ПРОБЛЕМИ СЕМАНТИКИ
[ПРОБЛЕМЫ СЕМАНТИКИ / PROBLEMS OF LINGUISTIC SEMANTICS]

УДК 81'276.6

ВПЛИВ СЕМАНТИКИ КОМПОНЕНТІВ У МОДАЛЬНИХ ДІЄСЛІВНИХ КОНСТРУКЦІЯХ З МОДАЛЬНІМИ ДІЄСЛОВАМИ «ПОВИННОСТІ» НА ЇХ ГРАМАТИЧНІ ТА СТАТИСТИЧНІ ОСОБЛИВОСТІ (НА МАТЕРИАЛІ ТЕКСТІВ ТЕХНІЧНОГО ДИСКУРСА)

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ПРОБЛЕМИ СЕМАНТИКИ, ПРАГМАТИКИ ТА КОГНІТИВНОЇ ЛІНГВІСТИКИ
[ПРОБЛЕМЫ СЕМАНТИКИ, ПРАГМАТИКИ И КОГНИТИВНОЙ ЛИНГВИСТИКИ]

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У статті представлено дослідження модальних дієслівних конструкцій з модальними дієсловами "повинність", must, have to+inf. Be to+inf., які функціонують в трьох технічних текстових корпусах і належать до технічних областей, не пов'язаних один з одним. Семантичні особливості аналізуються та порівнюються з граматичними та статистичними. Спостерігаються взаємозв'язки цих трьох характеристик у кожному компоненті, а також взаємозалежність між кожним компонентом модальних конструкцій дієслова в семантиці, граматиці та статистиці. Але домінуючою характеристикою є семантика.

Ключові слова: контекстний метод, логіка вибору одиниці, семантична група та підгрупа, текстовий корпус, частота використання.

Вплив семантики компонентів у модальних дієслівних конструкціях з модальніми дієсловами «повинності» на їх граматичні та статистичні особливості (на матеріалі текстів технічного дискурса) (Англійською)
[Влияние семантики компонентов в модальных глагольных конструкциях с модальными глаголами «долженствования» на их грамматические и статистические особенности (на материале текстов технического дискурса) (На англ. яз.)]

(Проблеми семантики [Проблемы семантики])

ВЛИЯНИЕ СЕМАНТИКИ КОМПОНЕНТОВ В МОДАЛЬНЫХ ГЛАГОЛЬНЫХ КОНСТРУКЦИЯХ С МОДАЛЬНИМИ ГЛАГОЛАМИ «ДОЛЖЕНСТВАНИЯ» НА ИХ ГРАММАТИЧЕСКИЕ И СТАТИСТИЧЕСКИЕ ОСОБЕННОСТИ (НА МАТЕРИАЛЕ ТЕКСТОВ ТЕХНИЧЕСКОГО ДИСКУРСА)

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В статье представлено исследование модальных глагольных конструкций с модальными глаголами "обязанность", must, have to+ Inf., be to + Inf., которые функционируют в трех технических текстовых корпусах и относятся к техническим областям, не связанных друг с другом. Семантические особенности анализируются и сравниваются с грамматическими и статистическими. Наблюдаются взаимосвязи этих трех характеристик в каждом компоненте, а также взаимозависимость между каждым компонентом модальных конструкций глагола в семантике, грамматике и статистике. Но доминирующей характеристикой является семантика.

Ключевые слова: контекстный метод, логика выбора единицы, семантическая группа и подгруппа, текстовый корпус, частота использования.

THE INFLUENCE OF COMPONENT SEMANTICS IN MODAL VERB CONSTRUCTIONS WITH THE MODAL VERBS OF "OBLIGATION" ON THEIR GRAMMATICAL AND STATISTICAL FEATURES (ON THE BASIS OF THE TECHNICAL DISCOURSE TEXTS)

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**PROBLEMS OF SEMANTICS, PRAGMATICS AND COGNITIVE LINGUISTICS
[PROBLEMY SEMANTYKY, PRAHMATYKY TA KOHNITYVNOI LINHVISTYKY]**

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The article presents the study of Modal verb constructions with the modal verbs of "obligation" must, have to+ Inf., be to + Inf. functioning in the scientific and technical discourse texts. The material of the research are three technical text corpora, which belong to engineering fields scientifically and technically unrelated to each other – "Electrical Engineering (Energy Supply and Power Management)", "Automotive Industry" and "Chemical Engineering" – and compiled on the basis of scientific journals of the United States and Great Britain. This allows to obtain the results that are supposedly of a universal nature and can be applied practically to any field of scientific discourse. The goal is to consider: firstly, which semantic groups of verbs (in different grammatical forms) are attached to a particular modal verb, i.e. the following interrelationship is defined: the semantics of a modal verb – semantics and form of a main verb (the second constituent of the modal construction); secondly, to what extent this interdependence affects the usage frequency of the various semantic groups of the main verbs that make up certain MVCs. The results of the research have demonstrated that in Modal verb constructions of this type functioning in the scientific

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technical discourse texts the predicative meaning of modal verbs is determinant for the semantic features of main verbs connecting to them (modal verbs). The main verb semantics in its turn influences on their (main verbs) grammatical and statistical characteristics. The modal verb must has the highest frequency of use in scientific texts. It gives imperative which underlines the author's stability of position and faultlessness of the obtained and presented results. Have to + Inf. MVC is much less frequent and it is a result of the modal component semantics of this construction. Modal verb constructions where the modal verb is be to + Inf. are used by the authors of scientific articles quite rarely, which can be also explained by semantic peculiarities of the verb be to + Inf. In Modal verb constructions with the modal verbs of "obligation" must, have to+ Inf., be to + Inf. the passive voice is more preferable than active voice because in the scientific and technical discourse texts human activity does not manifest evidently since the authors should take second place and be present indirectly through their scientific achievements.

Keywords: *logics of unit choice, semantic group and subgroup, usage frequency, text corpus, contextual method.*

The peculiarities of semantics of the modal verbs of "obligation" are presented in the newest linguistic literature in a variety of aspects: the syntactic semantics of statements with the meaning of necessity, which includes "must, ought to, have to + Inf" [7], the description of the obligational modal verbs functioning in the semantic field of modality [9]. But the majority of the researchers tend to consider the very phenomenon of modality and its elements presented in a discourse in one form or another [2; 10]. As a material they commonly use fiction or lexicographic resources [5; 10] or spoken speech [7]. The work by A. N. Selezneva stands separately and is worth mentioning. It describes the modal verbs found in the texts of scientific and technical discourse. However, here all the nomenclature of modal verbs is presented here without mentioning the statistical, semantic or grammatical features of their functioning, specific for technical discourse.

The given study considers the following problems: firstly, it deals not with the phenomenon of modality as a whole and its display, but only with the exact modal verbs with the meaning of "obligation" – *must, have to + Inf., be to + Inf.,* which form modal verb constructions (MVCs); secondly, the presented research is based on the description

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of the units encountered in real linguistic objects – text corpora, which relate to scientific and technical discourse. They have been created in using the methods of continuous sampling and expert evaluation, i.e. on the basis of consultations with professional experts.

Thus, the interest of linguists to such grammatical phenomenon as modal verbs, and lack of research on the interaction of semantic, grammatical and statistical features of the components that make up modal verb constructions (MVCs) with the modal verbs of "obligation", functioning in the texts of scientific and technical discourse, prove this article to be relevant and up-to-date.

The presence of text corpora provides us with the opportunity to use the contextual method and allows to set the following goal: to describe the influence of the semantic meanings of the components in modal verbal constructions of "obligation" on their (components) grammatical and statistical characteristics.

It should be emphasized that the authors believe that interaction of such two different scientific objects as statistics and linguistics makes it possible to carry out a study that explains many phenomena of discourse.

For this study, the texts of three completely different, unconnected technical fields were taken as material: "Electrical Engineering (Energy Supply and Power Management)", "Automotive Industry" and "Chemical Engineering". The text corpora were compiled on the basis of scientific journals of the United States and Great Britain: IEEE Transactions on Power Apparatus and Systems; Power Engineering; Power; Automotive News; Combustion; Control and Optimization; Machine Design; Machinery and Production Engineering; Automotive Engineer, Chemical Engineering, Chemical Engineering Progress, Process Engineering, etc. The total size of sampling was 700 thousand words.

The usage of the text corpora of three technical areas, which have absolutely different scientific and technical topics, allows us to obtain results that are supposedly of a universal nature and can be applied practically to any field of scientific discourse.

As mentioned above for the analysis the modal verbs with the meaning of "obligation" – *must, have to + Infinitive, be to + Infinitive* – and the main (notional) verbs, that form modal verb constructions (MVCs) with them, were taken as a subject of research. The exception was the verb "ought" – the least frequent in this group of modal verbs, which occurs only in two cases in all texts, probably due to its semantic features,

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which do not allow authors of scientific technical articles to use it quite often. This modal verb was excluded from the list of modal verbs of this type in the process of the conducted study.

It should be noted that the results of a statistical analysis of the frequency of modal verbs usage that have the meaning of "obligation", as well as an analysis of their grammatical forms, have already been cited in the article [7]. The given work will present the results of completely new studies of the features of the MVC, namely, their semantic characteristics, which will show, first, which semantic groups of verbs (in different grammatical forms) are attached to a particular modal verb, i.e. the following interrelationship is defined: the semantics of a modal verb – semantics and form of a main verb (the second constituent of the modal construction); secondly, to what extent this interdependence affects the usage frequency of the various semantic groups of the main verbs that make up certain MVCs.

However the urgent need of a clear and understandable presentation of the facts for readers makes them mention the statistics and grammatical analysis to determine the dependence of the quantitative and grammatical characteristics of the MVC elements on main verbs semantics. Since it seems that not the description of individual aspects of the speech phenomenon but their interaction provides a deeper understanding of the logics of lexical and grammatical units choice made by the scientists describing their inventions.

So, the first, preparatory, stage is devoted to the presentation of statistical data of the frequency of using the modal verbs of "obligation" (table 1) and the list of main verbs (the second constituents of the MVC) joining them (table 2). All data in the tables are arranged in the order of descending the frequencies.

Table 1
Frequency of usage of Modal Verbs having the meaning "obligation"

№№	Modal Verbs	T e x t c o r p o r a			Total Frequency F*
		Heat Engineering	Electrical Engineering	Automotive Industry	
		F	F	F	
1.	must	172	78	64	314
2.	have to+ Inf	26	46	56	128

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Вплив семантики компонентів у модальних дієслівних конструкціях з модальніми дієсловами «повинності» на їх граматичні та статистичні особливості (на матеріалі текстів технічного дискурса) (Англійською)
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3.	be to + Inf	23	25	15	63
	Total:	221	149	135	505

Table 1 consists of the statistical data of three modal verbs that have the meaning "obligation" and are most frequently used in the text corpora under study.

Table 2

Frequency of main verbs (the second constituent of MVC) included in Modal Verbal Constructions in different grammatical forms

№№	Main Verbs, used in Active (A) and Passive (P) forms	must		to be to +Inf		to have to+Inf		Total Frequency, F*
		A	P	A	P	A	P	
1	make	2	7	-	5	2	4	20
2	meet	7	1	-	2	1	1	12
3	take	2	6	-	-	3	-	11
4	design	-	8	-	-	-	1	9
5	use	1	1	4	1	1	1	9
6	have	5	-	1	-	1	-	7
7	add	1	5	-	-	-	1	7
8	provide	-	4	2	-	-	-	6
9	consider	-	4	-	1	-	1	6
10	find	-	4	-	-	-	1	5
11	operate	2	1	-	-	-	2	5
12	do	1	3	-	-	1	-	5
13	determine	-	2	-	1	1	-	4
14	reduce	-	2	-	-	-	2	4
15	remove	-	2	-	-	-	2	4
16	apply	-	1	-	-	-	2	3
17	control	1	2	-	-	-	-	3
18	calculate	-	1	-	1	-	1	3
19	increase	1	1	-	-	-	1	3

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20	select	1	-	-	-	2	-	3
21	build	-	2	-	-	1	-	3
22	generate	-	1	-	1	-	-	2
23	draw	-	-	-	-	-	1	1
	Total:	24	57	7	12	13	21	134

Table 2 shows 23 main verbs that form the appropriate constructions with modal verbs, with information about the frequency of their usage in various grammatical forms (Passive and Active).

The second stage is devoted to the description of semantic groups, in which the main verbs (the second constituents of the MVCs) were combined. For a more convenient understanding of the text of the article in each semantic group or subgroup, the total frequency and the total number of words included in the group or subgroup are given.

The entire list of the verbs presented in table 2, was divided into three semantic groups – words that can denote: a) actions performed by a person (operator, engineer, developer, etc.); b) actions performed by various types of equipment in the production process, as well as verbs used to describe equipment requirements and standards; c) actions performed by the computer. The following verbs were assigned to the first group: *determine, consider, find, select, take, use, apply, provide, remove, build, reduce* (F = 2). To verbs of the second group the words *reduce* (F = 2), *increase, generate, operate* (F = 2), *make, do, have, meet* – are referred. The third group includes the following verbs: *draw, calculate, design, add, control, operate* (F = 3). As can be seen from the lists, *reduce* and *operate* are represented twice in two different semantic groups in accordance with the meanings with which they were encountered in textual cases. Their total frequencies were also divided.

In its turn within the groups mentioned above the semantic subgroups were distinguished, which show the characteristic features of the semantics of the verbs presented in more details. Thus, in the first group the following subgroups are distinguished:

1) a subgroup whose verbs denote actions related to the process of human thinking (4 words, F* = 26) – *determine* (*must be determined*), *consider* (*is to consider*), *find* (*must be found*), *take* (*must be taken into account*). The introduction of the verb

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ISSN *2413-5593*
2018. № 33 (УДК 81) : 82-99
Social Sciences. *Arts and Humanities*
PROBLEMS OF SEMANTICS, PRAGMATICS AND COGNITIVE LINGUISTICS
[PROBLEMY SEMANTYKY, PRAHMATYKY TA KOHNITYVNOI LINHVISTYKY]
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http://philology.knu.ua/node/318

take may seem controversial, since it denotes a physical action, however in text corpora it is used in the phrase "*take into account*" and thus was assigned to the units of this subgroup;

2) verbal units that show the actual physical actions performed by a person (2 words, F* = 7) – *remove* (*has to be removed*), *build* (*must be built)*;

3) a subgroup, which can be attributed to the intermediate area between the first and the second subgroups. It contains verbs that name actions that are performed as a result of human thinking processes (5 words, F* = 23) – *use* (*is to be used*), *apply* (*must be applied*), *select (have to select), reduce* (*the price of the electro vehicle ... has to be reduced...*), *provide* (*conditions of must be provided*). Although these words can not be attributed to the process of human thinking, one can not also say that these are physical actions. The result of these actions can be the creation of some material/non-material object. The authors want to attract attention to the introduction of the verb *reduce* in this subgroup. This verb is used in a context that describes a situation where it is spoken about reducing, decreasing the price, and is found only in the text corpus "Automotive Industry";

Within the second group there are the following subgroups:

1) verbs showing the operations performed by different types of equipment (3 words, F* = 7) – *reduce* (*the speed of motor must be reduced to ...*), *increase* (*has to be increased*), *generate* (*must be generated*). These verbs characterize the operation of the engine, production equipment, power generation systems and are used in all three text corpora. Here the introduction of the verb *reduce* is justified by the fact that it describes, for example, such processes as the decrease in engine speed;

2) a subgroup of verbs that are literally applicable to the very act of doing the work (3 words, F* = 30) – *operate* (*The subsystems must operate more satisfactorily ...*), *make* (*has to make*), *do* (*must be done*). The verb *operate* is introduced into this subgroup, as in the texts of the studied specialties it has the meaning that is provided in Longman Dictionary [3]: b) if a machine operates in a particular way, it works in that way.

3) a subgroup made of verbs used to describe the standards or requirements for equipment, they can also be found in the instructions (2 words, F* = 19) – *meet* (*The requirements for the Software are to be met ...*), *have* (*must have*).

The verbs of the third group are divided into the following subgroups:

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(Problems of linguistic semantics)
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[ПРОБЛЕМЫ СЕМАНТИКИ, ПРАГМАТИКИ И КОГНИТИВНОЙ ЛИНГВИСТИКИ]
Київський національний університет імені Тараса Шевченка, Україна
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1) the verbs that denote computing processes (2 words, F* = 10) – *calculate* (*are to be calculated*), *add* (*must be added*);

2) the verbs that describe the actions that a computer performs with the help of computer design (2 words, F* = 10) – *draw* (*has to be drawn*), *design* (*must be designed*);

3) the verbs denoting the actions of the computer for control and monitoring purposes (2 words, F* = 6) – *control* (*must be controlled*), *operate* (*… the tool must be operated from the special place ...*). In this subgroup, the verb *operate* has the meaning "manage".

Now let us try to combine the semantics of modal verbs and main verbs. According to Longman Dictionary of Contemporary English [3] *must* has the meaning – 1) "to have to do something because it is necessary or important, or because of a law or order". According to Longman Essential Activator [4] *must* has the meaning: "have to do something, especially because you feel that you should do it or because there is a rule that says you have to do it." According to the definitions given in Webster's [11] *must* means: 1: an imperative need or duty: requirement 2: an indispensable item: essential. Definitions of *must* in Dictionary by Merriam-Webster [1] are as follows: used to say that something is required by a rule or law; used to say that someone should do something; used to say that something is very likely. As you can see, the general definitions of the three authoritative lexicographic sources coincide.

Some words concerning the statistics of the verb *must*. The modal verb *must* is joined by the vast majority of main verbs – 22 words, which is 96% of the number of all verbs in the list. Their total frequency is equal to 81 words, i.e. approximately 60% of the total frequency of usage in the texts of all verbs of the list. Here verbal units from all semantic subgroups are used (9 subgroups). As can be seen from table 2 the only verb that did not join it is the verb *draw*. The fact that almost all main verbs from the list are combined with *must* can be explained in the following way: *must* is more formal and more emphasizing the need for some action (in accordance with the definitions of Webster' [11] – emphatically imperative) than all other options meaning "obligation" (have + Inf., be + Inf.). It is obvious that the meaning of the imperative, present in the verb *must*, is more preferable for scientists describing their scientific objects, than more softened meanings of this verb variants.

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Вплив семантики компонентів у модальних дієслівних конструкціях з модальніми дієсловами «повинності» на їх граматичні та статистичні особливості (на матеріалі текстів технічного дискурса) (Англійською)
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Table 2 also demonstrates that in the text corpus of the studied specialties preference is given to the verbs in the form of passive voice (they are almost twice as many).

Let's see the verbs of what semantics disappear from the form of the active voice:

a) in the first group, in the subgroup "the process of thinking of a man" there is only a verb *take* left for using in the phrase "*take into account*" (*determine, consider* and *find* go); – further, the subgroup "real physical action performed by man" (verbs *remove* and *build*) completely disappears from the active voice; – in this form more than half of the verbs from the subgroup "naming actions that are performed as a result of human thinking processes" (*apply*, r*educe*, p*rovide*) are not used with only *use* and *select* remained; b) in the second group, in which verbs describe the actions performed by different types of equipment in the production process, only the verb *increase* is used in the active voice (the verbs *generate* and *reduce* are not used); c) in the third group, concerning the operation of the computer, the most important verb for describing the computational processes *calculate* does not have the form in the active voice, only *add* is left with its minimum frequency. The subgroup of the verbs that describe the actions performed with the help of computer design (*draw* and *design*) completely disappears.

The following subgroups of the verbs have not undergone any semantic limitations in the form of the active voice: – the verbs that are applicable to the description of the "act of doing the work" – *operate, do, make*; – the verbs that are used to describe the standards or requirements for equipment *meet, have;* – the verbs that name the actions of the computer when controlling *control, operate*.

Thus, in technical texts in the MVC with *must* in the form of the active voice, most verbs that describe the mental and physical actions performed by a person are not used. There is almost no personal presence of man who would have clearly controlled everything by himself, directed and designed the production processes, this is "entrusted" to the product of his intellectual activity – artificial intelligence, a computer. With the help of the verbs in the form of the passive voice the influence of a person manifests indirectly, the focus is on the production processes and objects, the operation of equipment, power systems, which need to be controlled, designed, built, viewed, etc.

The second place as to the frequency of joining the main verbs and, accordingly, the variety of semantic subgroups, is taken by *have to + Inf.* (F* = 34). The semantic meaning of *have to + Inf.*, according to Longman Dictionary of Contemporary English

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[3], is the following: have to do something: need to do something because it is necessary or important; the one presented in Longman Essential Activator [4] is the following: you must do it, especially because of the situation that you are in makes it necessary or because there is a rule that says you must do it. Such definition, in addition to the meaning of "necessity of action", clearly emphasizes the semantic tinge "forced action", which, of course, should affect the nomenclature of semantic subgroups of the verbs that join *have to + Inf.*

As in the case with the modal verb *must*, *have to + Inf.* can be used with most verbs (20 verbs, 87% of the number of all verbs from the list), three ones are the exceptions – *provide, control* and *generate.* If you compare the semantic characteristics of these unused verbs, you will get one word from the first group – an action performed as a result of thinking processes, one word from the second group – actions of different types of equipment, and one word from the third group – an action performed by the computer.

The total frequency of 20 verbs makes 34 word tokens, which is approximately 25% of the total frequency of the verbs of the entire list. Both the total number of words and the total frequency are dominated by the form of the passive voice – 14 words, $F^* = 21$; 9 words are used in the form of the active voice, $F^* = 13$. It is impossible not to notice that here the discrepancies in the number of verbal units and their total frequencies in both grammatical forms is not as crucial as that of the verb m*ust*, and the verbs in the lists of both forms are distributed more evenly, which is demonstrated by the results of the study presented below.

Let's consider dependence of grammatical characteristics of MVC with *have to + Inf.* from the semantics of the main verbs. The verbs of the following semantic groups (subgroups) are used in the active voice. The group "actions performed by a person" is presented by: – two verbs of the subgroup "human thinking" – *determine, take*; – one verb from the subgroup "physical action performed by man" – *build;* – two verbs from the subgroup "the result of human thinking processes" – *use, select.*

In the group "the actions performed by different types of equipment in the production process, as well as the verbs used to describe the requirements and equipment standards": – there is not a single verb of the subgroup "operations performed by different types of equipment"; – two verbs of the subgroup "verbs that

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apply to the very act of doing the work" – *make, do*; – both verbs of the subgroup "description of standards or requirements for equipment" – *meet, have*. None of the verbs is used in the passive form in the group "actions performed by the computer".

Semantic groups (subgroups) are used in the passive form in *have to + Inf.* MVC as follows. In the semantic groups concerning human actions in the passive voice there are: – two verbs of "human thinking" subgroup – *find, consider;* – one verb "physical action performed by a human" subgroup – *remove;* – three verbs of "action as a result of human thinking" subgroup – *use, apply, reduce.*

The group "actions performed by different types of equipment in the process of manufacturing, and also the verbs used for describing equipment requirements and standards" shows the following verbal units in the passive voice: – two verbs of "operations performed by different types of equipment" subgroup – *reduce, increase;* – one verb of the subgroup of verbs "literally applicable to the very act of doing the work" – *make*; – one verb of "describing equipment requirements and standards" subgroup – *meet*. In the group "actions performed by the computer" all the verbs *calculate, control, operate, add* are used exceptionally in the passive voice.

Thus, we can make the following preliminary conclusions concerning *have to + Inf.*: 1) *have to + Inf.* semantics admits that all kinds of actions registered in the semantic groups which refer to human activity were performed by a man both explicitly and implicitly. It follows from the fact that the units from all three subgroups of this group were presented in the forms of the active and passive voices practically equally; 2) as for the product of intellectual human activity – artificial intelligence, the computer – in this field the verbs describing the actions of a computer are used exceptionally in the passive voice; 3) if we consider the verbs of the group "operations performed by different types of equipment", we can mention that they are used in the active voice to a limited variant (the group "operations performed by different types of equipment" is deleted entirely), but all subgroups are presented without exception in the passive voice; 4) comparison of the opposite by their semantics groups "human actions" and "operations performed by different types of equipment" leads to the conclusion that in *have to + Inf.* MVCs there is some preference to the verbs denoting human activity. It is seen in quantitative characteristics – 10 verbal units (in all semantic subgroups) against 4 verbs. It is possible to object that the verbs of the group "operations performed by different types of equipment" are fewer quantitatively (8 words) than in the group

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"human actions" (11 words). Nevertheless, they are twice fewer when attaching to *have to + Inf.* MVC.

Be to + Inf. MVC is the third in terms of attaching verbal units and frequency of their usage in text corpora. As it follows from the mentioned above examples, the semantics of this word combination in the texts of the specialties under inquiry reflects the first two definitions in Longman Dictionary of Contemporary English [3]: a) used to talk about arrangements for the future; b) used to give an order or to tell someone about a rule.

Only 9 main verbs (approximately 4% of the whole word list) with the total frequency of 19 word tokens (14% of all word tokens) can be related to this type of MVCs. Two verbs *have, provide* (F* = 7) function only in the active voice, one verb *use* – in both the active and passive voice, 6 – only in the passive voice.

In the active voice: "actions performed by a man", the subgroup "the results of human thinking", two words *provide* and *use*; – from the group of verbs defining manufacturing processes, the subgroup "describing equipment requirements and standards" is presented by one word *have*.

In the passive voice the verbs of the following semantic groups are presented: "actions performed by a man", two subgroups – "human thinking" (*determine, consider, take*); – "the results of human thinking processes" (*use*); "actions performed by different types of equipment in the process of manufacturing, and also the verbs used for describing equipment requirements and standards", the subgroups: – "operations performed by different types of equipment" (*generate*); – "acts of doing the work" (*make*); – "describing equipment requirements and standards" (*meet*); "actions performed by the computer", the subgroup: – "calculation processes performed by the computer" (*calculate*).

Despite the low numerical indicators for the main verbs used in *be to + Inf.*, it is possible to notice some kind of consistency in exposition of units of different semantics. Thus, for example, the both opposition groups, representing both a man and a machine, function in the active voice. The units of practically all semantic groups and subgroups considered in this article are used in the passive voice. In other words, we can see more equal distribution of semantic groups comparing with *have to + Inf.* MVC.

The results of the analysis make it possible to come to the following conclusions.

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1. In Modal verb constructions with the modal verbs of "obligation" functioning in the scientific technical discourse texts the predicative meaning of modal verbs is determinant for the semantic features of main verbs connecting to them (modal verbs). The semantics of the main verbs in its turn influences on their (the main verbs) grammatical and statistical characteristics.

2. The modal verb *must* has the highest frequency of use in scientific texts. It gives imperative which underlines the author's stability of position and faultlessness of the obtained and presented results. In *must* MVCs the verbs in the active voice which denote actions describing human thinking processes or physical human activity are not occurred because the author should take second place and be present indirectly through their scientific achievements. It is possible when using the passive voice. But the result of human intellectual activities that is artificial intelligence, the computer which controls, manages, calculates, etc. takes priority. The verbs describing computer actions are used in the active voice. The verbs connected with manufacturing processes, work of equipment, power systems and motor-car construction are presented both in the active and passive voice. However, here the passive voice is more preferable because their work is not independent but is managed by a man or computer.

3. *Have to + Inf.* MVC is much less frequent and it is a result of the modal component semantics of this construction. Apparently, "the forced action", i.e. the fact, that the objects under their scientific observation depend on situations or circumstances, is not acceptable for the authors of scientific articles. In the text corpora the words with semantics concerning the mental and physical activity of a man are used in such MVC as the main verbs. It is possible to notice their quantitative preference. They are used equally in both grammar forms. In h*ave to + Inf.* MVC the verbs with the semantics "operations performed by different types of equipment" are presented quite limitedly in the active voice and in full – in the passive voice. In these MVCs all verbs referring to computer activities are functioning exclusively in the passive voice.

4. Finally, Modal verb constructions where the modal verb is *be to + Inf.* According to the statistical data received while researching text corpora "Electrical Engineering (Energy Saving and Power Management)", "Automotive Industry" and "Chemical Engineering", this construction is used by the authors of scientific articles quite rarely – 19 times just with 9 verbs. It can be explained by semantic peculiarities of the verb *be to + Inf.* itself. Scientists do not appear to need the element which would

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point directly at their presence in the form of any agreements, rules, etc. (the main semantic meaning of this modal verb) when they describe their results. Scientific articles of the researched fields of technical discourse are mainly about machines, equipment, manufacturing processes, laboratory researches and other objects of scientific activity. Nevertheless, these MVCs have been analyzed and we can make the conclusion that the preferable grammar form for the verbs of any semantics in this MVC is the passive voice.

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