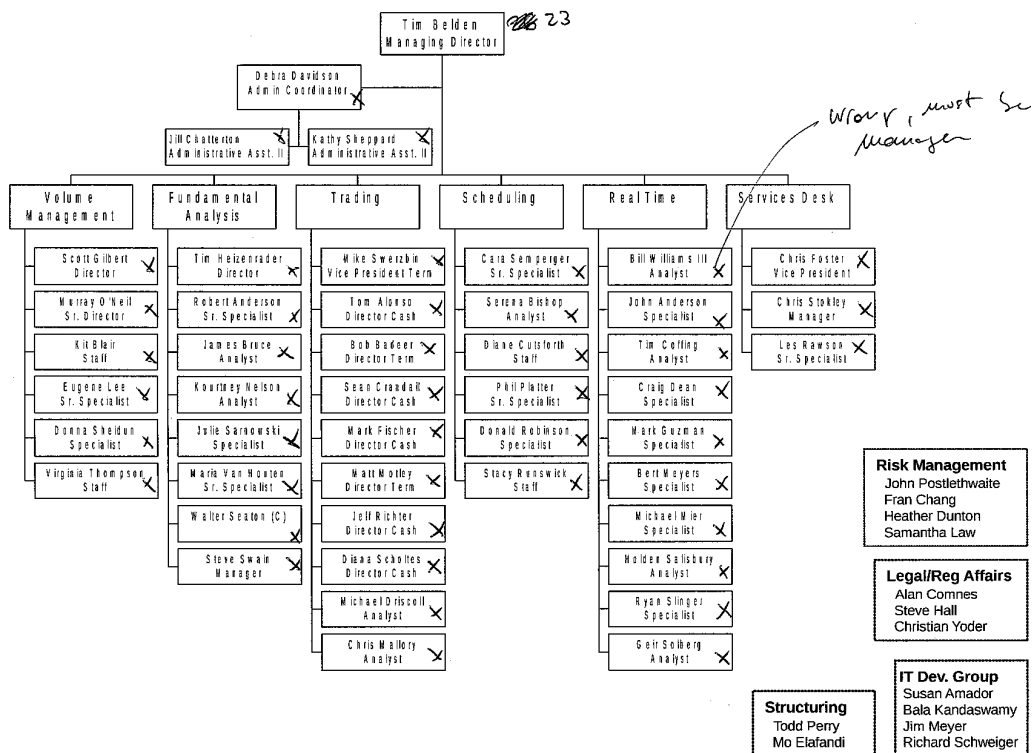
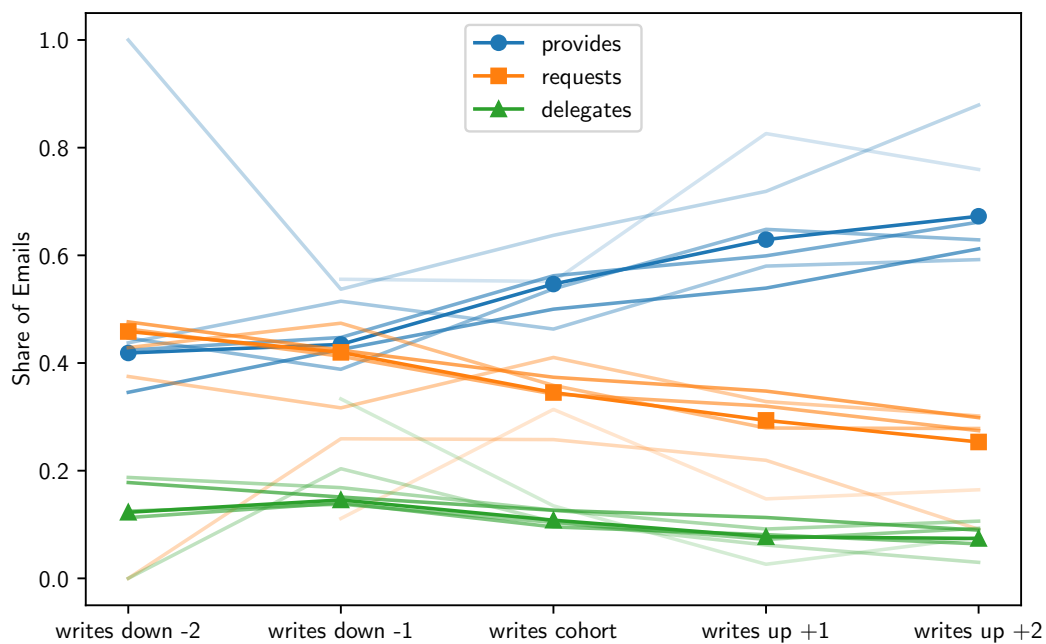


Figure 8: Example of hierarchical tree extracted from email attachments. It includes author's hand-written comments.

	Roles
1	['COO', 'President', 'CCO', 'Chairman', 'CFO', 'CIO', 'CEO', 'CAO', 'CTO']
2	['Managing Director', 'Vice President', 'Senior Vice President', 'Executive Vice President', 'Vice Chairman', 'Senior Director']
3	['Director', 'General Counsel', 'General Manager', 'lower than managing director', 'lower than vice president', 'lower than senior director']
4	['Manager', 'Assistant General Counsel', 'Deputy General Counsel', 'Senior Counsel', 'Senior Legal Counsel', 'Supervisor', 'Team Leader', 'Coordinating Manager', 'Superintendent', 'Controller', 'Operations Controller', 'European Controller', 'Business Controller', 'lower than director']
5	['Analyst', 'Senior Analyst', 'Analyst III', 'Lead Analyst', 'Specialist', 'Senior Specialist', 'Senior Lead Specialist', 'Lead Specialist', 'Counsel', 'Attorney', 'Senior Attorney', 'Senior HR Assistant', 'Treasurer', 'lower than manager']
6	['Staff', 'Representative', 'Senior Representative', 'Associate', 'Paralegal', 'Clerk', 'Senior Clerk', 'Trader', 'Technical Consultant', 'Consultant', 'Contractor', 'Counterparty', 'Phone Operator', 'Research Assistant', 'Intern', 'Junior Specialist', 'lower than technical consultant', 'lower than senior specialist', 'lower than specialist', 'lower than senior clerk', 'lower than staff', 'lower than associate', 'lower than senior tac analyst']

Role names assigned to each hierarchical level, from 1 (top-ranked) to 6 (bottom-ranked).

Table 2: Hierarchical Levels and Role Names



Share of emails that provide information (i.e. *provides*), request information (i.e. *requests*), or delegate tasks (i.e. *delegates*), conditional on the recipient(s) including the superior of the superior of the sender (*writes down +2*), the superior of the sender (*writes down +1*), someone in the same hierarchical level of the sender (*writes cohort*), the subordinate of the sender (*writes down -1*), or the subordinate of the subordinate of the sender (*writes down -2*). Faded line correspond to the share levels specific to different hierarchical levels, with paler tones identifying lower hierarchical levels. Hierarchical levels are based on employee roles' names.

Figure 9: Shares of Emails by Content and Hierarchical Level

Roles	Frequency
Manager	23
Director	22
Vice President	18
Senior Specialist	12
Specialist	11
Associate	8
Senior Counsel	3
Executive Vice President	3
Managing Director	3
Assistant General Counsel	3
Attorney	2
lower than manager	2
CEO	2
Chairman	2
Analyst	2
lower than vice president	2
COO	2
Team Leader	2
President	2
CCO	1
Clerk	1
lower than managing director	1
Counsel	1
Trader	1
lower than director	1
General Counsel	1
lower than senior specialist	1

132 email senders in the dataset used for the analysis are part of the employees whose mailbox was publicly released by the FERC. The table reports their roles and the respective frequency.

Table 3: Mailbox Owners' Roles