



**Title**

**Civil engineering research article Introductions:  
Textual structure and linguistic characterization**

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**Abstract**

This study reports on the examination of the Introductions of research articles in civil engineering in English. Specifically, this study has the objectives of 1) identifying the structural organization of the Introductions in terms of moves and steps, and 2) capturing linguistic features that are commonly used in each move and step. A dataset of civil engineering research articles was compiled to represent the high quality journals in the field. Subsequently, the dataset was analyzed by using Swales' genre analysis model (2004) to segment the Introduction texts into sub-units called 'moves' and 'steps,' respectively, according to their communicative functions. Finally, text segments representing each move and step were scrutinized to capture a typical set of linguistic features used to perform a given communicative function. While the two-tiered analysis reveals unique features of the language of civil engineering Introduction discourse, this study elucidates the proclivities of the civil

engineering discourse community in constructing its research articles. Pedagogically, the description of both the structure and the linguistic levels contributes to a better understanding of how research article Introductions are constructed in Civil engineering.

**Keywords:** structural organization; linguistic features; Introductions; genre analysis; civil engineering

## 1. Introduction

Due to Anglophone supremacy, English has become one of the most dominant international languages in both professional and academic settings. Academically, English is increasingly used in advanced education. Among all academic genres, research articles constitute a key genre used by scientific communities as a medium for the dissemination and ratification of knowledge (Kanoksilapatham, 2005: 270).

Writing a research article is a daunting task to both non-native speakers and native speakers of English (Canagarajah, 1996; Flowerdew, 2001). It requires, for instance, substantial skills in reading research articles published previously in order to know the state of the art of the field, individual scientists' expertise and contribution to the field, and finally writing skills to ensure that scientists can efficiently and successfully express themselves academically. For writing effectively, scientists need to make use of top-down and bottom-up approaches. Based on Cook (1990) and McCarthy (1991), the bottom-up knowledge of the research article genre refers to the scientists' knowledge gained from the smallest chunks of research article discourse (e.g., flexical and grammatical features) moving to more and more general features (e.g., sentences, discourse units, and structural organizations of the discourse units). In contrast, the top-down knowledge of the research article genre starts with general features of a text (e.g., from structural organizations of the discourse units) gradually moving to more specific ones (e.g., lexical and grammatical features).

A multitude of genre-based studies have focused on the rhetorical organizations of different sections of research articles, in particular the four sections of Introduction, Methods, Results, and Discussion (e.g., Brett, 1994; Nwogu, 1997; Kanoksilapatham, 2003; Martin, 2003; Posteguillo, 1999; Varttala, 2002). These studies reveal that, among the four typical sections of research articles, the Introduction section seems to display a relatively rigid and uniformed rhetorical

organization. Nevertheless, other studies have found that rhetorical variations of this particular section are discernible across academic disciplines (e.g., biochemistry and microbiology (Kanoksilapatham, 2007b); applied linguistics (Ozturk, 2007); wildlife behavior and conservation biology (Samraj, 2002). To illustrate, Kanoksilapatham (2007b) compared the rhetorical organizations typically followed in the corpora of 60 biochemistry and 60 microbiology research articles and found that the occurrence of ‘Move 3, Step 5: Announcing principal outcome’ in biochemistry is twice as frequent as that in microbiology (53 vs 26 instances). The study illustrates that each academic discourse community seems to have its own proclivities with regard to style and rhetorical structure for effective and efficient knowledge dissemination among its members.

However, to ultimately become professional genre writers within a discourse community, merely knowing and following the conventions of the genre might not be adequate for researchers. As challenged by Nunn and Adamson (2007) and as remarked by Carter (1995), being trained to follow such conventions can have unpleasant impacts, creating “unreflective writers who will be able to do no more than sustain the genres” (p. 55). As advocated by Harwood and Hadley (2004: 357-358), and subsequently substantiated by Flowerdew (2007), gate keepers of their respective discourse communities (be they journal editors or university tutors) and their roles in maintaining norms of academic writing practice should be challenged. Specifically, novice researchers of a discipline, having been exposed to those conventions, should “question the desirability of reinforcing these predominant norms” (Flowerdew, 2007: 22). This statement corroborates the notion of “conversations”, a term introduced by Bazerman (1980: 657) to refer to the practice when people engaged in actions whose meanings can be negotiated. Since academic researchers are not isolated persons, they are encouraged to get involved in “conversation”.

Whereas a number of scholars cited above emphasized that scholars should not only follow and readily accept the conventions laid down by the community, such a practice is rather intimidating for both novice researchers and for non-native speakers of English. To facilitate the long and arduous process of getting accepted as discourse community members, especially at its initial stage, by preparing them for the academic demands, this study focuses on the analysis of a civil engineering dataset to investigate how research articles are constructed. Civil engineering is known to be an academic discipline dating back to the year 1711, when John Smeaton,

the founder of a Society of Engineers and the builder of the famous Eddystone Lighthouse in Great Britain, claimed to be the first civil engineer (<http://whatiscivilengineering.csce.ca/civill.htm>). With a long history of over 300 years, any academic institution in the world that offers a degree in engineering tends to offer a degree in civil engineering. An insight from the analysis of civil engineering articles will thus be beneficial to a large number of scholars, practitioners, and fellow students in the field.

This study aims to provide a thorough description of the Introductions of civil engineering research articles. A corpus of 60 Introductions taken from top quality civil engineering journals was compiled and subsequently analyzed by Swales' (2004) theoretical framework of genre analysis. The objectives of the present study are twofold: 1) to identify the textual move structure in the Introductions of civil engineering journal articles, and 2) to provide the linguistic characterization of each individual move and step identified. This study elucidates how the Introductions of civil engineering journal articles are constructed, allowing scientists and practitioners in the field to effectively share and update their scientific knowledge, contributing to the growth of the discourse community at large.

## **2. Swales' analytical framework and linguistic features**

Genre analysis was developed by Swales in 1981 to describe the rhetorical organizational patterns of the research article genre. According to Swales (1990), the basic notion of genre analysis is that discourse communities are powerful in shaping the conventions of the genre. For instance, research articles, one of the most important academic genres, represent a good example of such discourse communities where novice writers are indoctrinated into the paper-writing genre in their advanced studies.

The objective of this discursal approach of genre analysis is to describe the communicative purposes of a text by categorizing the various discourse units within the text according to their communicative functions, a.k.a. moves (Swales, 1990, 2004). A 'move' refers to a text segment that performs a specific communicative function (Connor, Upton, & Kanoksilapatham, 2007: 17). In genre analysis, texts typically consist of a series of moves, with moves being functional units contributing to the overall communicative purpose of the genre. Since a move is semantically determined, the size of the move is not syntactically bound. That is, it can vary

ranging from a phrase, a sentence, a paragraph, to multiple paragraphs. But at least, a move contains a proposition. Not all moves occur equally frequently. Some moves occur more frequently than others, and they can be described as obligatory and optional, respectively. A rhetorical move can, in turn, consist of a number of elements that together, or in some combination, contribute to the same function of the move to which they belong. These elements are referred to as ‘steps’ by Swales (1990) or ‘strategy’ by Bhatia (1993).

Swales (1981) analyzed research article Introductions written in English from a wide range of disciplines including, physics, medicine, and social sciences; he observed that although taken from different academic disciplines, these Introductions displayed a common series of moves. In 1990, Swales proposed a three-move schema for article Introductions, the so-called Create a Research Space or CARS model. In a nutshell, the model depicts the preferred sequences of move types and steps which are found in research article Introductions from a wide range of disciplines. Swales’ CARS model for research article Introductions has been widely studied and validated by subsequent studies in other academic disciplines, e.g., medicine (Nwogu, 1997); computer sciences (Posteguillo, 1999) and professional genres (e.g., promotional letter genre (Bhatia, 1993). Focusing specifically on research article Introductions, Swales, incorporating the findings generated from these genre-based studies conducted during the last two decades, modified his 1990 model to accurately reflect the variations of Introductions in diverse research fields (Swales, 2004), as shown in Figure 1:

Figure 1. Swales’ revised model for research article Introductions (2004: 230, 232)

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**Move 1: Establishing a territory (citations required)\*\*\* via**

Topic generalizations of increasing specificity

**Move 2: Establishing a niche (citations possible)\*\*\* via**

Step 1A: Indicating a gap or

Step 1B: Adding to what is known

Step 2: Presenting positive justification\*

**Move 3: Presenting the present work via**

Step 1: Announcing present research descriptively and/or purposively (obligatory)

Step 2: Presenting research questions or hypotheses\*

Step 3: Definitional clarifications\*

Step 4: Summarizing methods\*

Step 5: Announcing principal outcomes\*\*

Step 6: Stating the value of the present research\*\*

Step 7: Outlining the structure of the paper\*\*

\* Optional and less fixed in order

\*\* Probable in some academic disciplines

\*\*\* Possible cyclical patterning of moves particularly in longer Introductions

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As shown above, Swales' (2004) model for Introductions in general consists of three moves. They are: 'Move 1: Establishing a territory,' 'Move 2: Establishing a niche,' and 'Move 3: Presenting the present work.' Each move, in turn, consists of a number of steps. At this juncture, it should be noted that there are two additional characteristics of moves in this revised model. First, the status of a move is specified based on its frequency of occurrence, either obligatory or optional. Second, a cyclical fashion of moves within Introductions is determined. By extension and corresponding to Swales, the model proposed is not to prescribe, but to provide guidelines with regard to how ideas are marshalled when writing Introductions.

Rhetorical organizations of texts are helpful, providing the schema of what informational elements or moves are presented. A pertinent question that emerges is: What are the typical linguistic features used to express these moves? In this regard, Swales (1990: 131-132) features the initial attempt to summarize the findings of 40 published studies which described the use of linguistic features in the four major sections of research articles. He concluded that, for instance, Introductions and Discussions have the functions of providing the background of the current study and interpretation of the results, respectively. The common linguistic features associated with these functions of the two sections are *that* complements, use of the present tense, and author's comments.

Swales' (1990) observation of typical linguistic features expressing each communicative function was illuminating, representing an initial attempt to linguistically characterize the language of particular sections of research articles. Meanwhile, his observation implies that a set of linguistic features is used to express a communicative function. However, each of the linguistic features identified by Swales might be considered too crude or a general category. For instance, the feature

of ‘*that*’ complement clauses, according to Biber et al. (2007: 267-271), embraces a number of sub-categories including ‘*that*’ clauses controlled by a verb, ‘*that*’ clauses controlled by an adjective, and ‘*that*’ clauses controlled by a noun. In turn, each subcategory can be further differentiated. For instance, a verb can be further categorized as non-factive verbs (e.g., *imply*, *resort*, *suggest*), attitudinal verbs (e.g., *anticipate*, *expect*, *prefer*), factive verbs (e.g., *demonstrate*, *realize*, *show*), and likelihood verbs (e.g., *appear*, *hypothesize*, *predict*). Therefore, the availability of a finer set of lexical and grammatical features would be helpful not only to accurately describe Introduction texts but also to help learners and practitioners in different academic disciplines to choose the appropriate set of linguistic features in crafting their research articles.

Biber’s (1988) tagger of linguistic features provides a headstart in this direction. With the continued development of computational programs and taggers, a more elaborate and thorough list of linguistic features has been developed (e.g., Biber, 1988; Biber et al., 2002, 2007). For instance, thanks to the Biber et al. (2002) tagger, Kanoksilapatham (2003, 2007a) demonstrated that scientific texts in biochemistry can be analyzed, in addition to the top-down approach like Swales’ genre analysis, by the bottom-up approach like multi-dimensional analysis (for more information, refer to Biber, 1988). The frequency counts of 80 linguistic features were fed into multidimensional analysis, yielding a detailed and accurate linguistic characterization of the biochemistry texts. For example, focusing on biochemistry research articles, Kanoksilapatham (2007a) revealed that in the Introductions, the instances representing ‘Move 1: Establishing a territory,’ on Dimension 5: Attributed knowledge vs Current study, contain frequent occurrences of present tense verbs, references, and type-token ratio (ratio between the number of different lexical items in a text and the total number of words in that text). In contrast, the instances representing ‘Move 2: Establishing a niche,’ on Dimension 7: Contradictory proposition, contain high frequent occurrences of concessive markers (e.g., *however*, *nevertheless*, *despite*), pointers, *not* negation, and adverbs.

Studies on the same academic genre of research article Introductions across disciplines reveal that discrepancies in the textual structure of Introductions are discernible (e.g., Kanoksilapatham, 2007b; Ozturk, 2007; Samraj, 2002). This finding implies that even though Introductions of research articles seem, to a certain extent, to follow the model outlined, each discipline has its own preferred rhetorical pattern

which might be identical to, or vary from, the model. In this regard, given the prominent role of civil engineering in the field of engineering, it is interesting to examine the characteristics of research article Introductions in this academic discipline to obtain top-down knowledge. In contingency to this premise, a set of linguistic features identified will equip scholars and practitioners in civil engineering with bottom-up knowledge. Pedagogically, these bodies of knowledge will be useful in training scholars in a focused discipline to write successfully and internationally to disseminate their research discoveries.

This study attempts to qualitatively examine civil engineering research article Introductions written in English to bring into focus the most appropriate academic style of writing in this discipline and genre. The two objectives of the present study are: 1) to identify moves and sub-moves or steps, their occurrence frequency, and their typical sequence, and 2) to examine the linguistic characterization of these moves and steps in this specific discipline.

### **3. Methodology**

#### **3.1. Dataset compilation**

A dataset of research articles in civil engineering was compiled. To assure that the Introductions analysed in this study represent the high quality journals in the discipline, the impact factors of the journals published in English on experimental research in the year 2005 (the latest impact factors available at the time of the study) were examined. At this juncture, it should be noted that, recently, the use of impact factors, though pervasively used in sciences, has been challenged, particularly in the humanities. For more details on this, please refer to Rogers, Campbell, Louhiala-Salminen, and Rentz (2007: 413). The five journals with the highest impact factors in civil engineering were 1) *The Journal of Hydraulic Engineering (JHA)*, 2) *The Journal of Water Resources Planning and Management (JWR)*, 3) *Earthquake Spectra (ESA)*, 4) *The Journal of Hydrologic Engineering (JHE)*, and 5) *Transactions on Intelligent Transportation Systems (INT)*. Then, twelve research articles published in each of these five journals during the year 2006 were randomly selected. In short, the dataset compiled for this study consists of 60 civil engineering Introductions. All of the 60 Introductions were referred to, for instance, as JHA1 to JHA12 according to the actual order of their publication.

### 3.2. Data analysis

Two main stages in analyzing data were used in the present study to address the two objectives. First, following Swales' (2004) theoretical framework, the Introduction dataset was subjected to genre analysis to identify moves and to examine their rhetorical schema. With relevance to this objective, the typical sequence of moves was identified. In addition, the frequencies of the moves identified were recorded to indicate how conventional/optional the moves are. Steps that belong to the same move represent possible options that writers have at their disposal to contribute to the major function of the move. The frequencies of the steps found in each move were also reported.

Second, individual moves and steps identified in the first stage were complemented with detailed linguistic characterization by identifying the lexico-grammatical regularities in each move and step. To address the second objective of the study, Biber's original list of 67 linguistic features developed in 1988 to characterize linguistic variation among a variety of text types provides an initial impetus for this study. Since 1988, the tagger of linguistic features has been incessantly developed, and the tagger has successfully captured major grammatical and lexico-grammatical features in a variety of texts (e.g., Atkinson, 2001; Biber & Finegan, 1994; Conrad, 2001; Reppen, 2001). Nevertheless, given the specificity of the current dataset of the single genre of research articles, the list cannot be exhaustive. That is, some features that are prominent in this single genre might not be captured by Biber's tagger. Therefore, to accommodate the specificity of the corpora and to accurately characterize the texts, additional features might be required. For instance, the *reference* feature, referring to citations (no matter how long the citations are), has been found to be prominent in a number of genres (e.g., Dong, 1966; Hyland, 1999; Kanoksilapatham, 2007a). This feature demonstrates the crucial role of citations in science, for instance, where current scientists need to be aware of relevant previous research and make connections with them. Given the consensus that, in academic settings, previous studies must be acknowledged and credited, this *reference* feature is considered essential in academic texts. The significance of references is clearly substantiated in Swales' (2004) model (Figure 1), in which Swales asserted that citations or references are prevalently used in Move 1 and Move 2. This study does not attempt to use the tagger to quantitatively analyze the linguistic characterization of individual moves. Instead, however, based on the

categories corresponding to those in Biber's (1988) tagger and some additional features mentioned above, this study aims to quantitatively characterize the regularity of the co-occurrence of the linguistic features within individual moves. Given the specific focus on Introductions of this study and consequently the limited size of the dataset and limited number of linguistic features prevalent in texts, quantitative analysis of the linguistic features like multidimensional analysis would not be feasible. For more details on certain requirements of multidimensional analysis, refer to Biber (1988) and Kanoksilapatham (2003).

#### 4. Results and discussion

##### 4.1. Textual structure of civil engineering Introductions

###### 4.1.1. Moves and steps

The results obtained from the application of genre analysis reveal that the Introductions of civil engineering articles, compatible with Swales' model, consist of the same set of three main moves: 'Move 1: Establishing a territory,' 'Move 2: Establishing a niche,' and 'Move 3: Introducing the present work.' The rhetorical pattern of civil engineering Introductions is delineated as follows:

Figure 2. Proposed model for civil engineering Introductions

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<b>Move 1: Establishing a territory* via</b>	<b>100.00%</b>
(Topic generalizations of increasing specificity)	
Step 1: Claiming centrality	48.33%
Step 2: Making topic generalization(s)	96.66%
Step 3: Reviewing previous studies	93.33%
<b>Move 2: Establishing a niche* via</b>	<b>71.67%</b>
Indicating a gap	71.67%
<b>Move 3: Introducing the present work* via</b>	<b>100.00%</b>
Step 1: Announcing present research purposively	78.33%
Step 2: Summarizing methods	66.66%
Step 3: Announcing principal outcomes	45.00%
Step 4: Stating research values	38.33%
Step 5: Outlining the structure of the paper	28.33%
Step 6: Justifying procedural decisions	20.00%

Step 7: Describing study sites

15.00%

\* Possible cyclical patterning of moves particularly in longer Introductions

As shown, the model generated by this study is similar to Swales' (2004) model at the move level, but not at the step level. It is noted that 'Move 1: Establishing a territory' identified in this civil engineering dataset is different from that in Swales' (2004) model. In this regard, the current model resembles Swales' (1990) model, in which Move 1 features a possibility of three steps. Swales' modification of his 1990 model was triggered by the fact that Swales (2004) and other genre analysts including, for instance, Samraj (2002), argue that the three steps identified in Move 1 are not easy to differentiate, especially from the analysis perspective. As such, Swales (2004) proposes to eliminate the steps of Move 1 and suggests that the accounts of this move are of increasing specificity. Even though this study substantiates Swales' (2004) observation about the nature of Move 1 whose contents feature topic generalization of increasing specificity, from the perspective of pedagogical implications, the identification of the three steps provides novice engineers and practitioners leeway and a more concrete guideline to construct Move 1 in a way that conforms to the conventions of the field.

The current model also deviates from Swales' (2004) model in the use of 'Move 2: Establishing a niche.' According to Swales, this single move can be manifested through two strategies or steps. They are: Step 1: Indicating a gap or adding to what is known, and Step 2: Presenting positive justification. In contrast to Swales' model, only one step of 'indicating a gap' is used in this dataset.

The analysis in general shows that most of the steps found in 'Move 3: Introducing the present work' of civil engineering are closest to Swales' (2004) model, except for two major deviations. First, Swales' steps of 'Presenting research questions or hypotheses' and 'Definitional clarifications' are not found in this dataset of civil engineering. Second, two additional steps of 'Justifying procedural decisions' and 'Describing study sites' are identified in this dataset. The step of 'Justifying procedural decisions' is to convince readers that the procedures employed are well thought-out and carefully selected. To avoid any possible doubt or questions on the methodological issues of the study, this step is used 12 out of 60 Introductions (20.00%) in civil engineering Introductions. Finally, the step of 'Describing study

sites' is deemed necessary in civil engineering (found in 9 Introductions or 15.00% of the entire dataset) because this discipline focuses on harnessing natural forces to improve and protect environments. To enable readers to appreciate the research accounts, a description of the sites is crucial. At this juncture, it should be noted that instances of moves and steps are presented and further scrutinized in Section 4.2.

#### **4.1.2. Move frequency and pattern**

As suggested by Swales (2004) and previous genre-based studies (e.g., Brett, 1994; Kanoksilapatham, 2005), the frequencies of occurrence of moves play a critical role in determining the status of the moves. As for the frequencies of occurrence of individual moves, the findings reveal that the three moves occur relatively often. 'Move 1: Establishing a territory' and 'Move 3: Introducing the present work' are the most frequent, occurring in every Introduction (100% of analyzed dataset). 'Move 2: Establishing a niche' is found quite frequently (71.67%), but not as frequent as the other two moves. Despite variations in their frequencies, all of the three moves are considered obligatory and prominent in performing their communicative functions in Introductions.

Based on the results of the move analysis of the 60 civil engineering Introductions, some observations about textual structure can be made with reference to move sequence and cyclical patterning. First, the scrutiny of the move sequence demonstrates that civil engineers vary in their construction of their research article Introductions. A number of move patterns are found but in a small number of Introductions (e.g., the move sequences of 1-3-2, 3-1-2, 3-1, and 2-3-1, in 7, 2, 1, and 1 Introductions, respectively), indicating possible and expected idiosyncrasy of individual writers or groups of writers. Despite minimal variations, the most preferred move sequence is 1-2-3 which is found in 33 Introductions or 55% of the entire dataset. The other move structure which is relatively frequent is 1-3, in 16 Introductions or 26.67%. The most prevalent move structure of civil engineering research article Introductions or the move sequence of 1-2-3 is congruent with those in Swales' model and studies in other disciplines, e.g. humanities (Fakhri, 2004); biochemistry and microbiology (Kanoksilapatham, 2007a, 2007b); applied linguistics (Ozturk, 2007); and wildlife behavior and conservation biology (Samraj, 2002). However, variations across academic disciplines are prevalent, especially in the use of steps. For instance, Samraj (2002) compared the move structures followed in

conservation biology and wildlife behavior Introductions ( $N = 24$ , 12 from each discipline). She found that the conservation biology Introductions preferred to use the step of centrality claims or Move 1, Step 2 (11 out of 12 Introductions) more frequently than the wildlife behavior Introductions (6 out of 12 Introductions).

In summary, genre analysis applied to civil engineering research article Introductions is elucidating. First, it reveals the construction of texts with regard to their subcomponents or move/step schema. That is 'Move 1: Establishing a territory' can be realized by the use of three steps, whereas 'Move 3: Introducing the present work' by a possible combination of up to seven steps. In contrast, 'Move 2: Establishing a niche' is realized with one possible step in civil engineering. Second, as for the frequencies of occurrence of these moves, Move 1 and Move 3 are invariably present, whereas Move 2 is frequent with 71.67% occurrence. Third, with regard to their typical sequence, the analysis also shows that Move 1 is typically the initial move and Move 3 is the final move. Cyclical patterning is prevalent in this dataset. In fact, all of the three moves are cyclic. Move 1 is the most cyclic, recurring in 52 out of 60 Introductions or 86.67%. Move 2 and Move 3 are cyclic, though to a lesser extent compared with Move 1: Move 2 in 11 Introductions or 18.33%, and Move 3 in 33 Introductions or 55%.

#### **4.2. Linguistic characterization of civil engineering Introductions**

The scrutiny of all the instances of each move makes it possible to describe the typical linguistic characterization of each move type, which is the second objective of this study. The following sections illustrate excerpts representing each individual move and step previously identified by genre analysis. Even though the communicative function of each move and step is explicit and self-explanatory from its move label, a brief description of its function is presented. All excerpts illustrating each move and step are taken directly from the dataset, with two modifications. First, citations in the excerpts were replaced by (R). Second, linguistic features that are found to be commonly used across text instances, be they grammatical or lexical, are highlighted in bold.

##### **4.2.1. Move 1: Establishing a territory**

The first move, establishing a territory, occurs in all Introductions. It is a typical opening move for the majority of civil engineering Introductions. The communicative

function of this first move type is to introduce the topic of the study. As Swales (2004) noted, this move usually begins with topic generalizations and ends with topic specificities. On this note, Swales' (1990) model seems to be more directly applicable to the textual structure of this dataset, featuring three steps of this move. They are namely, 'Step 1: Claiming centrality,' 'Step 2: Making topic generalization(s)', and 'Step 3: Reviewing previous studies.'

'Move 1, Step 1: Claiming centrality' is illustrated by the following instances. This step is for the author to announce their interest or the importance of the research topic.

- (1) *These instruments **are** now **used extensively** for measuring discharge in rivers throughout the world.* [JHE3]
- (2) *Spectral **acceleration**, SA, **is the most commonly used** intensity measure in practice today for analysis of buildings.* [ESA4]
- (3) ***Erosion** by different forms of jets **is perhaps one of the most studied** scour related problems (R).* [JWR6]
- (4) *The dynamics of internal waves in stratified reservoirs **have been extensively studied** in numerous publications (R).* [JHA11]
- (5) ***Prediction** of solute mixing occurring along a stream **is important** in many applications.* [INT12]
- (6) *Accurate **information** about rate of flow in rivers **is important** for a variety of hydrologic **applications** such as water resources planning and conveyance structures.* [JHA5]

These instances display the use of grammatical features like the non-past tenses (simple present tense, present perfect tense). The choice of active or passive voice is likely to be determined by the semantic categories of verbs. That is, the passive voice usually co-occurs with activity verbs (*used, studied*). Other prominent lexical categories of this step include amplifiers (*extensively, commonly*) and evaluative adjectives (*important, most*). Noticeably, the evaluative adjectives are used as a predicative adjective. Another lexical category includes nominalization or gerund which is formed from the conversion of verbs and adjectives into nouns to refer to abstract concepts (*erode-erosion, accelerate-acceleration, predict-prediction, inform-information, apply-application*). The co-occurrence of these features helps

contribute to highlighting the importance of the topic and on-going interest to investigate a particular concept or area of civil engineering.

‘Move 1, Step 2: Making topic generalization(s)’ represents a statement about the state of the art of a research topic, as illustrated by the following examples.

- (7) *...the **locally averaged instantaneous critical stress** is considered to be a property of the uniform sand particles.* [JHA2]
- (8) *Site response **includes** the effect of the uppermost several hundred meters of rock and soil and the **surface topography** at the recording site.* [ESA1]
- (9) *The **headspaces** of sanitary sewer systems are normally prone to pressurization and ventilation.* [JHE8]
- (10) *Scour of a **sediment bed** around a vertical **cylinder** involves a complex flow field marked by large-scale turbulence structures generated by flow around the pier or abutment....* [JHA1]
- (11) ***Acoustic Doppler current profilers (aDcp)** have become standard instruments for measurement of spatially distributed water velocities in both freshwater and marine environments.* [JWR5]

The use of the non-past tenses (simple present tense, present perfect tense) is prominent in Move 1, Step 2. Similarly, the choice of present simple or present perfect seems to correspond to particular semantic categories of the verbs. For instance, aspectual verbs (*become*) co-occur with the present perfect as shown in (11); whereas in other instances, existence verbs (*involve*, *include*) tend to co-occur with the simple present tense as shown in (8) and (9). In contrast to Step 1, the nouns used in Step 2 are not abstract ideas, but technical and concrete nouns (*acoustic Doppler current profilers*, *sediment bed*, *cylinder*, *instruments*, *headspaces*). These features co-occur to highlight the current state of the art, of knowledge, and of technique. The current accounts of the topic are comparatively more specific (as evidenced by concrete nouns), as opposed to Move 1, Step 1, which is relatively more general (as indicated by frequent use of abstract nouns).

‘Move 1, Step 3: Reviewing previous studies’ is the last step of this move. Through this step, selected previous research is reviewed, as shown by the following examples.

- (12) *Several **methods have been proposed**, for a review see **(R)**.* [ESA1]
- (13) *In **recent** years, artificial neural networks (ANNS) **have proved** to be a better alternative for modeling complex and nonlinear processes **(R)**.* [JHE11]

- (14) *Local scour has been studied primarily by means of laboratory flume experiments (R).* [JHE1]
- (15) *Many studies have been conducted with plane wall jets that interact with non-cohesive sand beds and related details can be found in (R).* [JHA6]
- (16) *Experiments have been performed by, among others, (R), all of which report the impossibility of adequate rough boundary measurements.* [JWR2]

Interestingly, these instances show the distinct use of the present perfect tense, which usually co-occurs with passive voice and activity verbs (*studied, conducted, performed, proved*). A unique feature of this step is the use of citations or reference (R), the feature previously found to be significant in scientific writing (e.g., Dong, 1996, Hyland, 1999, Kanoksilapatham, 2003). It is a tradition in any academic discipline that previous studies, to a certain extent, have provided a foundation for subsequent scholars to build knowledge on. As such, acknowledging the accomplishment and importance of previous research is a strongly encouraged practice. Finally, in congruence with the reference feature, the instances illustrated above reveal the frequent use of common nouns to refer to specific studies or research work (*methods, studies, experiments*). Through this step, civil engineers demonstrate their familiarity with relevant work in the field, build rapport and consensus within the discourse community, and express attribution to previous contributors in the field. In short, to successfully establish the research territory, civil engineers convince the readers by claiming the significance of the research area, by introducing the knowledge of the topic, and by showing familiarity with the topic.

#### 4.2.2. Move 2: Establishing a niche

This move serves the function of identifying the more specific areas of research that require further investigation. In contrast to Swales' (2004) model, which outlines two possible steps of this move, Move 2 of civil engineering research article Introductions is relatively much more homogenous, featuring only the use of 'Step: Indicating a gap,' as shown in the following examples.

- (17) *Despite the numerous studies on hydrologic applications of ANNs, only a few studies have addressed the problem of predicting hysteretic looping stage–discharge relations.* [INT5]
- (18) *Unfortunately, the stage–discharge relationship is not always a simple unique relationship.* [JHA5]

- (19) *The main **drawbacks** of this approach, though, are the **inability** to preserve the monthly correlation between the first month of a year and last month of the previous year. [JHE5]*
- (20) *To date, there **has been little** study of the effect of basin-scale internal waves on the dynamics of selective withdrawal. [JHA11]*
- (21) *No experiments involving the systematic variation of the deflection angle **have been carried out** to date, and therefore it **is not** known how the flow pattern varies. [JWR10]*
- (22) ***However**, the logistics of collecting direct measurement of streamflow on a continuous basis **is costly**.... [JHE5]*
- (23) ***Despite** the numerous studies on hydrologic applications of ANNs, **only a few** studies **have addressed** the problem of predicting hysteretic looping stage–discharge relations. [JHA5]*
- (24) *This model however assumes that there **is no** wastewater in the sewer conduits. This supposition is **a handicap** for an accurate prediction of ventilation dynamics of an operating sewer system. [JHA8]*
- (25) *The writers suggest that laboratory-based equations used for predicting local scour depths at cylinders **inadequately take** into account the similitude considerations .... [JHA1]*
- (26) ***but** one substantial similitude effect **seems** to have been **overlooked** in prior studies. [JHA1]*

Move 2 performs a communicative function of indicating a gap in previous research. To accomplish its function, the non-past tenses (simple present tense, present perfect tense) are commonly used. The lexical entries used in this move are quite diverse, involving a large set of lexical words ranging from attitudinal verbs (*overlook*), attitudinal nouns (*drawbacks*, *handicap*, *inability*), evaluative adjectives (*costly*), evaluative adverbs (*inadequately*, *unfortunately*), negation devices (*little*, *not*, *no*, *only a few*), and contradiction connectors (*however*, *despite*, *but*, *yet*). Despite their diverse syntactic categories, these lexical words, to a certain extent, share some common semantic category of negative evaluation. This is in congruent with the purpose of this move of identifying gaps in previous studies, pinpointing how inadequate they are. Through these features, civil engineers successfully construct critical comments based on the scrutiny of previous research. At the same time, this

move provides a transition for civil engineers to highlight their own research work in Move 3.

#### 4.2.3. Move 3: Introducing the present work

While Move 1 and Move 2 contextualize the current study by establishing the significance of the topic and providing accounts of previous research related to the topic, Move 3 focuses on the study being reported. Swales' (2004) model stipulates a possibility of seven steps for Move 3. However, the analysis of civil engineering research articles Introductions reveals that this move type can be realized by seven steps. The two steps delineated in Swales (2004), but not found in this dataset, are the steps of 'Presenting research questions or hypotheses' and 'Definitional clarifications.' The absence of the step 'Presenting research questions or hypotheses' indicates that while scholars from other academic disciplines tend to use either the step of 'Presenting research questions or hypotheses' or the step of 'Announcing present research purposively' as stipulated by Swales (2004), civil engineers possibly prefer to address the goal of the study by 'Announcing present research purposively' (with the frequency of occurrence of 78.33%). Similarly, the absence of the step of 'Definitional clarifications' in this civil engineering dataset, as substantiated by Connor, Upton, and Kanoksilapatham (2007), is usually not found in research article Introductions but in PhD thesis Introductions. The following sections discuss individual steps of Move 3.

'Move 3, Step 1: Announcing present research purposively' typically announces the objective(s) of the research presented.

- (27) *The purpose of the experiments was to investigate the nearfield characteristics of the discharge for a range of port spacings encountered in outfall design practice.* [JHE4]
- (28) *In the present paper, a new comprehensive enumeration model is developed for this "intractable" layout problem.* [JHA9]
- (29) *The objective of this research is to present a new approach for calculating the overall space average and fluid bed shear stresses for uniform-sized sand particles.* [JHA2]
- (30) *The purpose of this paper is to assess the cost-effectiveness of various levels of seismic design and construction quality, ... .* [ESA3]

- (31) **The objectives of the study were:** (1) to compare the accuracy of vDGPS from various DGPS units ...; and (2) to determine which DGPS correction procedures are acceptable .... [JWR3]
- (32) **The purpose of this paper is** to examine the utility of data-driven computational techniques to model and predict such complex relations that are encountered in low-gradient coastal streams. [INT5]

These instances of Move 3, Step 1 state explicitly the objective(s) of the research. The simple present tense and past tense of verb-to- be are used interchangeably in this step. Also commonly found are common nouns (*research, experiment(s), paper*), cognitive nouns (*purpose, objective(s)*), and deictic references to the present texts, including specific determiners and demonstrative adjectives (*this, the*). In fact, the combination of these grammatical and lexical features forms a typical formulaic expression delineated as follows:

	<i>objective(s)</i>			<i>research</i>		<i>is, are</i>
<i>The</i>	<i>purpose(s)</i>	+	<i>of the/this</i>	+	<i>paper</i>	+
	<i>aim(s)</i>			<i>experiment(s)</i>		<i>was, were</i>
				<i>study</i>		

‘Move 3, Step 2: Summarizing methods’ provides an account of the experimental procedures of the research. However, only major procedural features are selectively presented in the Introductions.

- (33) *Data from four different **DGPS** corrections **were collected** simultaneously during 22 repeated **aDcp** surveys of a single river cross section. The accuracy of the calculated boat velocity from various **DGPS** correction strategies (**vDGPS**) **was estimated** by comparison with boat velocity by bottom tracking (**vBT**) and the resulting influence on discharge measurement **was assessed**.* [ESA3]
- (34) *... the experiments **focused on** discharges driven primarily by buoyancy. The model diffuser **consisted** of T-shaped risers with horizontally opposed ports. Dilutions **were measured** by a precision **microconductivity probe** and the geometrical wastefield characteristics ... **were measured** ....* [JHA4]
- (35) **The tests were performed** with a single circular pile, two uniform diameter cohesionless **sediments**, and a range of water depths and flow velocities. All but four of the tests **were conducted** in the live-bed scour range. [JWR7]

- (36) *On a seasonal scale, **fluctuations in temperature and turbidity** of withdrawn water **are compared to** the internal wave dynamics. Steady-state formulas of selective withdrawal **are used to** obtain layer thickness in the reservoir where density stratification is unsteady due to internal wave activity; the results **are compared** to measured water quality data. The interaction of long internal waves and selective withdrawal **is studied** in detail on one particular seiching event, where the lake **hydrodynamics is assessed** using direct and inverse methods, followed by the interpretation of observed fluctuations of the water quality. [INT11]*
- (37) *In the current study, the method of **fragments-modified (R) (MFM)** disaggregation model and the nonparametric Markov order 1 model with long term persistence (NPL) **are applied** to generally monthly rainfall sequences .... [JHE5]*

The grammatical features used to express this step in the discipline of civil engineering include both the present simple tense and past tense. Lexical features include activity verbs (or to be precise research activity verbs) which are prevalent (*collect, estimate, assess, substantiate, perform, measure, compare, study, apply*) and are usually used in passive voice.

‘Move 3, Step 3: Announcing principal outcomes’ showcases significant findings generated by the research.

- (38) ***This paper presents the results** of 24 local sediment scour experiments conducted by the lead writer in the Hydraulics Laboratory at the University of Auckland in Auckland, New Zealand. [JHA7]*
- (39) *Generalized fragility curves are developed and a simple expression **is presented**, which is envisioned to be useful for design. [ESA10]*
- (40) ***The writers present insights** showing that two parameters...substantially **influence** equilibrium scour depth. [JHA1]*
- (41) ***In this paper** a system formulation incorporating system variables and major air energy inputs **is presented** for analyzing air movement in sanitary sewer systems. [JHA8]*
- (42) ***This technical note presents the results** of clear water local scour generated by 3D wall jets in a non-cohesive sand bed at low tailwater depths. [JHA6]*

The linguistic features used to express this step include the simple present tense together with a communication verb (*present*). Prevalent lexical features

include the use of the cognitive nouns (*results, insights*) and deictic elements (*the, this, this paper*) which are followed by common nouns (*paper, technical note*). All these features contribute to highlighting certain discoveries from the current study.

‘Move 3, Step 4: Stating the value of the present research’ claims the significance or contribution of the study being reported.

- (43) ***This study brings some new understanding** of the physical processes affecting dispersion in meandering channels with a loose bed.* [JHA12]
- (44) *Once validated, **this approach can be used** to design enhanced anaerobic bioremediation systems.* [JHE6]
- (45) ***These models would be a substantial advancement** in the field of traffic management due to their potential **contribution** towards traffic safety as well as freeway operations.* [INT2]
- (46) ***This information will be used** to comment on the validity of selected models found in the literature.* [JHA12]
- (47) ***In the future this data may also be useful** for the development and validation of new theoretical and numerical models.* [JWR12]
- (48) *...some **implications** regarding the prediction of the nature of bed geometry in sine-generated meandering streams **are discussed**.* [JHA10]

This step goes beyond scientific results, which are objectively generated by the study being reported. As a result, the simple future tense (*will*) or time adverbial indicating the future tense (*in the future*) is used. Other key linguistic features include cognitive nouns (*understanding, contribution*) and likelihood nouns (*implications*), and predictive and possibility modals (*will, would, can*). Deictic elements including specific determiners or demonstrative adjectives (*this, these*) followed by common nouns (*data, study, models*) are highly frequent in these texts. All these linguistic features co-occur to project a possible contribution of the research results.

‘Move 3, Step 5: Outlining the structure of the paper’ familiarizes readers with the structure of the research article being read. The information allows readers to know what to expect while reading the research article.

- (49) ***We begin this paper with** a brief introduction to relevant aDcp and DGPS theory. **We then describe** the various DGPS units tested, the field site, and data collection procedures. The analytical techniques developed to process the data **are presented**. The resulting accuracy estimates for single ping velocity*

*and full transect discharge measurements are presented. Finally, the results are generalized through a simulation....* [JHA3]

- (50) *First, a description of the study site and the available stage and discharge measurements is presented. Then, the two modeling methods are briefly explained. Afterward, the setup and the results of each model are presented. The paper closes with conclusions and recommendations.* [JHA5]
- (51) *We begin by providing some background on the project, and then detail our analysis and findings.* [ESA3]

A prominent grammatical feature is the simple present tense. The choice of active or passive voice seems to be determined by the presence or absence of deictic elements (*the/this paper, we*). That is, with the presence of deictic elements, verbs are in active voice; without deictic elements, verbs are usually in passive voice. The presence of deictic elements also seems to determine the verb choices because they usually co-occur with activity verbs (*begin, close*). Otherwise, a communication verb (*present, explain, describe*) is very common. The most distinct lexical feature of this step is sequential connector (*first, then, afterward, finally*). By using these linguistic features, civil engineers are able to direct readers' attention to how a research article is outlined or structured.

'Move 3, Step 6: Justifying procedural decisions' allows civil engineers to assure article readers that a procedure adopted is carefully thought out and justified.

- (52) *We select significant duration because it is relatively stable with respect to the definitions of beginning and end thresholds (R).* [ESA12]
- (53) *DSPM was chosen because it can simulate snow accumulation and....* [JHE 4]
- (54) *To avoid any confusion, in this paper, we define and use the terms acceptable routes and service level in the stochastic scenario.* [INT3]

Common linguistic features found in these instances include cause connectors (*because*) and 'to' clauses controlled by a desire, intention, and decision verb (*avoid*). Both of these linguistic features share the same communicative function of introducing reasons or purposive propositions. The co-occurrence of either of these two features with deictic elements (*we, in this paper*) contributes to the communicative function of announcing the justifications for choosing a procedural step in the research in order to safeguard the authors from possible inquiry.

'Move 3, Step 7: Describing study sites' is a step that provides general information or description of the target site(s) for conducting research.

- (55) *The **study area** is located in **cold** regions. Snow accumulation and spring snowmelt are **important** factors that can cause **significant** spring floods.* [JHE4]
- (56) *Six **sites** have varying amounts of **soft**, clay material over possible Pleistocene till, over bedrock. The seventh site (PCG) is situated on competent bedrock.* [ESA1]
- (57) *The **test site** for this application is **the Snake River**, the **largest** tributary of **the Colombia River**.* [JWR4]

The scrutiny of these instances reveals that the grammatical feature frequently found include the simple present tense (*is, have*). Lexical features include the use of common nouns (*study area, sites, test sites*), attributive adjectives (*cold, soft, significant, important, largest*), and specific place names (*the Snake River, the Colombia River*). These features provide precise and accurate description of the sites.

This step can be claimed to represent a unique feature of the Introductions of civil engineering research articles because it is neither included in Swales' (2004) model, nor found in other disciplines such as biochemistry, microbiology, humanities, and social sciences (Kanoksilapatham, 2005, 2007b; Fakhri, 2004). A question that emerges and is worth investigating is why this step is uniquely found in this discipline. A look at the history of this discipline is enlightening. According to the American Society of Civil Engineers (<http://live.asce.org/hh/index.mxml>), civil engineering

... is the profession in which a knowledge of the mathematical and physical sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the progressive well-being of humanity in creating, improving, and protecting the environment, in providing facilities for community living, industry and transportation, and in providing structures for the use of humanity.

Based on the above definition, civil engineers plan, design, construct, and operate on facilities essential to modern life. Clearly, civil engineering research deals closely with the environment. As a result, description of the environment is an essential element to be presented in Introductions.

This section illustrates that each move and each step belonging to individual moves in research article Introductions perform their communicative functions through different co-occurrence patterns of linguistic features. In conclusion, addressing the two objectives put forward, the study has shown that the Introductions of civil engineering research articles can be analyzed into sub-units of moves and steps. The three moves have proved to be crucial and prevalent due to their high frequencies of occurrence. These moves seem to occur in a specific order or pattern. For some articles, certain moves can occur more than once. The examination of move/step instances also highlights the fact that each move or step seems to use a particular set of linguistic features to help achieve its communicative function.

## **5. Implications**

The genre analysis of the Introductions of civil engineering research articles in English has important pedagogical implications for ESP instruction in general and for civil engineering in particular. As pioneering and influential work in English for Specific Purposes (ESP), Swales' (1981) genre analysis was designed to help non-native speakers of English to read and write research articles. Although the dataset of civil engineering research article Introductions is only a small part of academic English, it is hoped that the contribution of this research should not be limited to the field of civil engineering but should extend to include the scientific community at large.

The results generated from this research show how genre analysis can be applied in the teaching of ESP in resonance with Swales' impetus in creating genre analysis. The study identified the frequency of occurrence of each move and the typical organizational pattern provides civil engineers, especially novice civil engineers, with basic knowledge on how to start crafting their own Introductions.

In today's world, English is one of the most dominant modes of communication in all academic activities. It is thus necessary to prepare ESP learners to meet the needs and challenges of academic settings. In this respect, learners should be exposed to, and should engage in, a variety of academic genres to learn rhetorical variation, not only across genres but also across academic disciplines. They should also be guided to make an appropriate choice of rhetorical or linguistic features to suit the demands of the academic settings in which they are likely to operate. Once the learners can answer why a particular text is used and written the way it is (Bhatia,

1993, 1997), they will fully understand and be able to successfully construct a genre in the discourse community in which it is routinely used.

In the broader scope of the teaching and learning of ESP, this study demonstrates that ‘generic competence’ (Bhatia, 2004: 145) should be considered a primary goal to attain so that learners are equipped with suitable knowledge for communicating in various academic settings. According to Bhatia (2004), generic competence refers to “the ability to identify, construct, interpret, and successfully exploit a specific repertoire of professional disciplinary or workplace genres to participate in the daily activities and to achieve the goals of a specific academic/professional community” (p. 145). Generic competence will enable learners to gain understanding of the practices and conventions of particular communicative tasks embedded within academic and professional settings.

In this regard, the notion of conforming to the norms and conventions laid down by the discourse community should be adopted with great caution. Genre writers should be trained to be sensitive to different move structures of genre usage, especially in response to the demands of changing socio-cultural practices and evolving genres; that is, they should feel free to adopt or subvert the dominant practices as they wish. Additionally, they should be able to manipulate their genre knowledge to serve their own intentions and also meet the demands of today’s ever-changing and complex professional communities. As stated by Rentz (2005: 291), while scholars are concerned with incorporating gatekeepers’ feedback for publication purposes, they should try their best to maintain their “primary ownership”, contributing to the enhancement of research quality (Lave & Wenger, 1991). Although current trends do not seem to favor scholars who are non-English speakers, it is hoped that one day these non-English speakers will be able to get involved in “conversations”, negotiating the genre conventions as recommended by Bazerman (1980). Having achieved this, not only can the role of gatekeepers and researchers be balanced (Rentz, 2005: 91) but also the “primary ownership” be maintained (Rentz, 2005: 291), contributing to the enhancing of research quality (Lave & Wenger, 1991).

The learners of ESP should be guided to be genre explorers themselves. In a class, students may be assigned a piece of writing, for example, abstracts, the methods section, and acknowledgements. Their first task should be a small discussion in which students analyze the text and try to list the stages of those writings. Leading questions from the teachers may be “What is the writer trying to tell us?”, “What kind

of information is included in the writing?”, “Is there any sequence in which the story is written?”, “What kind of information is likely to be found in the beginning and at the end of the story?”, and “What are the typical linguistic features found in texts?”.

In class discussions, when the students are more familiar with a genre, the teachers should ask them to write a text of a particular genre and share it with the class. In this manner, the students are likely to gain a better understanding of genre knowledge rather than teaching them formulaic patterns. At the same time, students should be provided with an opportunity to compare texts across languages, cultures, and disciplines. The comparison will enable students to be aware of the volatile nature of each academic genre and its prevalent variations in order to enhance their sensitivities to different characteristics of various academic texts.

The language used in one academic discipline may be somewhat different from that in another discipline. Therefore, people involved should train novice civil engineers to be sensitive to certain conventions prevailing in their own discipline. Pedagogically, teachers or practitioners should bear in mind that the principal objective of teaching is to help prepare their students to communicate and disseminate their discovery successfully in their research articles. Students should be exposed to different language styles and guided to make appropriate language choice, by examining authentic research articles. Teachers should allow students to analyze texts by themselves. In so doing, students can learn conventions and variations revealed from texts, and so they can become more effective in manipulating other academic genres.

## **6. Conclusion**

This study analyzed a representative dataset of Introductions of civil engineering research articles, using both top-down and bottom-up approaches to discourse analysis. A series of three moves in the Introductions contributes to the overall communicative purposes. These three moves are frequently but not always arranged in the order of Move 1, Move 2, and Move 3. Furthermore, they are cyclic. In addition to the textual organization, the study elucidates the linguistic characterization of each move and step identified. The insights obtained from both the rhetorical structure and the linguistic characterization will help form the pedagogical template for research article Introductions to develop coping strategies in response to the rigorous writing demands of academia encountered by advanced learners of English

in the civil engineering discourse communities. Students of civil engineering and practitioners who are interested in writing research articles can use the description of the textual organization and linguistic characterization as a guideline of how professional research article writers construct their Introductions. On this final note, caveats are in order. The findings are generated from the specialized dataset of civil engineering containing 60 Introductions, and thus may have little capacity for generalizations to be extended to the same genre of other academic disciplines in English and other languages and other genres in general. Finally, without interviews with civil engineers, especially those who are prolific article writers, it is difficult to deeply probe into the contexts of creating research articles.

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