



The Double-Edged Sword of Digital Communication: A Social Network Analysis of Email's Influence on Employee Performance and Well-Being

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Abstract

This study explores the dual role of digital communication on employee performance and well-being. Prior research highlights that individuals with central positions in communication networks benefit from greater access to information, enhanced innovation, and improved organizational outcomes. However, recent findings point also to the risk of information overload as digital connectivity increases. This research examines whether employees' structural position in an email communication network is positively associated with work performance, engagement, and job satisfaction and whether this relationship follows a curvilinear pattern. The analysis is based on over 1.4 million emails exchanged among 1149 employees of a major Italian bank over a 1-year period during the COVID-19 pandemic. Social network data were integrated with survey responses on job satisfaction and engagement, as well as supervisor-rated performance evaluations. Social network analysis and regression techniques were employed to examine the associations between employees' structural positions in the email network and individual outcomes. The results reveal that the breadth of distinct contacts and the volume of email exchanges operate through theoretically distinct mechanisms depending on the outcome considered. These findings offer new theoretical and practical insights into how email communication structures relate to employee well-being and productivity and highlight the need to balance connectivity and communication volume in digitally mediated work environments.

Keywords Email communication · Social network analysis · Human resource management

Research on human resource management (HRM) has widely recognized that, in organizational settings, who you know matters as much as what you know (Cross & Prusak, 2002). Employees who occupy more central positions within communication networks—i.e., those who communicate and create connections with many individuals—can benefit from more innovative ideas (Burt, 2004), better work performance

(Burt, 1992; Carboni & Ehrlich, 2013; Methot et al., 2016), higher job satisfaction, and increased work engagement (McGrath et al., 2017).

The impact of social connections on individual outcomes is not a new topic in organizational research (Borgatti & Foster, 2003; Brass, 1984). However, recent advances in workplace technologies (Cascio & Montealegre, 2016), as well as the unprecedented acceleration of their use during the COVID-19 pandemic (Wang et al., 2021), have significantly expanded the scope and nature of employee digital interactions (Becker et al., 2022). The pandemic, which forced most organizations to adopt remote work, temporarily eliminated physical proximity and made digital communication tools—such as email, chat, and video calls—the main (and sometimes only) channel of collaboration (Franken et al., 2021). At the same time, the broader digital transformation that predated the COVID-19 crisis has continued beyond the pandemic. Even as organizations returned to a sense of normality, many of the practices and interaction patterns

Additional supplementary materials may be found here by searching on article title <https://osf.io/collections/jbp/discover>.

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that emerged during that period have been retained, and now shape contemporary work systems (Georgiadou et al., 2024).

Research shows that employees can collaborate more effectively across physical and temporal boundaries, thanks to digital communication tools (Schmid & Dowling, 2022). These tools support the coordination of complex activities (Olaisen & Revang, 2017), enable more flexible work arrangements (Wang et al., 2021), and give individuals greater autonomy over how and when they respond to communications (Mazmanian et al., 2013), enhancing both time management and job satisfaction (Matusik & Mickel, 2011).

Despite all these benefits, a growing body of research highlights the potential downsides of this persistent accessibility to information provided by communication technologies (Lechner et al., 2010). The constant connection with others and the presence of multiple acquaintances can be intrusive, making it difficult for people to disconnect from work (Ter Hoeven et al., 2016). Further, a continuous flow of information can overwhelm individuals, resulting in what is known as information overload (Oldroyd & Morris, 2012). As a result, people may struggle to focus on specific tasks, decreasing the efficacy during working hours and seeing a reduction in their levels of well-being (Ateeq et al., 2022).

Human resource management studies (such as Braukmann et al., 2018; Oldroyd & Morris, 2012) highlight that communication can have both beneficial and adverse impacts on employee performance and well-being. This is particularly pressing in modern working environments, in which we observe a progressive shift from face-to-face interactions to increasingly digital ones (Malhotra, 2021; Olaisen & Revang, 2017). In these settings, both academics and practitioners are increasingly interested in how communication can be optimized to sustain both effectiveness and well-being (Nguyen et al., 2022; Ter Hoeven et al., 2016).

Despite this growing interest, current literature still relies on traditional individual questionnaires to measure employees' interactions (Barley et al., 2011). Personal answers of respondents may be influenced by different factors (Steiner & Rain, 1989) that do not accurately represent the actual communication dynamics within an organization (Johns & Miraglia, 2015). Assessing networking based only on traditional surveys introduces biases (Hollenbeck & Jamieson, 2015) and potentially leads to an inaccurate (or misleading) accumulation of knowledge (Banks et al., 2021). Therefore, it becomes important to give new theoretical and practical insights rooted in empirical evidence that goes beyond the perception of connections.

To address all these gaps, we analyzed the emails of 1149 employees working within a large Italian bank for 1 year (from November 10, 2021, to November 9, 2022), combining them with data collected from surveys and performance evaluations. During this period, most employees worked remotely due to COVID-19 restrictions, and email was the

primary channel for internal communication, serving as a digital record of decision-making and knowledge sharing (Mazmanian et al., 2013). This context provides a convenient empirical setting for capturing most of the connections between colleagues. Furthermore, the insights derived from this context extend beyond the pandemic, offering valuable implications for understanding how digital connectivity continues to be associated with patterns of performance and well-being in today's hybrid work environments.

Our study offers several contributions. First, we simultaneously examine how employees' degree of centrality within their email communication network relates to job performance, satisfaction, and engagement. To our knowledge, this is the first study where the practical outcomes of performance and employee well-being are simultaneously explored in relation to email communication patterns. Our study seeks to integrate the performance and well-being dimensions, addressing a key limitation of traditional HRM approaches that tend to prioritize performance while overlooking employee health and satisfaction (Guest, 2017). Second, from a methodological and phenomenological viewpoint, we aim to avoid the biases that rely on participants' memories of their communication networks by analyzing objective data from corporate information systems. By using email data, we provide objective evidence that goes beyond perceptions, aiming to measure behavior through actual observed actions (Antonakis, 2017).

Research Background and Hypotheses

In network research, relationships are considered a social asset created and shaped by the connections established with other actors (Inkpen & Tsang, 2005). In other words, privileged access to information and knowledge is the primary source of value for network ties (Burt, 1997). Therefore, starting from the premise that knowledge in an organizational context is not a static element, but evolves dynamically through the exchange among individuals (Nonaka, 1994), we recognize the fundamental role of communication as the mechanism through which knowledge is transmitted and enriched (Farnese et al., 2019).

Despite the debates on how communication is linked to individual and organizational outcomes, academic research is particularly lacking on how email communication is associated with these outcomes. Digital technologies increasingly shape organizational communication structures, influencing how knowledge is distributed and accessed within organizations (Leonardi, 2014). Furthermore, since work communications are changing and are nowadays mainly mediated by digital technologies (Malhotra, 2021), it becomes important to provide new findings and contributions that help in taking a new perspective on organizational

communication networks, overcoming the limited reliability of self-reported behavioral measures (typically assessed retrospectively). To achieve this, we leverage recent studies from the field of computational social sciences (e.g., Stier et al., 2020), which collect digital traces of human behavior in a non-intrusive manner—with high precision and granularity.

We decided to extract and analyze emails, as they serve as the primary digital channel for communication among employees (Mazmanian et al., 2013). Although email has great potential to reflect organizational communication patterns and behavior, it has been used in a limited number of past studies (Sosa et al., 2015). This research aims to explore how employees' structural positions within the email communication network relate to work performance, engagement, and satisfaction.

In this light, we expect that employees' network centrality in email communication is positively associated with these outcomes, and we empirically examine this possibility.

In the following paragraph, we outline the hypothesized relationships that clarify the connections among these variables.

The Influence of Email Network Centrality on Individual Job Performance

Academic literature suggests a positive linear relationship between network centrality and individual work performance (Cross & Cummings, 2004; Sparrowe et al., 2001). Individuals who occupy central positions in email networks, who have many connections and are highly visible within an organization, tend to acquire more knowledge and contacts, strengthening their position and exponentially increasing their access to information and resources (Borgatti & Cross, 2003; Cross & Prusak, 2002). Consequently, individuals with greater access to relevant and diverse information are better equipped to identify emerging trends and problems, develop more creative solutions, and achieve superior performance (Aral et al., 2012).

However, recent studies show that high levels of network centrality are not always positively associated with employee performance (Soucek & Moser, 2010). In many networks, people tend to connect with a few important individuals (Newman & Park, 2003) who establish many connections that become excessive, and can no longer be managed effectively. This phenomenon—known as information overload—refers to the condition of receiving more information than one can process in a period (Eppler & Mengis, 2004), limiting one's ability to concentrate due to numerous interruptions, and reducing the ability to make effective decisions (Jett & George, 2003). In fact, an excessive number of connections and interactions can hinder the achievement of goals rather than help, thus reducing effective

communication, knowledge sharing, thinking processes, and personal development (Bawden & Robinson, 2009).

Moreover, it has been shown that the use of different forms of electronic communication (such as email) can increase the number of connections and, thus, interruptions in the workplace, leading to increased distraction and reduced work effectiveness and efficiency (Mano & Mesch, 2010). People who receive multiple communications tend not to focus on their core work, as these interruptions require users to reactivate the visual scanning mechanism, which can be difficult after paying attention to a notification (Speier et al., 1999).

These considerations on information overload and its influence on individual productivity call attention to the importance of analyzing the balance between the advantages and threats of high network centrality, highlighting the pivotal role of properly managing email communication networks. Based on these considerations, we formulate the following hypothesis:

Hypothesis 1: *While active email communication is associated with higher individual performance, exceeding a certain number of connections is related to lower performance, consistent with information overload.*

The Influence of Email Network Centrality on Individual Well-Being

Organizations are increasingly prioritizing the psychological well-being of their employees (Peccei & Van De Voorde, 2019) since it plays an essential role in achieving organizational goals (Tims et al., 2013), as well as in reducing absenteeism and turnover (Harter et al., 2002). Addressing the topic of psychological well-being, a distinction is made between hedonic, related to job satisfaction, and eudaimonic, associated with work engagement (Guest, 2017). The former refers to workers' perceptions of their work, viewed in positive or negative terms, depending on the degree to which expectations and needs are met (Yeh, 2013). The second represents a more dynamic and deeper concept, expressed through vigor, dedication, and absorption in one's work (Schaufeli et al., 2002).

In this framework, network centrality is viewed as a key element linked to employees' experiences of well-being. The literature has shown that effective internal communication, enriched by high levels of information exchange, significantly contributes to job satisfaction and work engagement (Nadales-Gallego et al., 2025). On the one hand, increased connectivity can enhance job satisfaction by creating a diverse and extensive network of contacts that facilitates the exchange of information and access to valuable resources. On the other hand, employees who build many connections

within their network develop a sense of belonging to the community, which boosts their feelings of support and security, enriches their work experience, and strengthens their professional identity (Birmingham et al., 2024). This deeper engagement with their roles is often associated with increased empowerment, as employees feel more in control and appreciated, which in turn enhances their commitment and dedication to their work. Furthermore, high communication with colleagues and an effective exchange of information fosters transparency, innovation, and collaboration, all of which add to a fulfilling and stimulating work environment (Davenport & Prusak, 1998).

As previously discussed, however, the advantages of high network centrality and extensive communication are counterbalanced by the risk of information overload. This condition, characterized by intense work pressure and overlap and confusion between private and professional life, can seriously impact well-being, leading to negative consequences for both employees and organizations (Speier et al., 1999). These risks, although reported, have often been overlooked in the HRM literature, making it relevant to explore them further (Cascio & Montealegre, 2016).

Changes in the way we communicate are linked to shifts in engagement and satisfaction: while these developments offer positive opportunities, including more autonomy and flexibility and increased access to information, they can also pose challenges to employee job satisfaction by increasing demand and generating work overload (Derks & Bakker, 2010). Moreover, information overload can make managing and prioritizing information difficult, causing stress and a perceived loss of control over one's work and responsibilities (Kushlev & Dunn, 2015). This condition can erode self-esteem and work engagement, as well as raise concerns about one's adequacy and competence in work contexts (Barley et al., 2011). Based on these arguments, we would expect that:

Hypothesis 2: *While active email communication is associated with higher work engagement and job satisfaction, exceeding a certain number of email connections is related to lower levels of both outcomes, consistent with information overload.*

Method

Data Collection and Participants

Data have been collected in an Italian bank with 6581 employees, referred to as *Sissi* for confidentiality reasons. The company has been selected due to its significant organizational breadth and variety of operational functions. The

decision was based on the hypothesis that a structure of this scale can provide a rich and varied empirical context, useful for validating organizational theories and observing multidimensional communication phenomena within large organizations (Memon et al., 2020). Before proceeding with data gathering, research objectives and privacy policies were explained to *Sissi* employees, ensuring the anonymity of the collected information and reducing their evaluation apprehension (Podsakoff et al., 2003).

As already mentioned, email is the primary channel of communication used by the company for sharing information and everyday activity coordination, allowing people to be available even when they are not physically present (Mazmanian et al., 2013). The organizational context further reinforces the predominance of email as a communication medium. According to the company, much of the communication related to tasks and coordination regularly takes place via email, because the bank operates through a widely distributed network of branches and offices across Italy. Since many employees collaborate across geographically distant locations and have limited opportunities for in-person interaction, email works as the primary infrastructure for coordinating daily operations, sharing updates, and sustaining cross-unit collaboration. Moreover, employees work under different schedules: for instance, frontline staff in branch offices usually follow fixed opening hours, while employees in central or corporate offices typically work standard office hours. These differences in working time further limit the use of synchronous communication channels (such as phone or video calls) and reinforce the central role of email in everyday coordination practices. Furthermore, this reliance on email was further amplified during the period of analysis, which coincided with the COVID-19 pandemic. Health restrictions and social distancing measures led to an increased use of emails to maintain business operations and communication among employees. Therefore, this dataset offers a unique opportunity to observe the communication dynamics in a context of intensive use of digital media.

Data were collected through three sources: surveys, performance evaluations, and emails. First, a web-based questionnaire was administered in May 2022 through email. The questionnaire has been articulated in two parts. The first consisted of questions on socio-demographic characteristics (i.e., age, gender, role, seniority within the company, and business unit affiliation). The second part was composed of questions on the constructs analyzed (i.e., employee engagement and satisfaction). A detailed explanation of all measures is provided in the "Measures" section below.

Second, individual performance evaluations have been collected from *Sissi's* performance management system, consisting of evaluations provided by supervisors and used to assess employee work performance.

Third, we gathered all emails exchanged via the enterprise email system from November 10, 2021, to November 9, 2022. Due to privacy agreements, the analysis was focused on examining only email communications, without bodies and subject lines. In addition, for the same privacy-related reasons, all temporal metadata (i.e., dates and timestamps of the messages) were removed by the partner organization during the anonymization process, meaning that only sender-recipient pairs and aggregated volumes of interaction were available for analysis. We obtained a sample of 1,438,386 emails exchanged among 1149 individuals, along with their responses to the survey and performance evaluations. The full organizational email network initially included all 6581 employees, and centrality metrics were computed on this complete network to preserve the integrity of the network topology (Gloor et al., 2017). For the statistical analyses, we focused on the 1149 employees who completed the survey. The final sample is described in Table 1.

Measures

Work Performance It was assessed using the company's formal performance management system. Each year, employees receive an overall performance rating assigned by their immediate supervisor as part of the organization's standardized appraisal process. Ratings are provided on a 1–7 scale, with higher scores indicating better overall job performance. This rating reflects supervisors' evaluations of employees' goal achievement and job-related behaviors over the appraisal period and is used to inform key HR decisions such as bonuses, promotions, and development plans.

The appraisal process follows a structured annual cycle. Managers monitor employees' performance throughout the year and progressively form preliminary judgments based on observed progress toward goals and job-related behaviors. To enhance comparability and limit idiosyncratic bias, the organization adopts a structured performance management process in which ratings are jointly reviewed during cross-departmental calibration meetings. In addition, managers are formally expected (and trained) to assess employees in accordance with clearly defined performance standards. Final ratings are subsequently agreed upon, formally validated at the end of the appraisal cycle, and then transmitted to HR.

For the present study, we used the performance rating assigned during the 2022 evaluation period.

The following constructs have been developed using validated measurement items drawn from prior scientific literature. All items have been adapted, translated into Italian, and rated on a 7-point Likert scale, from "totally disagree" to "totally agree". The translation process consists of three main steps: (i) items have been translated from English to

Table 1 Final sample distributions

Descriptive variables	Full sample	
	<i>n</i>	%
Gender		
Female	362	31.5
Male	787	68.5
Seniority		
< 5 years	107	9.3
5–9 years	204	17.8
10–14 years	89	7.7
15–19 years	291	25.3
20+ years	458	39.9
Age		
20–29	77	6.7
30–39	316	27.5
40–49	355	30.9
50–59	326	28.4
60+	75	6.5
Role		
Managerial	187	16.3
Non-managerial	962	83.7
Business unit		
1	22	1.9
2	10	0.9
3	26	2.3
4	38	3.3
5	61	5.3
6	6	0.5
7	8	0.7
8	28	2.4
9	20	1.7
10	75	6.5
11	8	0.7
12	2	0.2
13	60	5.2
14	81	7.0
15	62	5.4
16	45	3.9
17	42	3.7
18	51	4.4
19	43	3.7
20	69	6.0
21	35	3.0
22	19	1.7
23	17	1.5
24	17	1.5
25	35	3.0
26	14	1.2
27	11	1.0
28	31	2.7
29	24	2.1

Table 1 (continued)

Descriptive variables	Full sample	
	<i>n</i>	%
30	91	7.9
31	73	6.4
32	3	0.3
33	5	0.4
34	17	1.5

Italian, (ii) a bilingual translator back-translated the items to English to check the correspondence with the original formulation, (iii) the items have been pilot-tested on three experts, asking them to rate the clarity of the instructions and the items of the scale.

Work Engagement It was assessed using the 9-item Utrecht Work Engagement Scale (Schaufeli et al., 2002) composed of the 3 sub-dimensions of vigor, absorption, and dedication. The construct presents a Cronbach α value of 0.91. An example item is “I am enthusiastic about my job”.

Job Satisfaction It has been measured using the 6-item scale proposed by Schriesheim and Tsui (1980), obtaining a Cronbach α value of 0.82. A sample item is “How satisfied are you with the work you are doing?”

Descriptive Variables

We considered gender, role, age, seniority in the company, and business unit affiliation to be descriptive variables, collecting this information through the survey. Gender was coded by assigning 1 to men and 0 to women. Role was measured by assigning 1 to individuals with managerial positions and 0 to individuals with non-managerial positions. Age was categorized into five groups as follows: 1 = (20–29 years); 2 = (30–39 years); 3 = (40–49 years); 4 = (50–59 years); 5 = (60+ years). Regarding seniority, we considered the following classes: 1 = (< 5 years), 2 = (5–9 years), 3 = (10–14 years), 4 = (15–19 years), 5 = (20+ years). The company’s business units were coded using numerical values from 1 to 34, representing all 34 organizational units within the company. These variables are considered potential influencers of individuals’ email communication behavior and their job performance, work engagement, and satisfaction (Timberlake, 2005). Therefore, we included them in the preliminary analyses.

Data Analysis

Social Network Analysis

The first step of our analysis involved the creation of a social network to map the email interactions among employees. This network was represented by a graph with N nodes, each corresponding to an individual employee, and M arcs (ties) connecting employees based on their email exchanges. Therefore, there is a directed arc from node A to node B if A has sent at least one email to B , with the weight of these ties reflecting the volume of emails exchanged.

To evaluate employees’ communication behavior, we used the most common metrics of network centrality (Wasserman & Faust, 1994): degree, betweenness, and closeness. Scholars have used these measures over the years to understand the different aspects of individuals’ (actors’) positions within social networks, since each metric captures a distinct and complementary aspect of structural positioning (Wasserman & Faust, 1994). Although network science offers a wide range of centrality measures, this study focuses on the metrics most commonly used in organizational research (Freeman, 1978). This choice reflects the need to balance analytical completeness with interpretability, while ensuring alignment with prior organizational network research (Borgatti et al., 2013; Wen et al., 2020).

Due to the topology of the network, centrality metrics are evaluated considering a weighted and directed graph. A detailed exploration of each selected metric is presented below.

Degree Centrality This measure identifies the number of direct links of a node. In the case of a relationship that considers the direction of the link, two indices are defined: in-degree centrality and out-degree centrality. The in-degree centrality of a node v is given by the expression:

$$\text{In-degree centrality}(v) = \frac{k(v)}{N-1}$$

where $k(v)$ is the number of incoming connections in node v (i.e., the number of people a person receives emails from), and N is the number of nodes in the graph.

The out-degree centrality of a node v is given by the expression:

$$\text{Out-degree centrality}(v) = \frac{z(v)}{N-1}$$

where $z(v)$ is the number of outgoing connections from node v (i.e., the number of people a person sends emails to), and N is the number of nodes in the graph. In the context of an email network, degree centrality reflects how actively employees are

connected to others and the diversity of information to which a person is exposed (Everett & Borgatti, 2005).

The weighted in-degree and out-degree of a node represent the total sum of the weights of its incoming and outgoing arcs, respectively. In the context of email networks, the weighted in-degree reflects the total number of emails received, while the weighted out-degree indicates the total number of emails sent. These measures analyze the degree of interactivity of employees, reflecting the intensity of interactions through the number of emails exchanged.

Closeness Centrality This measure indicates how close a node is to all the others in the network. The closeness centrality of a node v is given by the expression:

$$\text{Closeness centrality}(v) = \frac{N-1}{\sum_i d_{iv}}$$

where d_{iv} is the distance from node i to node v , and N is the number of nodes in the graph. In this study, we consider a directed and weighted network; accordingly, the closeness distance function computes the incoming distance to node i in directed graphs. Weighted distances are computed using the inverse of edge weights. Nodes with high closeness centrality can rapidly interact with all other actors and are less likely to rely on intermediary nodes to reach their peers quickly. In this case, it can be interpreted as the embeddedness of a node in the email network.

Betweenness Centrality This measure corresponds to the probability of being on the shortest path in the network. The betweenness centrality of a node v is given by the expression:

$$\text{Betweenness centrality}(v) = \frac{1}{(N-1)(N-2)} \sum_{i \neq j \neq v} \frac{\#d_{ij}(v)}{\#d_{ij}}$$

where $\#d_{ij}$ is the total number of shortest email communication paths from node i to node j , $\#d_{ij}(v)$ is the number of those paths that pass through v , and N is the number of nodes in the graph. In the case of a weighted and directed network, as in this study, the measure is normalized by $\frac{1}{(N-1)(N-2)}$. This measure can be interpreted as the ability to access (or control) valuable flows of resources (such as information or knowledge) through the network – sometimes interpreted as the potential to have a gatekeeping role (Borgatti et al., 2009).

Regression Analysis

The second step was to examine the relationships between employees' centralities in the email network and their work-related outcomes through regression analysis. We adopted a variable-centered analytical approach to test our hypotheses

regarding the effects of email communication patterns on work performance, work engagement, and job satisfaction. Network centrality indicators in email networks tend to exhibit substantial intercorrelations (Krackhardt, 1990; Wen et al., 2020), which creates potential multicollinearity problems when multiple metrics are simultaneously included as predictors in regression models. While some studies address this issue by selecting a single network indicator based on theoretical considerations (Krackhardt, 1990; Owen-Smith & Powell, 2004), this approach presupposes a well-established theoretical foundation for determining which indicator should be privileged (Wen et al., 2020). Given the exploratory nature of our investigation, we estimated separate ordinary least squares (OLS) regression models for each centrality measure.

Each model included the focal centrality metric, its quadratic term, and the full set of control variables. Quadratic terms were included to test for curvilinear relationships. To reduce non-essential multicollinearity between linear and quadratic components, all network variables were mean-centered (Cohen et al., 2003).

Results

Descriptive Statistics

Table 2 presents the means, the standard deviations, and the correlations of the studied variables and metrics. Results show that work performance is not significantly correlated with job satisfaction or work engagement. Conversely, as expected, work engagement is significantly positively correlated with job satisfaction.

Centrality metrics (in-degree, out-degree, weighted in-degree, weighted out-degree, betweenness, and closeness) are significantly positively correlated. This is understandable as they all measure aspects of an individual's position within the organizational network (Shao et al., 2018).

Regression Analysis Results

We estimated a series of regression models including each centrality metric separately. For each model, both linear and quadratic terms were included, together with control variables (gender, role, age, seniority, and business unit fixed effects). The results are reported in Table 3.

Work Performance

For in-degree centrality, the linear term is positive and significant, while the quadratic term is negative and significant. A

Table 2 Means, standard deviations, and inter-correlations

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. WE	5.47	0.90	—													
2. JS	5.04	0.99	.61**	—												
3. WP	6.01	1.34	.01	-.05	—											
4. Age	3.01	1.04	.06*	.12**	-.02	—										
5. Gender	0.68	0.46	.00	.04	-.09**	.14**	—									
6. Role	0.16	0.37	.14**	.15**	.01	.12**	.15**	—								
7. Seniority	3.69	1.39	.03	.03	.18**	.59**	.07*	.17**	—							
8. BU	16.59	8.87	-.06*	-.07*	.14**	.02	.02	-.04	.05	—						
9. InD	0.30	0.25	.15**	.15**	.02	-.01	-.01	.17**	.01	.00	—					
10. OutD	0.30	0.25	.15**	.16**	.02	-.02	-.01	.14**	.01	.01	.97**	—				
11. WInD	0.05	0.09	.15**	.16**	-.04	-.01	-.02	.23**	-.01	.01	.55**	.54**	—			
12. WOutD	0.04	0.07	.13**	.15**	-.06*	.00	-.02	.21**	.01	.00	.52**	.53**	.89**	—		
13. Clo	0.71	0.19	.13**	.08**	.09**	-.16**	.02	.34**	.01	.04	.31**	.30**	.36**	.30**	—	
14. Btw	0.05	0.11	.16**	.15**	-.06*	.05	.08**	.44**	.09**	-.01	.38**	.37**	.52**	.53**	.39**	—

$N=1149$. *WE*, work engagement average; *JS*, job satisfaction average; *WP*, work performance average; *BU*, business unit; *InD*, in-degree centrality; *OutD*, out-degree centrality; *WInD*, weighted in-degree centrality; *WOutD*, weighted out-degree centrality; *Clo*, closeness centrality; *Btw*, betweenness centrality

* $p < .05$. ** $p < .01$

similar pattern emerges for out-degree centrality, with a positive linear term and a negative quadratic term. Conversely, weighted in-degree and weighted out-degree centrality are not significantly associated with work performance in either their linear or quadratic specifications. Closeness centrality and betweenness centrality are not significant in their linear terms, while the quadratic terms are negative and significant. Across all models, gender and age are consistently negative and significant, and seniority is positive and significant. Role is not significantly associated with work performance.

Work Engagement

For in-degree centrality, the linear term is positive and significant, while the quadratic term is not significant. A similar pattern is observed for out-degree centrality, with a non-significant quadratic term. Weighted in-degree centrality shows a positive and significant linear term and a negative and significant quadratic term. Weighted out-degree centrality shows a similar pattern. Closeness centrality is positively and significantly associated with work engagement, and its quadratic term is also positive and significant. Betweenness centrality shows a positive and significant linear association with work engagement, while the quadratic term is not significant. Role is consistently positive and significant, while gender, age, and seniority are not significantly associated with work engagement.

Job Satisfaction

For in-degree centrality, the linear term is positive and significant, while the quadratic term is not significant. A similar pattern is observed for out-degree centrality, with a non-significant quadratic term. Weighted in-degree centrality shows a positive and significant linear term and a negative and significant quadratic term. Weighted out-degree centrality shows a similar pattern. Closeness centrality and betweenness centrality are positively and significantly associated with job satisfaction, while the quadratic terms are not significant. Role is consistently positive and significant, age is positive and significant, and seniority is negative and significant. Gender is not significantly associated with job satisfaction.

Discussion and Conclusions

Theoretical Implications

This research investigated how network centrality in organizational communication, analyzed through email data, relates to employee well-being (i.e., work engagement and job satisfaction) and work performance. For this purpose, we analyzed the email communication of employees working for a large Italian bank, integrating this data

Table 3 Regression analysis results

Variable	Work performance	Work engagement	Job satisfaction
Weighted in-degree centrality			
Network (linear)	0.52 (0.95)	2.47 (0.68)**	3.09 (0.75)**
Network ²	2.11 (1.84)	-2.54 (1.31)*	-3.37 (1.44)*
Gender	-0.22 (0.08)**	-0.03 (0.06)	0.03 (0.06)
Role	0.04 (0.11)	0.28 (0.08)**	0.30 (0.09)**
Age	-0.20 (0.05)**	0.02 (0.03)	0.11 (0.04)**
Seniority	0.22 (0.03)**	-0.01 (0.02)	-0.05 (0.03)*
R ²	.21	.10	.12
Weighted out-degree centrality			
Network (linear)	-0.97 (1.10)	3.09 (0.78)**	3.52 (0.86)**
Network ²	-1.20 (1.86)	-2.92 (1.33)*	-2.80 (1.46)*
Gender	-0.24 (0.08)**	-0.03 (0.06)	0.03 (0.06)
Role	0.09 (0.11)	0.30 (0.08)**	0.32 (0.08)**
Age	-0.20 (0.05)**	0.02 (0.03)	0.11 (0.04)**
Seniority	0.22 (0.03)**	-0.01 (0.02)	-0.06 (0.03)*
R ²	.21	.10	.12
In-degree centrality			
Network (linear)	2.07 (0.36)**	1.27 (0.26)**	0.98 (0.29)**
Network ²	-4.16 (0.71)**	-0.70 (0.52)	-0.44 (0.57)
Gender	-0.23 (0.08)**	-0.04 (0.06)	0.01 (0.06)
Role	-0.13 (0.11)	0.25 (0.08)**	0.32 (0.09)**
Age	-0.14 (0.05)**	0.03 (0.03)	0.12 (0.04)**
Seniority	0.19 (0.03)**	-0.03 (0.02)	-0.06 (0.03)*
R ²	.24	.11	.11
Out-degree centrality			
Network (linear)	2.08 (0.35)**	1.05 (0.25)**	0.92 (0.28)**
Network ²	-4.43 (0.68)**	-0.33 (0.50)	-0.11 (0.55)
Gender	-0.23 (0.08)**	-0.05 (0.06)	0.01 (0.06)
Role	-0.12 (0.11)	0.28 (0.08)**	0.33 (0.08)**
Age	-0.14 (0.05)**	0.03 (0.03)	0.11 (0.04)**
Seniority	0.20 (0.03)**	-0.02 (0.02)	-0.06 (0.03)*
R ²	.24	.11	.11
Closeness centrality			
Network (linear)	0.28 (0.25)	0.82 (0.18)**	0.46 (0.20)*
Network ²	-1.61 (0.83)*	1.42 (0.60)*	0.86 (0.66)
Gender	-0.22 (0.08)**	-0.05 (0.06)	0.00 (0.06)
Role	-0.01 (0.11)	0.25 (0.08)**	0.36 (0.09)**
Age	-0.17 (0.05)**	0.03 (0.03)	0.11 (0.04)**
Seniority	0.21 (0.03)**	-0.02 (0.02)	-0.05 (0.03)*
R ²	.22	.10	.10
Betweenness centrality			
Network (linear)	0.53 (0.70)	1.64 (0.50)**	1.43 (0.55)**
Network ²	-2.79 (1.25)*	-1.63 (0.90)	-1.23 (0.99)
Gender	-0.23 (0.08)**	-0.06 (0.06)	0.00 (0.06)
Role	0.11 (0.12)	0.26 (0.08)**	0.31 (0.09)**
Age	-0.20 (0.05)**	0.01 (0.03)	0.10 (0.04)**
Seniority	0.22 (0.03)**	-0.01 (0.02)	-0.05 (0.03)*
R ²	.22	.10	.11

N = 1149. All models include business unit fixed effects (32 dummy variables, not reported for brevity)

p* < .05. *p* < .01

with responses to a survey on psychometric constructs and performance evaluations provided by managers. Our study contributes to HRM literature in several ways.

First, our findings partially support Hypothesis 1 and reveal an interesting pattern between the number of distinct contacts and the volume of communication. Degree centrality shows a positive linear effect together with a negative quadratic term, while weighted degree centrality shows no significant association with performance in either its linear or quadratic specification. This distinction is theoretically meaningful. The number of distinct contacts captures the breadth of an employee's relational reach, which is the structural property that grants access to non-redundant information, diverse viewpoints, and complementary expertise, the mechanisms through which network position is traditionally linked to productive outcomes (Burt, 2004). Each new contact potentially brings a different perspective, a different knowledge base, or a different coordination opportunity, and this variety is what translates into performance gains. In contrast, the volume of exchanged emails reflects the intensity of interaction rather than its diversity. Additional messages with the same contacts tend to carry more redundant content, usually reiterating information that has already been shared. However, the negative quadratic effect of degree centrality on performance indicates that relational breadth has diminishing returns. As the number of distinct contacts grows, employees must manage increasingly heterogeneous expectations, norms, and interaction styles, each demanding a separate cognitive context. This translates into frequent task-switching, re-contextualization, and attention fragmentation. Once the set of relationships exceeds a manageable size, these coordination costs accelerate (Oldroyd & Morris, 2012), and the informational advantage of breadth is offset by the cognitive burden of sustaining it, consistent with information overload theory (Jackson & Farzaneh, 2012).

Second, our results also partially support Hypothesis 2, but the mechanism appears to differ from that observed for performance. All centrality measures show positive linear associations with work engagement and job satisfaction, revealing that employees who occupy more central positions in a communication network—whether in terms of number of contacts, volume of interaction, reachability or brokerage—tend to experience more positive motivational and affective states. This is consistent with the view that network embeddedness satisfies fundamental psychological needs, including the need for relatedness, perceived competence, and social recognition (Deci & Ryan, 2000). From a hedonic perspective, employees with a strong network of relationships within the organization receive greater emotional and professional support, which can enhance their job satisfaction. Regarding eudaimonic well-being, an extensive and robust network fosters collaboration and contributes to a sense of community in the workplace, improving employee

engagement. In accordance with social exchange theory (Blau, 1964; Emerson, 1976), individuals engage in interactions with one another or help without immediately seeking reciprocation. Instead, they anticipate a future *do ut des*, characterized by deferred reciprocity and trust. This anticipation of mutual support fosters increased motivation and engagement in the workplace (McGrath et al., 2017). However, the negative quadratic effects are significant only for weighted degrees. As communication volume grows beyond a manageable threshold, the affective experience of connectivity shifts from supportive to burdensome, consistent with the technostress literature documenting how high volumes of digital communication generate overload, anxiety, and emotional exhaustion that progressively erode engagement and satisfaction (Marsh et al., 2024; Tarafdar et al., 2019). This constant pressure may lead employees to feel unable to meet expectations and to doubt their own competencies and value within the organization, negatively affecting their sense of professional self-efficacy and, consequently, their satisfaction and engagement (Derks & Bakker, 2010). Communication volume, rather than breadth of relational contacts, drives the overload effect on well-being, while for performance, it is the number of distinct contacts that generates both gains and cognitive overload, pointing to theoretically distinct mechanisms through which network centrality affects individual outcomes. Qualitative accounts of organizational networks have long noted that central employees who handle large volumes of communication struggle to cope with expanding demands (Cross & Prusak, 2002), yet the precise boundary between relational breadth and communication volume as sources of overload has remained underexplored. Our findings suggest that these two dimensions operate through different pathways depending on the outcome considered, and we call for future research to investigate these mechanisms more systematically.

Third, one additional finding merits discussion, though its interpretation requires caution. Closeness centrality shows a positive linear association with both work engagement and job satisfaction, suggesting that employees who can reach others more efficiently in the network tend to experience more positive affective states, consistent with the view that greater reachability implies faster access to resources and a stronger sense of organizational embeddedness. Surprisingly, the quadratic term for closeness on work engagement is positive, suggesting increasing returns at high levels of reachability. One plausible interpretation is that highly reachable employees are exposed to more supportive interactions, experiencing a compounding sense of relevance and recognition that amplifies engagement. An alternative reading, however, is that causality may run in the opposite direction: employees who are already highly engaged may invest more actively in building relationships, becoming more structurally reachable over time. Without longitudinal

data enabling temporal ordering of network position and well-being outcomes, these interpretations cannot be disentangled, and we leave their elaboration to future research.¹

Fourth, to our knowledge, this is the first study simultaneously exploring performance and employee well-being (both considering eudaimonic and hedonic perspectives) in relation to email communication patterns, offering a comprehensive vision of the integration of these two perspectives and overcoming the limitations of dominant HRM approaches, which have primarily focused on employee performance (Guest, 2017).

Fifth, our work contributes to the HRM and organizational networks literature by integrating subjective perceptions of behavior with objective behavioral data obtained from email communications, offering a more comprehensive understanding of the relation between communication network position on the one hand and performance or well-being outcomes on the other. Traditionally, quantitative social scientists have relied primarily on self-administered questionnaires to study the impact of network centrality on different individual and organizational aspects, since they are a valuable tool for researchers (Steffensen et al., 2022). However, these tools have intrinsic limitations making it difficult to assess behaviors and can lead to confusion between behaviors and perceptions or evaluations (Antonakis, 2017). The approach used in this study goes beyond subjective perceptions to evaluate the real employees' digital behaviors. This shift enhances our understanding of social connections, enriching the existing theory and opening new opportunities for research in the field.

Lastly, our findings highlight that, beyond email communication patterns, several individual and organizational characteristics (e.g., role, seniority, age, gender) account for additional variance in the outcomes. In particular, hierarchical role is strongly related to motivational and affective states, suggesting that autonomy and influence primarily shape how employees experience their work rather than how their performance is evaluated. Furthermore, gender emerges as a significant predictor of performance, indicating the presence of gender-related dynamics in performance evaluations or role expectations. Results for age and seniority appear less consistent and do not follow a clear or

theoretically interpretable pattern. Given the absence of a strong a priori expectation and the potential influence of contextual factors, we refrain from over-interpreting these findings and leave their investigation to future research.

Managerial Implications

The analysis of employees' positions within organizational email communication networks through social network analysis provides organizations with a data-driven understanding of how employees interact and exchange information. This helps HR professionals and managers to adopt targeted plans and strategies. If leaders understand how each employee communicates, they can help them improve their work and overall well-being.

Our findings indicate that expanding the number of distinct contacts benefits performance only up to a threshold, beyond which cognitive and coordination costs begin to outweigh the informational advantages. This suggests that organizations should resist the assumption that more connectivity is always better, focusing instead on the quality and strategic relevance of connections. At the same time, high volumes of email communication are associated with declining work engagement and job satisfaction, even when the number of distinct contacts remains manageable. Employees who occupy highly central positions in the email network can be supported by sharing communication duties across teams, setting up shared channels for common information, and using tools like regular summary updates. Conversely, employees with lower levels of network centrality may benefit from structured opportunities to build connections, such as cross-functional projects, mentoring programs, or guided collaboration, increasing their access to information and sense of organizational inclusion.

Moreover, network information can be used not only to spot potential communication bottlenecks and identify key connectors, but also to map how information, decisions, and support actually move around inside the organization. These hidden interaction patterns may help managers to understand whether communication flows are focused on a few people, whether certain groups are cut off from the main network, or whether some employees act as important connections across teams even though they do not have formal leadership roles. Importantly, identifying these informal connectors allows HR professionals and managers to make their contribution visible and actionable. First, it enables formal recognition of employees whose relational and coordination work is not captured by job titles or formal responsibilities, for example, by incorporating their connective role into performance evaluations or development discussions. Second, because these individuals often bear a disproportionate share of communication demands, network insights allow organizations to monitor and manage their workload,

¹ Two additional results are reported here for completeness, though we deliberately refrain from drawing post-hoc conclusions. For closeness centrality on work performance, the combination of a non-significant linear term and a significant negative quadratic term does not lend itself to a theoretically coherent reading, as the absence of a linear component prevents the identification of a meaningful pattern. For betweenness centrality on work performance, the significant negative quadratic term may be a statistical artifact, driven by a small number of employees with unusually high betweenness values and not necessarily reflecting a genuine curvilinear relationship. We encourage future research to investigate both results more rigorously.

thereby reducing the risk of relational overload and burnout. Third, informal connectors can be strategically involved in change initiatives, cross-unit coordination, or knowledge-sharing processes, leveraging their trusted position in the network to facilitate communication and adoption. In this way, organizations can develop a more balanced and transparent communication ecosystem, where information flows efficiently, workload is managed fairly, and employees' relational value is properly recognized.

In the era of hybrid work, our findings highlight the critical importance of balancing digital communication to improve employee well-being and performance. For this reason, organizations could offer specific training on how an optimal use of digital communication tools can help employees avoid information overload and make the best use of available technologies for effective and efficient work.

Limitations and Future Research

This study has limitations that suggest important directions for future research.

Firstly, the research was conducted on a partial sample of employees working within an Italian bank. The data obtained reflect the specificities of a particular organizational context and cannot be generalized (i.e., may change from company to company). Therefore, we suggest replicating the study in different empirical contexts and countries, using the entire corporate population to evaluate the communication patterns. Furthermore, the study only examined email communications within the organization. Future research should analyze an organization's interactions with external entities.

Additionally, our analysis was limited to email exchanges without examining the body and subject of the messages (due to privacy restrictions). Future research could benefit from examining the content of communications to apply semantic or sentiment analysis. This approach would enable the assessment of not only the structure of communication networks but also the quality and nature of exchanges between employees. Semantic analysis can be used to identify the main themes in conversations, distinguishing between work-related discussions and exchanges of a more personal or informal nature. This can provide insights into the organizational environment and team dynamics, offering significant information on how communication content relates to employee well-being and productivity. Moreover, the application of sentiment analysis could, for instance, highlight how appreciation expressed in messages positively influences employee motivation and engagement or how emails with negative tones could be an early indicator of internal problems, such as dissatisfaction or disengagement.

Another limitation is the exclusive use of email to assess company communication, using this type of means as a

proxy to explore employees' position within organizational communication networks. While email is an important source of business information, we recognize it may not capture all interpersonal dynamics. Physical interactions, face-to-face communications, and other rich and synchronous forms of digital communication, such as instant messaging or video calls, have not been considered. At the same time, in our specific context, this potential bias is partially mitigated by the fact that, as reported by the organization, a considerable part of cross-unit and operational coordination routinely occurs via email, also due to the geographical dispersion of branches across the Italian territory, making email exchanges a comprehensive trace of day-to-day collaboration. Nevertheless, email alone cannot fully represent the broader communication ecosystem. Future research could examine these communication channels to refine the assessments made. It would also be useful to distinguish between synchronous and asynchronous communication tools, as they may have different effects on employee performance and well-being. For instance, synchronous communication may allow for immediate feedback and transmit paraverbal cues such as tone and pace, which might enhance understanding and emotional connection, while asynchronous tools may offer greater flexibility but could potentially limit relational depth.

Moreover, this study examines how different aspects of email communication, captured through network centrality measures, are associated with employee well-being and performance. However, due to data protection requirements imposed by the partner organization, this study does not aim to prove causality. Although significant associations were found, future research is needed to explore the causal effect of email communication on the studied constructs, potentially through a longitudinal analysis considering email timestamps. This approach could offer important insight into the development of communication dynamics and their effects on well-being and performance over time.

Lastly, although several individual and organizational characteristics showed statistically significant associations with the outcomes, examining these relationships was not the primary objective of the present study. These variables were included as control factors to isolate the contribution of centrality metrics in the email network. Future research could more explicitly examine the role of demographic and organizational characteristics, such as gender, age, seniority, and business unit affiliation, analyzing the mechanisms through which they relate to employees' motivational states and performance evaluations. In particular, longitudinal and mixed-method approaches may help clarify how individual and organizational characteristics are linked to employee outcomes and the extent to which network centrality may condition, mediate, or reshape these relationships over time.

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Data Availability The authors do not have permission to share data.

Declarations

Ethical Approval This study adhered to ethical guidelines and regulations as outlined by the Italian General Data Protection Regulation, while also following the ethical principles outlined in the Declaration of Helsinki. All participants were fully informed about the nature and purpose of the study and provided written informed consent to participate. The authors declare that data were treated with strict confidentiality. Data handling was carried out using a pseudo-anonymization technique based on a double alphanumeric coding system, which prevented direct identification of individuals while maintaining data integrity for analysis.

Conflict of Interest The authors declare no competing interests.

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