Semiotic Analysis of E-Document as a Composite Digital Sign: The Case of E-Boarding Pass

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Abstract. This study draws on organizational semiotics models to analyze e-document as a composite digital sign. E-documents are increasingly becoming important in contemporary digital world. Yet research specifically focusing on analyzing it as an important information systems component remains limited. Moreover, in organizational semiotics research, semantic relationships between signs, objects and intepretants have traditionally been viewed from a single triangle perspective. This study therefore seeks to analyze e-document as a composite digital sign from multiple triangle perspective, using e-boarding pass as an illustrative case.

Keywords: organizational semiotics, e-document, composite sign, digital sign, e-boarding pass

1 Introduction

The term document generally refers to an identified collection of recorded information [11]. Document is physical when it is on paper or electronic when it is in digital format. An e-document is considered as a composite object because it can contain multiple elements in varied forms, including text, image and diagram. Moreover, each of the individual elements can be considered as an object in its own right.

Following the emergence of the printing press and subsequent diffusion of computers and printers, documents have increasingly become significant parts of organizations and society. Moreover, administrative and governance systems in modern organizations have resulted in increased volume of documents in daily routines [10]. As Latham [2] points out, documents are found in almost every area of human lives.

Documents have traditionally been paper-based. However, the advent of information and communication technologies has created the opportunity for e-documents [4] as digital objects. Compared to paper documents, e-documents are not only cheaper but also more flexible, remotely accessible and easily transferrable. As a result, organizations and society in general are increasingly migrating from paper to e-documents. Yet information systems research specifically focusing on e-document as object of analysis in its own right remains scanty. This study therefore draws on organizational semiotics to highlight e-document as an important information system component for analysis.

The rest of this paper is structured as follows. Section 2 reviews related works on e-documents. Section 3 discusses the semiotic triangle and the semiotic framework as theoretical models for the study. Section 4 uses the two models for the e-document analyses. Section 5 uses e-boarding pass to illustrate e-document as a composite digital sign. Section 6 concludes the paper and offers direction for future research.

2 Related Works

2.1 E-Documents

While physical documents are paper-based, the advent of computers and related networks such as the Internet has afforded the creation and use of e-documents [5, 9] as a collection of binary digits [1]. Paper documents are static and have limited media content. However, e-documents are dynamic and multi-media. Their varied contents and formats can include text, audio, video and animation [5, 11]. With these attributes, e-document can be considered as a composite digital object [11].

2.2 E-Documents Analysis

Information system studies [e.g. 4, 6, 9] on e-documents have largely focused on standards for interoperability. E-document standards were traditionally proprietary and thus restricted interoperability. However, recent development of platform and application-independent standards promotes open exchange and interoperability [6]. The extensible mark-up language (XML) is an example of such open standards [9]. Unlike proprietary standards, XML promotes open document exchange and interoperability [4]. Thus various attempts on e-document analysis have focused more on standardization [6], which in semiotic terms relates to syntax. Less research therefore exists on other human and technical dimensions of semiotics. This study draws on organizational semiotics for e-document analysis beyond syntax.

3 Organizational Semiotics

Semiotics concerns the study of signs. Sign itself refers to anything that stands to someone for something else in a given context [12, 13]. Organizational semiotics is a branch of semiotics that studies development and use of information systems in organizations [3]. This study draws on its semiotic triangle and framework [13] for the analysis of e-document as a composite digital sign.

3.1 E-Documents Analysis

From a triadic perspective, Peirce's version of semiotic triangle presents semantic relationship between a sign, its referenced object and interpretant [8]. The semiotic

triangle helps to explain how signs are interpreted by humans in a given context. Figure 1 shows a generic view of the semiotic triangle and its triadic relationship.
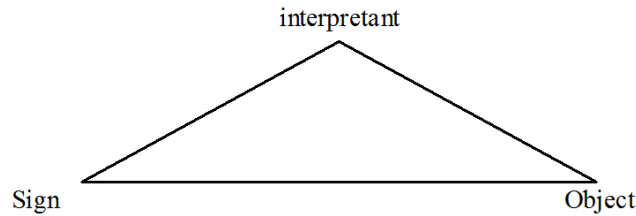

Fig. 1. Semiotic Triangle [13]

As Fig. 1 shows, a sign stands not for itself but for something else; the referenced object. Interpretant is the sense made of the sign in relation to the object; the interpreter is the person who makes sense of the sign [3, 8]. The position of this paper is that a single triangular relationship may be sufficient for simple signs with just one referenced object and interpretant. However, composite signs with multiple referenced objects and interpretants/interpreters such as e-documents require multiple triangular relationships.

3.2   The Semiotic Framework

The semiotic framework [3, 13] presents six levels of a sign: physical, empirical, syntactic, semantic, pragmatic and social effects, as shown in Fig. 2. The six levels are further divided into two categories: the technical platform and human information contexts. The technical platform comprises the first three levels, namely the physical, empirical and syntactic; the human information context comprises the remaining three: semantic, pragmatic and social effects.

Human Information Functions		**Social (what the consequences of using the sign)** Social consequences
	Pragmatic (how useful is the sign) uses and effects of signs	
	Semantic (what does the sign mean?) Sense making of signs in relation to referred object, interpretant and interpreter	
IT Platform	**Syntactical (what are the required standards for the sign?)** Required rules, grammar and standards for construction of signs	
Empirical (how does it get transmitted?) communication and transmission of signs		
Physical (how does it exist?) embodiment, format (physical and digital) and medium of signs		

Fig. 2. Generic semiotic framework, Adapted from [7]

The *physical* level comprises the material properties and structure of a sign including its storage, communication and access media. For documents, the physical

level refers to paper and its properties in the case of physical documents or binary digits and related properties in the case of e-documents. The *empirical* level concerns the technical attributes and quality measures of transmission and communication of signs. For physical documents, the empirical level deals with quality measures of postal and personal delivery systems; for an e-document, the empirical concerns quality attributes and measures of electronic communication media including e-mail and document exchange protocols. The *syntax* layer deals with the technical structure of a sign in terms of rules and standards for its composition.

For the human information functions, the *semantic* layer concerns the meaning of a sign. For a document, the semantic layer deals with its interpretation. The *pragmatic* layer refers to interpersonal communication and use of a sign in relation to intentions and behavior of senders and receivers as responsible agents. The pragmatic level can be used to analyze the intentions a sender attaches to a document and its content as well as the subsequent reaction of the receiver. Finally, the *social* level concerns the effects of norms that result from the use of signs, such as agreements, commitments and obligations. At this level, a document can serve as evidence of a contract or commitment to an action. This study employs the semiotic framework to analyze e-document as a composite digital sign.

4   Semiotic Analysis of E-Document

This study employs the semiotic triangle and the framework to analyze e-document as a composite digital sign. In this study, digital sign refers to any sign that is electronic and therefore based on binary digit format; composite sign is any sign that contains other signs.

4.1   Semiotic Triangle View of E-Document

The semiotic triangle is used to model e-document as a composite digital sign - a sign of signs. Fig. 3 illustrates the triangular relationships between an e-document as a sign and its multiple referenced objects and interpretants.
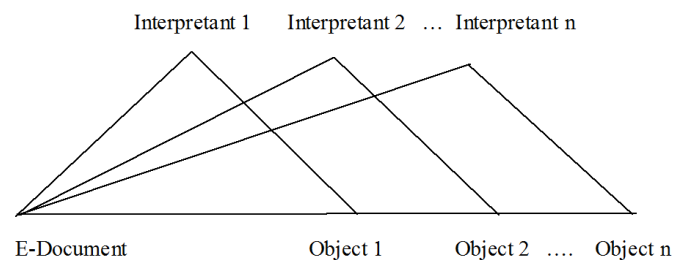

Fig. 3. Semiotic Triangle Composite signs

The figure shows that as a composite sign, an e-document can stand for multiple objects in relation to multiple interpretants. Moreover, while the e-document itself can be a sign, each of its components can also be a sign on its own. Traditionally,

semantic analysis in organizational semiotics research has focused on signs with single objects and interpretants. However, the composite nature of e-document calls for a more complex triangular relationships.

4.2 Semiotic Framework View of E-Document

The semiotic framework provides a useful model for representing e-document as digital sign. Fig. 4 shows the semiotic framework view of e-document in terms of its technical platform and human/social context. The *physical layer* concerns binary digits as the base constituents of an e-document. It also includes the multi-media forms of e-documents including, text, image, audio, video and more. Other components of the physical layer include computer and network devices that provide the medium for the existence of e-document as a sign. Examples of such devices include desktop, mobile devices (mobile phones, PDAs, tablets and laptops), servers and telecommunication devices (modems, hubs and bridges) that support the display and communication of digital signs.

The *empirical layer* concerns quality attributes of e-document communication via computer displays and telecommunication devices. Examples of such empirical attributes include readability, clarity, brightness, size and software/hardware protocols that affect such qualities during display and communication of e-documents. The *syntactic layer* deals with rules, standards and conventions that govern the structural composition of e-document as a digital sign. For e-documents, such syntactical issues concern the natural language of composing the document, related application/platform standards as well as international, national and industry standards. An example of such standards is XML. Specific industries such as air transportation and international trade also have specified standards for specific documents just as some countries have also defined technical standards for specific documents.

Human information functions	**Social:** contracts, agreements, commitments, promises, approval		
		Pragmatic: intended action of the sender and effects on the recipient	
			Semantic: interpretation of document and its constituents
Technical platform		**Syntactical:** language syntax, application format (doc, .pdf, html), technical standard, industry standard and international standard	
	Empirical: file size, display, transmission (e-mail, ftp, htpp, EDI), channel capacity, digital		
Physical: binary digits, text, images, audio, video, signals/symbols, hypertext, computer devices and network devices			

Fig. 4. Semiotic Framework View of E-Document as a Digital Sign

The *semantic layer* deals with the meaning of an e-document in relation to a particular interpreter. Since a digital document can be multi-media, there could be multiple semantics of it at the same time given different interpretants/interpreters. The *pragmatic layer* deals with intention behind the communication of an e-document by

a sender and intended effects on a receiver. It concerns the assessment of the effectiveness or otherwise of the intended purpose on the receiver of the e-document. As in the case of the semantic layer, an e-document communication from a sender to receivers can generate multiple pragmatic effects.

Finally, *social effects* refer to norms that result from using an e-document in a given context. Again, like the semantic and pragmatic layers, the social effects layer can also be multiple for a given e-document. As Fig. 5 shows, an e-document with a single technical platform can have multiple social contexts involving multiple human actors with varied forms of semantics, pragmatics and social effects.

Social Context 1	Social Context 2	…	Social Context n
Technical Context			

Fig. 5. Socio-technical semiotic framework for e-document as a composite digital sign

5   Semiotic Analysis of E-Boarding Pass

Following the semiotic analysis at the generic level, this section provides an illustration of e-boarding pass as an exemplary composite digital sign. The issuing of e-boarding pass is increasingly becoming the norm in air transportation. Fig. 6 shows an excerpt of a sample e-boarding pass used for the illustration.

Fig. 6. An excerpt of e-boarding pass

5.1 Semiotic Triangle View of E-Boarding Pass

From semiotic perspective, e-boarding pass can stand for different objects to different people. Fig. 7 shows e-boarding pass as a composite sign with multiple interpreters and referenced objects. Examples of relevant interpreters are passengers, ground airline staff and flight attendants. As shown in Figure 7, each interpreter can interpret the e-boarding pass or any of its constituents differently. For the passenger, the boarding pass can point to the particular flight and boarding gate. For the ground airline staff, it can point to passenger identity check and boarding permit. For the flight attendant, the boarding pass can stand for the class type and seat number.
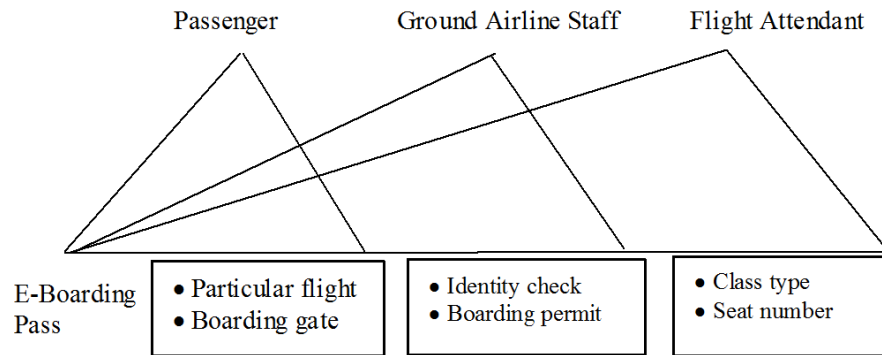

Fig. 7. Semiotic triangle view of e-boarding pass as a composite digital sign

5.2 Semiotic Framework View of E-Boarding Pass

From the technical platform of the semiotic framework, e-boarding pass exhibits various attributes at the physical, empirical and syntactic levels as shown in Fig. 8. The *physical* attributes of e-boarding pass refers to its composition as well as storage, access and communication media. The composition include text, images and barcodes. Storage and access media include disks, servers, mobile devices, desktop, internet networks, and barcode readers; the communication media include electronic display and transmission media. The *empirical* attributes concern display and communication quality measures such as screen resolution, network accessibility, speed and sharpness of applications and devices used for the display and communication. The *syntax* attributes concern the rules, standards and protocols that govern the design of e-boarding pass. Such standards include grammar and conventions of the relevant natural language as well as technical and industry standards including IATA (International air transport Association) regulations.

		Social - social consequences	
Human information Functions		Pragmatic -uses and effects of signs between actors	
	Semantic - Sense making in relation to referred object, interpretant and interpreter		
Technical platform	Syntactical - language, industry, platform and application requirements		
	Empirical: screen resolution, accessibility, timeliness, quality		
Physical: e-boarding pass (text, images, barcodes), servers, mobile devices, desktop, internet devices, barcode readers etc.			

Fig. 8. Semiotic Framework View of e-boarding pass

While the technical level illustrate the physical composition of the e-boarding pass as a single unit, the human information context shows multiple forms of semantic, pragmatic and social effects attributes, given the involvement of multiple interpreters and referenced objects. The *semantic layer* deals with how each of the different interpreters makes sense of the e-boarding pass. For example the passenger, the ground airline staff and the flight attendants may each interpret the boarding pass differently.

The *pragmatic layer* concerns communication of the e-boarding pass from one actor to another. Within the boarding process, there can be multiple communication of the e-boarding pass, such as from the airline's server to the customer's mobile phone, the customer showing the e-boarding pass to ground staff and the customer showing it to a flight attendant. In each of these interactions, there could be counter communication from the receiver to the sender, thus reversing the communication direction. Hence, there could be several scenarios of pragmatic enactments. Similarly, there could be multiple scenarios of *social effects* depending on the variety user groups involved, including permission to travel, right to travel, right to sit on a particular seat etc.

6　　Conclusion

This paper focused on organizational semiotic analysis of e-document as a composite digital sign. It used an extended version of the semiotic triangle and alternative conceptualization of the semiotic framework to analyse e-document as a composite digital sign and illustrated the analysis with an e-boarding pass case. The study contributes to organizational semiotic research in two ways. First, it extends the single triangle view of sign-object-interpretant relationship to a multiple triangle view for composite signs. The extended model can be used for analysis and modelling of information system components that share characteristics of component signs.

Second, the study offers alternative conceptualization of the semiotic framework to account for semiotic analysis of composite digital signs with single technical platform but multiple human contexts. Again, this reconceptualization can be used for organizational semiotics research on individual information technology components with varied human information contexts, given multiple stakeholders' interpretations, intentions and social effects. For practical contribution, the conceptualization of composite digital signs can be used by information systems analysts and designers to account for attributes of entities with different interpretations by varied user groups. Future research can focus on pragmatic analysis of e-document communication in networked organizational environments.

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