



Construing Structure in Engineering Text in the Framework of SFL

Mulyati Khorina¹, Saudin², Danny G. Nugraha³

English Department, Politeknik Negeri Bandung

mulyati.khorina@polban.ac.id, saudin@polban.ac.id, danny.nugraha@polban.ac.id

Abstract

This paper deals with how a structure is construed in engineering texts. Hence, the purpose of this study is to investigate the realization of structure viewed from Systemic Functional Linguistics (SFL). The method used in this study was a qualitative one. The data were obtained from two engineering textbooks functioning as references. Analyzing the data by applying SFL reveals that the structure is construed by relational process clauses, especially circumstantial relational clauses. The relational process belongs to attributive ones realized by various lexical verbs: support, assemble, attach, fasten, and bolt. Whereas, the circumstantial elements which represent Attribute semantically serves as Means and Place.

Keywords: *Systemic Functional Linguistics (SFL), engineering texts, circumstantial clauses, structure, circumstantial element*

Introduction

In recent years, Systemic Functional Linguistics (SFL) proposed by Halliday has been a powerful approach to investigating language in use. SFL was used to analyze healthcare communication in the form of medical consultations (Matthiessen, 2013), scientific discourse (Hao, 2020), and scientific and political (Kazemian & Hashemi, 2014; Suherman, 2018), for example. Specifically, this approach may be used to find out how people use language to interact through Mood and Modality system (Martin, 2018; Koussouhon & Dossoumou, 2015; (Hermawan & Rahyono, 2019), and how experiences or ideas are construed through the Transitivity system (Alaei & Ahangari, 2016)(Hermawan & Rahyono, 2019)(Hutabarat et al., 2020).

The transitivity system representing ideas or experiences works on six types of processes which are labeled material, relational, mental, verbal, behavioral, and existential (Halliday & Matthiessen, 2013). The relational process as a primary process in the system occurs frequently in disciplinary texts which is one of the characteristics of such kinds of texts. The relational process is sub-divided into attributive and identifying and may appear in three types of relational process clauses called intensive, possessive, and circumstantial which possess several particular roles as listed by (Wignell et al., 1993). The roles are definition, classification, composition, properties, and function. Whereas (Khorina et al., 2017) found another role, that is, structure in electrical and energy engineering texts. This study focusing on mechanical engineering texts has a purpose to find out how structure is construed in this field. In Cambridge online dictionary, the meaning of structure is the way in which the parts of a system or object are arranged or organized, or a system arranged in this way. The structure will be represented in the mechanical engineering texts since this field deals a lot with objects, such as tools or machine tools.

Understanding how structure is realized grammatically in lexicogrammar may have some benefits either theoretically or praxis. Disciplinary language has become a problem for those who study the discipline (Wellington & Osborne, 2001) especially, the lexicogrammar (Halliday, 1993). Therefore, modelling the lexicogrammar of the disciplinary texts is essential to help understand the texts. Besides, disciplinary texts have something to do with teaching English for Specific Purposes (ESP) which is defined as the teaching and learning of English as a second or foreign language where the goal of the learners is to use English in a particular domain (Paltridge & Starfield, 2012). Accordingly, one of ESP major characteristics is centered on the language (grammar, lexis, register), skills, discourse and genres appropriate to these activities Dudley-Evans and St John (1998) in (Basturkmen, 2010). It means, studying a disciplinary text is essential to enable to model the lexicogrammar used in the text. Thus, this study aimed to find out the verbs used to realize the relational process in circumstantial and to analyze how structure is realized by circumstantial clause.

Several studies related to engineering texts have been found in some papers. Some studies were concerned with the lexical bundles found in ESP textbooks and electrical introductory textbooks Chen (2010), lexical frequency which occurs in engineering texts (Mudraya, 2006), or language patterns of discipline-specific used (Nekrasova-Beker, 2019). Other studies focused on engineering research articles (Dong & Lu, 2020; Farzannia, 2017; Kanoksilapatham, 2015; Musa et al., 2015). Although Khorina (2018) investigate the circumstantial clauses, she had not stated yet about the role of the clauses in engineering texts. It could be implied that construing structure in engineering texts, especially in mechanical engineering texts has not been done yet.

Theoretical Framework

Engineering Texts

Engineering texts can be easily distinguished from other types of texts. They have special features. First, they are realized by scientific language which is free from bias as stated by Reeves (2005). Second, scientific language is realized by special lexicogrammar (Halliday, 1993). The lexicogrammar does not only become the characteristic of engineering texts but also an obstacle for learners to understand the texts. Third, Martin (1992) specified that texts with special registers, such as science are dominated by identifying relational process which occurs in relational process clauses. One type of relational process clause is called a circumstantial relational process clause because one of the participants in the clause is realized by a circumstantial element or the circumstantial element is manifested by the process.

Circumstantial clause

A circumstantial clause appears to be different from other two types of relational process clauses. This clause is called circumstantial clause since one of its participant either as Attribute or Value is realized by a circumstantial element or the circumstantial element is manifested by the relational process as exemplified by Eggins (2004).

1) *The bomb was in her luggage.*

<i>The bomb</i>	<i>was</i>	<i>in her luggage</i>
Carrier	Process: attributive	Attribute

2) *The operation lasted one hour.*

<i>The operation</i>	<i>lasted</i>	<i>one hour</i>
Carrier	Process: attributive	Attribute

Both of the clauses above belong to circumstantial clauses operate on attributive mode. However, in clause 1), the circumstantial element is realized by Attribute. Whereas, in clause 2), it is manifested by the relational process instead on Attribute. Furthermore, the circumstantial element in 1) is realized by adverbial of place which serves as circumstantial element of place. But, in 2), the Attribute is realized by nominal group instead of adverbial element. The discussion of circumstantial elements is presented below.

Circumstantial Elements

Circumstantial elements may be viewed from two points: structure and semantics. Structurally, circumstantial elements are realized by either adverbial group or prepositional phrases (Halliday and Matthiessen, 2014: 222). Whereas semantically, they have nine basic meanings as listed in Table 1. Halliday & Matthiessen (2013) classified it into nine types: Extent, Location, Manner, Cause, Contingency, Accompaniment, Role, Matter, and Angle.

**Table 1. Types of Circumstantial elements
(simplified from Halliday & Matthiessen (2013, p 313))**

TYPE	Sub-type	Question answered	Examples
Extent	distance	How far?	He ran <u>three miles</u>
	duration	How long?	He ran <u>for three days</u>
	frequency	How frequently	He ran <u>every day</u>
Location	Place	Where?	He ran <u>in Toronto</u>
	Time	When?	He ran <u>last year</u>
Manner	Means	By what means?	He saved her <u>with a rope</u>
	Quality	How?	She saved him <u>quickly</u>
	Comparison	Like what?	She ran <u>like the wind</u>
	Degree	How much?	She loved him <u>more than anyone</u>
	Reason	Why?	She ran <u>because she loved to</u>
	Purpose	For what purpose?	She ran <u>to raise money</u>

Cause	Behalf	On whose behalf?	She ran <u>for her sister</u>
Contingency	Condition	Under what condition?	<u>In the event of fire</u> leave the building
	Default	Under what negative condition	<u>Without an agreement</u> , the plan will fall
	Concession	With what concession?	<u>Despite her help</u> , the plan failed
Accompaniment	Comitative	Who/what with?	John ran <u>with Jane</u>
	Additive	Who/what else?	John wears mitten <u>in addition to his gloves</u>
Role	Guise	What as?	She spoke <u>as his mentor</u>
	Product	What into?	He was transformed <u>into a prince</u>
Matter	Matter	What about?	He warned me <u>about the film</u>
Angle	Source	According to whom?	<u>According to the lecturer</u> , the class is cancelled
	Viewpoint	From whose viewpoint/perspective?	To me, he's an idiot

Method

The method used in this study was a qualitative one with descriptive analysis. The data used in this study were taken from Khorina (2018) who collected them from two mechanical engineering textbooks: "Mechanical Engineering Fundamentals" and "Shygle's Mechanical Engineering Design". In analyzing the data, the SFL framework offered by (Halliday & Matthiessen, 2013) was applied to analyze the relational process clauses, especially circumstantial one while in discussing the role of the clauses to reveal the structure, the approach used refers to (Khorina et al., 2017). The instance of the analysis can be seen as follows:

The shaft is supported by ball bearings on each side of the belt (Khorina, 2018)

Carrier	Attributive	Attribute
The shaft	is supported	by ball bearings on each side of the belt
Nominal group	Verbal group	Nominal group

Results and Discussion

Results

As shown by Table 2. that the lexical verbs which realize the relational process in circumstantial relational process clauses are attach, assemble, bolt, and fasten. The lexical verbs define the meaning of the element of circumstance. When the relational process is realized by either lexical verb *attach*, *bolt*, or *fasten*, the meaning of the element of circumstance is Place. On the other hand, there are two lexical verbs *assemble* and *support* which may require the lexical element of Means or Place.

Table 2
The lexical verbs and the element of circumstance type

Lexical verb	Elements of circumstance	
	Means	Place
attach		√
assemble	√	√
bolt		√
fasten		√
support	√	√

Discussion

Structure is defined by Cambridge online dictionary as the way in which the parts of a system or object are arranged or organized, or a system arranged in this way. The arrangement may be realized by circumstantial clause which is a type of relational clauses as shown by the data below.

- (1) *The shaft is supported by ball bearings on each side of the belt.*
- (2) *A two-tier system to repair bridge infrastructure is supported by two steel cables for each platform.*
- (3) *The shells are assembled by clamping, bolting, or pasting.*

All the clauses above are classified as circumstantial clauses having certain characteristics. First, the clause works on attributive relational process realized by verbal groups *is supported*, *is supported*, and *are assembled*. The participants acting as Carrier are realized by nominal groups *The shaft*, *A two-tier system to repair bridge infrastructure*, and *The shells*. However, the participants representing Attribute are realized by prepositional phrases *by ball bearings on each side of the belt*, *by two steel cables for each platform*, and *by clamping, bolting, or pasting* as the circumstantial elements whose meanings refer to Means. To probe the meaning, the question *By what means?* is applied. Thus, *By what means is the shaft is supported?* *By what means is a two-tier system to repair bridge infrastructure supported?*; *By what means are the shells assembled?*. The answer is encoded by the Attribute realized by the prepositional phrases as illustrated in Table 4.

Table 4
The analysis of circumstantial clauses representing structure expressing Means

Carrier	Process: attributive	Attribute (Means)
The shaft	is supported	by ball bearings on each side of the belt.
A two-tier system to repair bridge infrastructure	is supported	by two steel cables for each platform.
The shells	are assembled	by clamping, bolting, or pasting.
Nominal group	Verbal group	Prepositional phrase

The following data also show that the circumstantial relational process clauses represent structure. The clauses have attributive processes realized by verbal groups *is supported* (4), *is attached* (5)-(6), *is fastened* (8), *are bolted* (9). These nominal groups relate the participant acting as Carrier to another one representing Attribute which are realized by prepositional phrases. Although the Attribute is realized by prepositional phrases which serve as circumstantial elements as the characteristic of circumstantial clauses. In these data, the circumstantial elements have semantic functions as Place which can be probed with the question *Where?*. *Where is the workpiece supported?*; *Where is a spool attached?*; *Where is the output gear directly attached?*; *Where is the spur attached?*; *Where is the eyebolt fastened?*; *Where are three tension rods bolted?*. The answers of these questions structurally are encoded by prepositional phrases whose meanings are Place as seen in Table 5.

- (4) *The workpiece is supported on a table.*
- (5) *A spool is attached to the rear axle.*
- (6) *The output gear is directly attached to the front drive axle.*
- (7) *The spur gear is attached to the 1-inch-diameter shaft.*
- (8) *The eyebolt is fastened to a thick base plate.*
- (9) *Three tension rods are bolted to a gusset plate.*

Table 5
The analysis of circumstantial clauses representing structure expressing Place

Carrier	Process: attributive	Attribute (Place)
The workpiece	is supported	on a table
A spool	is attached	to the rear axle
The output gear	is directly attached	to the front drive axle
The spur gear	is attached	to the 1-inc-diameter shaft
The eyebolt	is fastened	to a thick base plate
Three tension rods	are bolted	to a gusset plate
Nominal group	Verbal group	Prepositional phrase

Conclusion

Structure which is the arrangement of parts of an object is represented by language. The structure is realized by circumstantial clauses as found by Khorina et al., (2017) in electronic and energy engineering. In this study, the findings reveal that the circumstantial clauses operate solely on attributive relational process which are realized by several lexical verbs. The lexical verbs are support, assemble, attach, fasten, and bolt. In addition, the circumstantial elements which represent Attribute semantically serves as Means and Place.

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