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MODELING OF INFORMATION RESOURCES PROCESSING IN ELECTRONIC CONTENT-COMMERCE SYSTEMS

Introduction and the general problem formulation

Main task of electronic content-commerce systems (ECCS) is to facilitate the information resources work of the moderators, authors, analysts and administrators. The main goal of ECCS functioning is improving the information resources functionality for users of the content. ECCS selected topical issues range in a content set from various external sources for moderators and authors according to their ranking through the commercial content formation subsystem. Author creates a commercial content according to automatically matched information analysis from various sources of actual content. Moderator creates the new rules when necessary to content filter from different sources. He also updates the other sources addresses in the subsystem of commercial content formation. Analyst analyzes the the target audience activity and ECCS functioning. As a result he develops new rules of statistics and dynamics analyzing of the commercial content lifecycle through commercial content support subsystem. These rules can increase the target audience range; visits number; the unique visitor's number; repeat visits; visits number from search engines; direct visits number; regional visits number; thematic visits number, etc. for information resources in the ECCS.

The problem of the relationship with important scientific and practical tasks

The article purpose is modeling of information resources processing in ECCS. This allows a general approach for the design, construction and implementation of similar systems. Such problems solving promotes methods generalization and standardization of information resources processing in ECCS using stages of commercial content formation, management and support. This helps to reduce the construction time for a typical e-business systems building. Such systems implementation allows to reduce time in the production of its own commercial content, to analyze outdoor commercial content derived from external sources, to analyze the dynamics of content lifecycle, to analyze the statistics of the ECCS functioning, to analyze the statistics of user activity of information resources in the ECCS, to increase the target audience of information resources and to expand the feature set in ECCS. As a result of modeling and development of information resources processing in ECCS is a set of functional requirements and standardized specifications for similar systems creating. The purpose of these requirements is to provide a generalized approach for ECCS developing as an online newspaper, online magazine, online publishing, distance learning, online shop for content selling in the form of electronic books, photos, videos, audio and more. The requirements standardization for the ECCS construction provides a generalized approach creating for developers of such systems. This reduces the time for such systems design and implementation with the phase avoidance of the respective project development.

Recent research and publications analysis

The process of ECCS designing and creating is an iterative as Internet marketing result (Fig. 1). It contains in its structure of stages number (from a plan analysis, design and development to a prototype build and experimental tests). This process begins with the specifications and layout formation, content template creation, content formation and its subsequent placement of structures according to information resources [1-3,

6-8, 12]. In the initial stages (before the functional requirements defining and the development process beginning) are involved regular users in the process through poll letters, alternative design and prototyping of varying degrees of readiness. Without much effort is collected information thus valuable. At the same time evoke a direct involvement sense of users in the design process and their trust conquering.
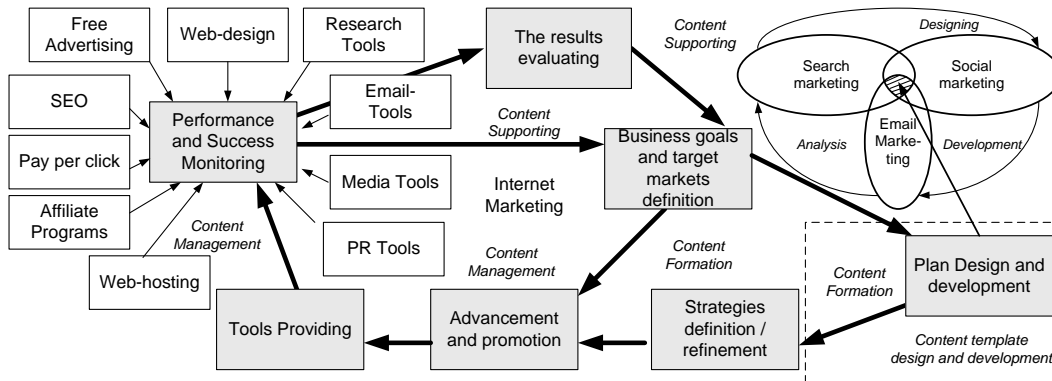

Fig. 1. Mechanisms application scheme of Internet marketing in electronic content commerce systems

The main component of the project is the information architecture development. First need define the basic requirements for the project (access to content about the conference or the audience) through monitoring users performance and success. By users response form the information architecture of the site (Fig. 2) according to the system type of content trading [1-2, 12-14]. The main classes of users/personage site (clients, working group's managers and administrators) define information resources design and decision making process. Then determine important content and its connection with the main users classes. Next moderators create site content architecture by electronic catalogs, its hierarchy, representation methods and each users class interaction with this information (eg, conference data include topics and issues on the agenda and session planning of these issues).
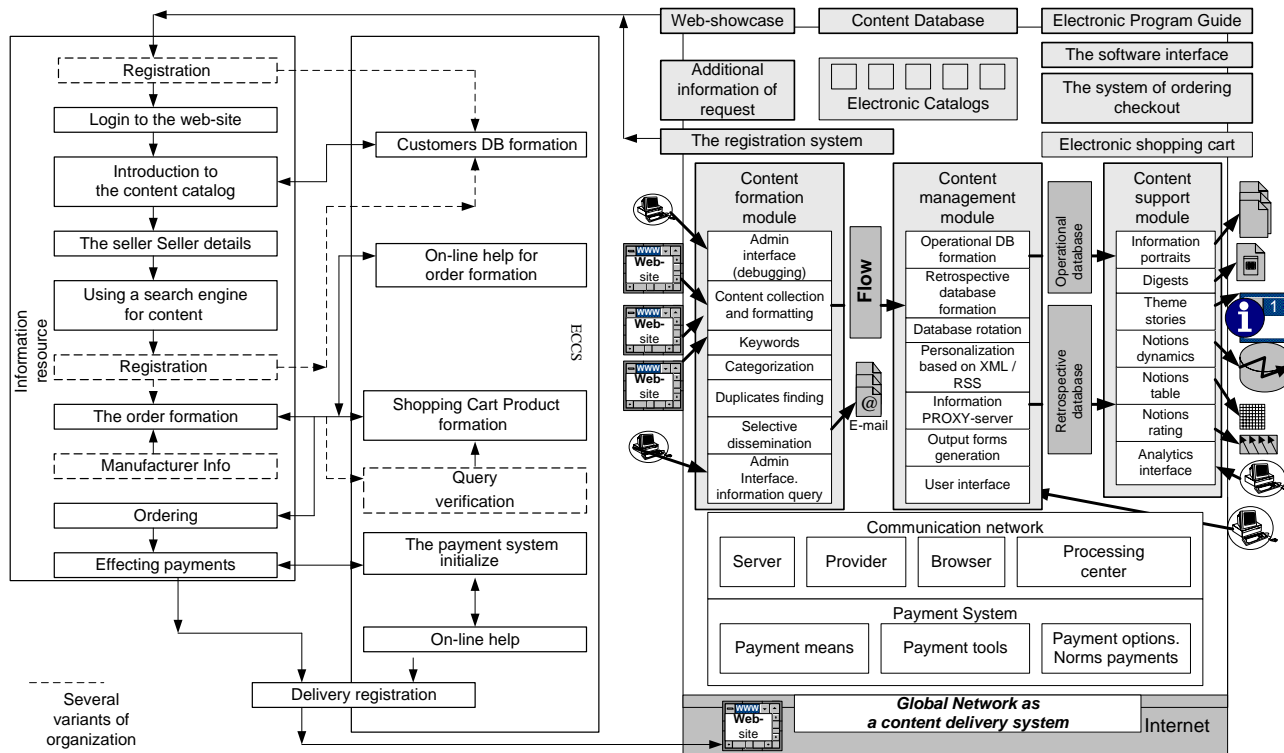

Fig. 2. Interaction scheme between the components in electronic content commerce systems

Electronic catalogs are classified as common (supports a wide list of different items), commercial (focus on the characteristics of the market, suppliers, competitors) and specialized (dedicated to a narrow topic) [1-2]. In Fig. 3 presents a typical diagram of information resources processing in the ECCS. The user/buyer fills in the form after content selecting, indicating of payment/delivery method. Interaction is carried out over a secure SSL channel to personal content protect. The content gathered about the customer goes to the ECCS after the order formation and user registration. Then the system initiates a request to the payment system. In ECCS formed delivery ordering after the notification on the on-line payments implementation.
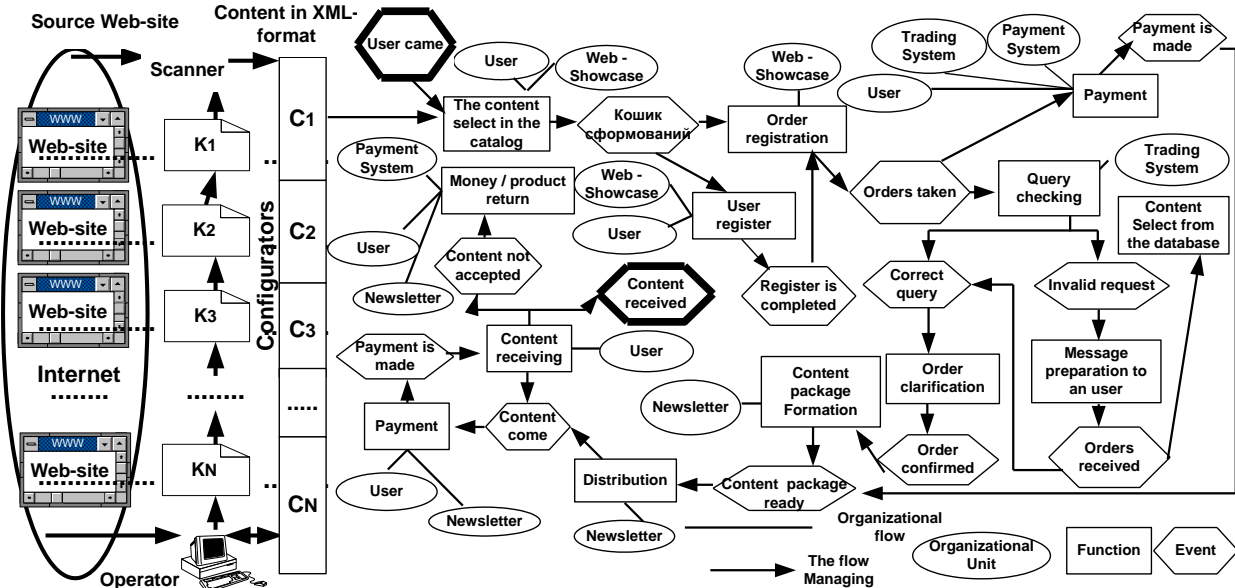

Fig. 3. General scheme of content management

ECCS management complex structure is implemented as three-tier client/server architecture. The content processing carried under the "client/server applications – databases". Request processed applications server. It communicates with the database and payment system at the same time. It also communicates content with relevant systems when connected to the business process of the organization. ECCS is a Web-showcase and trade system set (front-systems and back office). The main functions of ECCS are as information service of user, orders processing, payments, statistical data collection and analysis [1-8, 10-12]. Program complex of ECCS forms interface with user and functional capabilities of the system, based on the company needs. A potential user has the opportunity at any time to get answers to any question (after-sale service provided, consultation with features payment, etc.) that accompanies the buying/selling process. Registration/ authorization occurs before/after choosing of the content. In the first case a registry entry for regular users in ECCS. They are realized by a special scheme of service and cost. Ability to register after the content selection allows the user to remain anonymous and saves time. The system secures the personally identifiable information user. This is used secure channel (SSL protocols or SET) for data transfer. ECCS receives complete content about visitors to the Web-site. This allows building in accordance with its marketing system.

CMS can collect statistical information up to analyze and to use it efficiently (find the position on the site, best for advertising information; automate the advertising campaign progress). Additional content publication is implemented using a single server of applications (publications area) and databases. ECCS is to use information technology in the interaction of trading companies with retail buyers. It also provides sales and full lifecycle of commercial content. Workers omposition in ECCS are much wider. It includes users (sellers, customers), a financial institutions number (the issuing bank, the seller/buyer bank, esquire bank), computer centers, etc. Users perform primarily natural persons as well as agencies, social institutions, other customers (legal entities). ECCS is to support content the lifecycle (Table 1) [1-3, 6-8, 10-12].

Content lifecycle classification

№	Stages of information resources processing		
	Content formation	**Content management**	**Content supporting**
1	Content collection/creation (data collecting from different Web-sites and formatting).	Content developing (databases formation, their rotation and access ensuring).	Content structuring (content themes identify, notions relationship tables build).
2	Content systematization (key words and notions identification, duplication, automatic categorization).	Content analysis (personalization and statistical analysis of users work).	Content moderation (information portraits and digests formation).
3	Content distribution (moderators ranking and selective distribution of content).	Content presentation (searches providing in the database, output forms generation, interaction with other databases).	Content generalization (notions ratings calculated, new events identifying, them tracking and clustering).

Sellers in the ECCS are different organizational forms of trading content. Communication networks form providers, servers, processing centers and more. Delivery system form the corresponding exchange channels and Internet resources [1-2]. All components interact in a system of relationships. This guarantee the ECCS stability and reliability. Important elements of ECCS are the organizational forms of electronic content-commerce. They have a single focus – rocess providing of retail sale. But they differ in composition, structure, purpose of ECCS [1-2]. Web-showcase belonging to the common organizational forms of content selling. It serves as an independent component or is part of ECCS. Web-showcase is a tool to attract customers and does not provide the full cycle of goods sale. This task performs the ECCS, which provides full range of interactively content purchase/sale through the Web an electronic catalog using. Electronic catalogs – a directory of content searchable for characteristics as name, designation, date, category, etc.; systematic content set of available navigation system) [1-2].

ECCS provides the catalog review, content categories choice, ordering, mutual implementation, the order tracking. ECCS is hardware-software components for the operation: Web- showcase (front office) on the Web-server, e-catalogs, payment system, modules of content formation, management and support. Web-showcase have the active content, is static in ordinary HTML-files or dynamic display of content from the database. Web-showcase contains information about the name, profile, status of ECCS owner, content and services range, payment means, discounts, warranties, terms of content delivery [1-2].

Problems selection

The process of processing information resources implemented as follows *content formation* $\rightarrow$ *content management* $\rightarrow$ *content support*. Ago model of electronic content commerce systems presented as $S = \langle X, Formation, C, Mamagement, Realization, Y \rangle$, where the value $X = \{x_1, x_2 \ldots, x_{n_X}\}$ – input data set, *Formation* – the operator of content formation, $C = \{c_1, c_2 \ldots, c_{n_C}\}$ – content set, *Management* – the operator of content management, *Realization* – operator of commercial content support and $Y = \{y_1, y_2, \ldots, y_{n_Y}\}$ – set of output data. Input variables x_i are independent and content set c_j and output y_k are dependent [2, 10-11]. Stage of content formation is described by the operator $c_j(x_i, t) = Formation(U_F, x_i, t, \Delta t)$ in terms $U_F = \{u_{f_1}, u_{f_2}, \ldots, u_{f_m}\}$ of outcome $c_j = \left\{ \bigcup u_{f_k} \middle| (x_i \in X) \wedge (\exists u_{f_k} \in U_F), U_F = U_{Fx} \vee U_{F\bar{x}}, i = \overline{1,m}, k = \overline{1,n} \right\}$. Stage of content management described by the operator $c_j(q_l, t) = Management(U_M, q_l, t, \Delta t)$ when user requests prompted $Q = \{q_1, q_2, \ldots, q_{n_Q}\}$ with terms $U = \{u_{f_1}, u_{f_2}, \ldots, u_{f_m}\}$. Commercial content management is as

$c_j = \left\{ \bigcup u_{m_k} \middle| (q_i \in Q) \wedge \left(\exists u_{m_k} \in U_M \right), U_M = U_{Mq} \vee U_{F\bar{q}}, i = \overline{1,m}, k = \overline{1,n} \right\}$. Content support Stage is described as

$y_k(t + \Delta t) = Realization(U_R, c_j, q_l, t, \Delta t)$ under   conditions $U_R = \{u_{r_1}, u_{r_2}, ..., u_{r_z}\}$,   that   is

$y_j = \left\{ \bigcup u_{r_k} \middle| (q_i \in Q) \wedge \left(\vec{c} \in C \right) \wedge \left(\exists u_{r_k} \in U_R \right), U_R = U_{Rc} \vee U_{R\bar{c}}, i = \overline{1,m}, k = \overline{1,n} \right\}$. Thus, the efficient and adequate model establishment of the content formation, management and support enables a uniform standardized approaches for ECCS construction. This task performing, in turn, will greatly simplify and accelerate the such systems creation and implementation.

Goals formulation

The aim is to build a model of the information resources processing in ECCS to the functional requirements determine for the subsystems of commercial content formation, management and support. Accordingly, this involves each of the actions modeling that implement these subsystem. Then these actions models must combine and synthesize them into a single coherent model. It should describe the requirements for the ECCS functioning in general.

Research results analysis

Information resource in ECCS is a data plural with a properties set that are object to technology action for them transform into content. The result of the same technology applying can be another information source. Content in information technology is formalized information and knowledge that placed in the system environment. And, in contrast to the data, they are no detailed specification of their properties, methods of formalization and regulation. The one important problem of the ECCS construction and operation is different data convert (by nature, meaning and origin) in a consistent, centralized information resource. The procedure for information resources forming and using in ECCS determine the data selection methods from primary sources, their fixation and filtering, conversion to the specified format for content create and location in the database. The content value determines its attractiveness to the consumer. Content integrating makes an attractive information resource and applications integration – useful. ECCS use does not require software installation. Moderators are using a browser for contetnt editing and information resource administration. Intuitive interface and work simplicity with system facilitates the information resources management and reduce the further cost of contetnt support. ECCS includes the following features: fast updates and search of content in information resources; data collect about permanent/potential customers; questionnaires creation and editing; visiting analysis of information resource.

A set building of formal models provides problem solving of the basic processes research, analyze and describe of information resources processing in ECCS. The purpose of each model is the manipulation, actions and transformations specification performed by a commercial content. The main processes in ECCS (modeling which is described in this paper) are commercial content the formation, management and implementation.

The content formation modeling. This process provides the information obtaining from a variety Web-sites and its formatting; content keywords and concepts identify; content categorization; content duplication identify; selective dissemination of commercial content.

The commercial content formation for an information resource provides a link between a input data set from different sources and set of commercial content formed into the appropriate database in ECCS, ie $Sourse(x_i) \rightarrow x_i \rightarrow X \rightarrow Formation(u_f, x_i, t_p) \rightarrow c_r \rightarrow C \rightarrow DataBase(C)$, where $Sourse(x_i)$ – the x_i content source, x_i – i-th content from the source, X – the data set of relevant sources, $Formation(u_f, x_i, t_p)$ – the operator of content formation from the source content x_i to the fixed time t_p for the content formation conditions u_f, c_r – formed under condition u_f of r-th commercial content, C –the prevailing commercial content set, $DataBase(C)$ – database of generated commercial content. Content formation realize as content-

monitoring systems to content collect from different data sources. Also, in the process provide a content database creation according to the information users needs. Content leads to a common format by gathering and initial processing. Then it is classified according to the specified rubricator. Also, he is credited descriptors with keywords. The general model of content formation is presented as a type tuple

$$Formation = \langle X, C, Gathering, Formatting, Key, Categorization, Backup, Dissemination \rangle,$$

where $X = \{x_1, x_2, ..., x_{n_X}\}$ – input data set to the Web-site or from moderators, $C = \{c_1, c_2, ..., c_{n_C}\}$ –content set, $Gathering$ – operator of information collecting from sources, $Formatting$ – operator of information formatting and converting in the content set, Key – the operator of keywords identify, $Categorization$ – automatic categorization operator, $Backup$ – the operator of duplicate content detection, $Dissemination$ – the operator of selective content distribution.

Effective solutions (they can help navigate in the dynamic input information from different sources) provide data syndication process (data collection from sources and further distribution of its fragments according to user needs). Content syndication technology contains learning programs of data collect and structural features analysis of individual sources (with Web-site, from the moderators, users, visitors, journalists, editors), directly content scanning and the general XML-format bringing, categorization. Means of content classification and distribution is information retrieval system of selectively content distributing (content router). The resulting content is analyzed for compliance with thematic queries. Relevant content sent to users and loaded into thematic database. The content set form the operator $C = Formatting\left(Gathering\left(X, U_G\right), U_{FR}\right)$, where U_G – set of data collecting conditions from various sources, U_{FR} – the set of data formatting conditions. The operator of content duplication identify $C = Backup\left(C, U_B\right)$, where U_B – conditions set of content duplication identify. Content duplicate detecting in the ECCS shall be made on the basis of linguistic statistical methods. They consist in general terms identifying. Terms strings form the verbal content signature. The content properties analysis on reflexivity, symmetry ($\forall i, j : a_{ij} = a_{ji}$) and transitivity ($\forall i, j, k : a_{ij} = 1, a_{jk} = 1 \Rightarrow a_{ik} = 1$) uses the equivalence relation, ie the ratio of the content coincidence or duplication. Content duplicate property is more solid criterion of similarity, for example, the 3, 4 or 5 terms coincidence shows some affinity of content. Each content c_j is associated with a vector with elements a_{ij} of the above algorithm for matching terms in the signature. This vector is a value $c_j \equiv c_k$ equal to 1, otherwise 0. Next system explores the similarity criteria. For this purpose it changes volume in comparison terms signature. It does to achieve for a coefficient achieving of asymmetry (the previous definition of duplicates) and transitivity (duplicate definition of completeness). These coefficients are used for the related approach validate to the equivalence properties.

Operator of categorization is $C_{Ct} = Categorization\left(Key\left(C, U_K\right), U_{Ct}\right)$, where $Key\left(C, U_K\right)$ – keywords and concepts detection, U_K – conditions set keywords and concepts identify, U_{Ct} – conditions set of automatic categorization, C_{Ct} – classified content set.

Content set developing C built on the principle of keywords finding in content (terms) to meaningful keywords identify. The process is based on Zipf's law. It comes down to words choice with an average frequency of occurrence (frequently use words ignored by stop-dictionary, and rare words in messages are not included). The selective distribution operator of content is $C_D = Dissemination\left(C_{Ct}, U_{Ds}\right)$, where C_{Ds} – set of selectively distributed content, U_{Ds} – conditions set of selectively distributed content. Selective dissemination of the content list $C_{Ds} = \sup(C_{Ct})$ depends on the demand level for this content.

Association rules of a content list generate consists of original content list C_{Ct} and the content list, selected from the original – the derivative list C_{Ds}, that is $C_{Ct} \rightarrow C_{Ds}$. Association rules Formation is to create content, formed by the merger of the original list and the derivative list. The probability of association rules creating is the probability with which the content of the original list C_{Ct} appear with the content C_{Ds} in the database, ie. $Conf(C_{Ct} \rightarrow C_{Ds}) = \dfrac{\sup(C_{Ct} \cup C_{Ds})}{\sup(C_{Ct})}$. The derivative list of selected rules determines user. Frequently used content list is a list, the formation of which exceeds the minimum level. Even with this condition is a lot frequently used content on the queries. Result particularly limited in $Imp(C_{Ct} \rightarrow C_{Ds}) = \min(\forall C`_{Ct} \subset C_{Ct}, Conf(C_{Ct} \rightarrow C_{Ds}) - Conf(C`_{Ct} \rightarrow C_{Ds}))$.

Model of information resource management. The main tasks of content management are: databases formation and rotation of commercial content; access providing to them; operational and retrospective databases formation; user personalization; personal user queries and sources maintaining; operation statistics counting; search maintaining in database; initial forms generation; information interaction with other information resources. Modelling of content management is implemented as follows.

1. <u>Pages generate on request</u> is based on action sequences – "*content editing → record in Database → content presentation*". Stage model of pages generation on the user request is served as $Management_Q = \langle X, C, Q, R, Edit, Y \rangle$, where X – input data set, C –content set, Y – generated pages set, Q – queries set, R – function operator of page formation and presentation, $Edit$ – content editing operator, ie. $\vec{c}(x_i, t) = Edit(\vec{c}, x_i, t)$. Pages formation is described by the operator $\vec{y}(t + \Delta t) = R(\vec{q}, \vec{c}, Weight, t, \Delta t)$, where $Weight$ – the total weight of the content block, that is

$$y_i = \left\{ \bigcup c_j \Big| (\forall c_j \in C_q) \wedge (\exists q_i \in C_q), C = C_q \vee C_{\bar{q}}, j = \overline{1,m}, i = \overline{1,n} \right\}.$$

2. <u>Pages generate when editing</u> is to create a static pages set when changes are made to the site content. That process takes place under the "*Edit subsystem → database*". It does not take into account the interactive communication between visitor and website content. Stage model of pages generation when editing present as $Management_E = \langle C, Edit, Y \rangle$, where C –content set, $-Y$ – set of static pages, $Edit$ – operator of content editing/modifying, ie. $\vec{y}(t) = Edit(\vec{c}, Weight, t)$.

3. Mixed type combines the advantages of the first two types. It is implemented under the "edit → information blocks database → collect → presentation" one of two ways.

1. *By means of caching*. The presentation module generates a page once. Further, it is much faster loading from the cache. The cache is updated automatically after a certain period of time, when updating certain sections of the site, or manually by the admin team.

2. *Information blocks formation*. This is to save the blocks in the site editing stage and page collection with these blocks when user requesting.

Mixed type model served as $Management_M = \langle X, C, Q, R, Edit, Caching, Y \rangle$, where X – set of input data, C –content set, Y – set of generated pages, Q – queries set, R – operator of page formation and presentation, $Edit$ – operator of content editing and updating, $Caching$ – operator of cache or cache information blocks formation, where the cache $Cache = Caching(\vec{y}, Weight, t, \Delta t)$, that

$$Cache = \left\{ \bigcup y_i \Big| y_i \in Y, t + \Delta t, i = \overline{1,n} \right\}.$$

Process model of content realization. As part of this process is provided information portraits formation; digests formation (publications summaries); thematic stories identify; tables construction of concepts relationship; concepts ratings calculation; new events identifying, tracking and clustering their. Formal models of content realization specifies the tuple form

$$Realization = \langle X, C, BuInfPortr, BuDigest, IdThemTop, ConCorrTablConc, CalRankConc, Y \rangle,$$

where X – input data set, C – content set, $BuInfPortr$ – operator of information portraits formation, $BuDigest$ – operator of digest formation, $IdThemTop$ – operator of thematic scenes detection, $ConCorrTablConc$ – operator of concepts relationship tables building, $CalRankConc$ – operator of concepts rankings calculating, Y – - set of initial information.

The content set is $C = \langle C_P, C_D, C_T, C_C, C_R \rangle$, where C_P – a content subset of information portraits, C_D – a subset of digest content, C_T – a content subset of the thematic scenes, C_C – a content subset of the concepts relationship tables, C_R – a content subset the of concepts ratings. The content set of information portraits $C_P = BuInfPortr(X, U_P, C_P)$, where U_P –set of conditions for the information portraits formation. The set of digests content $C_D = BuDigest(X, U_D)$, where U_D – set of conditions for the digests formation.

The set of thematic stories is defined as $C_T = IdThemTop(X, C_T, U_T)$, where U_T – set of conditions for thematic scenes identify. The set of concepts relationship tables $C_C = ConCorrTablConc(C, U_C)$, where U_C – conditions set of tables building of relationship concepts. The set of concepts ratings $C_R = CalRankConc(C_C, Tonality, U_R Spam)$, where U_R – parameters set of concepts ratings calculation, $Tonality$ – content tone criterion, $Spam$ – the operator of spam definition. The set of initial information is $Y = Realization(C_D, C_R)$.

In assessing of content tone examined the hypotheses space. It contains tone $Tonality = H_{-1}$ (negative), $Tonality = H_0$ (neutral) and/or $Tonality = H_1$ (positive). For example, if in content ishypotheses H_1 (positive tone) and $\overline{H_1}$ (not positive tone) then from the positive tone set elected specific terms to this content. Among these choses terms t with probability > 0.5, such as 0.6, which is calculated by the Bayes formula. Such terms are called tonal-colored or tonal terms that have value semantics and $\forall t$ weight $Weight = \alpha$. Positive and negative tone is antagonisms. So, the final decision on content tone take into account the difference between the values of the weighted hypotheses estimates H_1 and H_{-1}.

ECCS model is universal and easy to describe of typical systems operation. Models of information resources processing allow standardize of basic system functions as the content formation, management and realization. Based on the developed models, in particular, solve the problem of a typical architecture building of ECCS. Also for typical systems and their components form the specification of functional and non-functional requirements such as interaction means with the end user. In turn, in ECCS implement the procedures for content analysis, statistical data collection and processing of information resources visit. Models of content the formation, management and implementation allow to simplify the process of ECCS designing through methods unification and standardization of information resources processing.

Conclusions and recommendations for further scientific studies

In the paper analyzes sequence methods and models of information resources processing in electronic content-commerce systems. It also allocated the basic laws of the transition from commercial content

formation to its implementation. Created formal model of ECCS allows to implement phases of the commercial content lifecycle. For this are developed a formal model of information resources processing in electronic content-commerce systems, allowing us to create a generalized typical architecture of ECCS. In the paper are proposed a generalized typical architecture of ECCS, which helped implement the processes of commercial content formation, management and realization.

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