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Kudriashova Alona, Doctor of Technical Sciences, Associate Professor
https://orcid.org/0000-0002-0496-1381
Slipetskyi Yurii, Postgraduate student
https://orcid.org/0009-0003-6931-6767
Lviv Polytechnic National University, Lviv, Ukraine

ONTOLOGICAL MODEL OF FACTORS OF PREPRESS PROCESSING OF NEWSPAPER AND MAGAZINE PUBLICATIONS

Kudriashova A., Slipetskyi Yu. Ontological Model of Factors of Prepress Processing of Newspaper and Magazine Publications. The article addresses the problematics of prepress processing of newspaper and magazine publications, the quality of which directly determines both the perception of informational content and the overall quality of printed products. It has been established that individual component of this process — namely dimensional parameters, typographic, illustrative and compositional design, layout design, and typesetting — define the structural and functional characteristics of a publication. The lack of an integrated system for their formalized representation complicates the unification of terminology and creates obstacles to the automation of publishing workflows. An ontological model of prepress processing factors is proposed, providing a formalized representation of key parameters and their interrelations. The ontology implements a hierarchical structure of concepts and attributes reflecting the interaction among page dimensions, column organization, typographic solutions, illustrative materials, and compositional schemes. The principal classes of the developed ontology correspond to the factors influencing the quality of prepress processing of newspaper and magazine publications, each of which incorporates subclasses of the second level. This approach enables the creation of a coherent knowledge environment suitable for reuse, extension, and integration into contemporary publishing information systems. A methodology for quality assessment of prepress processing of newspaper and magazine publications is proposed, based on the developed ontology that determines the correspondence of factor parameters to recommended design standards and the integral quality indicator. A quality assessment algorithm for prepress processing of newspaper and magazine publications has been developed, which enables users to input layout parameters, aligns them with the respective ontology classes and properties, verifies compliance with normative thresholds, calculates the integral quality index, and generates recommendations for optimization.
Keywords: prepress processes, newspaper and magazine publication, ontology, illustrative design, typographic design, compositional and graphic design, typesetting, layout design, dimensional parameters, algorithm.

Кудряшова А. В., Сліпецький Ю. Б. Онтологічна модель факторів додрукарського опрацювання газетно-журнальних видань. У статті розглянуто проблематику додрукарського опрацювання газетно-журнальних видань, від якості виконання якого безпосередньо залежить рівень сприйняття інформаційного контенту та якість готової поліграфічної продукції. Встановлено, що окремі складові цього процесу, зокрема розмірні параметри, шрифтове, ілюстративне та композиційне оформлення, макетування і верстання, визначають структурно-функціональні характеристики видання. Відсутність інтегрованої системи їх формалізованого представлення ускладнює уніфікацію термінології та створює перешкоди для автоматизації видавничих процесів. Запропоновано онтологічну модель факторів додрукарського опрацювання, яка забезпечує формалізоване відображення основних параметрів та їх взаємозв'язків. Онтологія реалізує ієрархічну структуру понять і атрибутів, що відображають взаємодію між розмірними характеристиками шпальти, колонковою організацією, типографічними рішеннями, ілюстративними матеріалами та композиційними схемами. Тобто, основними класами розробленої онтології є фактори впливу на якість додрукарського опрацювання газетно-журнальних видань. Кожен з основних класів містить класи другого рівня. Такий підхід дозволяє створити цілісне знанняве середовище, придатне для повторного використання, розширення й інтеграції в сучасні інформаційні системи видавничої галузі. Запропоновано методику оцінювання якості додрукарського опрацювання газетно-журнальних видань на основі розробленої онтології, згідно якої визначається відповідність параметрів кожного фактора рекомендованим нормативам оформлення та інтегральний показник якості. Розроблено алгоритм оцінювання якості додрукарського опрацювання газетно-журнальних видань, який дозволяє користувачам вводити параметри макету, зіставляє параметри з відповідними класами та властивостями онтологічної моделі, перевіряє відповідність параметрів нормативним діапазонам, обчислює інтегральний показник якості та формує відповідні рекомендації.
Ключові слова: додрукарські процеси, газетно-журнальне видання, онтологія, ілюстративне оформлення, шрифтове оформлення, композиційно-графічне оформлення, верстання, макетування, розмірні параметри, алгоритм.

Problem statement. In contemporary publishing practice, the quality of newspaper and magazine editions is determined to a large extent by prepress processing, which is understood as typographic, illustrative, and compositional design, layout design, and typesetting. Nevertheless, despite the existence of numerous studies devoted to particular aspects of printing production, a unified formalized model is not developed that integrates the key factors influencing the quality of prepress processes into a coherent system of knowledge. As a result, the unification of terminology, the automation of analytical procedures, and the consistency between editorial and technical stages of publication preparation are complicated.

Analysis of recent studies and publications. Ontological modeling is regarded as one of the principal means of knowledge formalization. Domain-oriented ontologies increase the unification of

terminology and the quality of subsequent analytical procedures, particularly in engineering and production systems [1]. Contemporary studies [2] demonstrate the successful combination of ontologies with other representation methods, including graph neural networks and large language models. Methods of ontology alignment are developed to reduce the heterogeneity of descriptions and to simplify the integration of submodels in complex information environments.

A number of studies [3, 4] confirm the statistically significant dependence of reading speed and accuracy on font parameters, letter spacing, and spatial organization of text. Font recommendation systems are also proposed, which formalize the correspondence of the emotional semantics of content to typographic attributes [5]. Methods of document analysis that focus on the recognition of historical newspaper layouts and the detection of structural zones in document images are actively developed. For instance, study [6] shows the effectiveness of modern detectors and multimodal architectures for the segmentation and classification of text blocks.

Identification of previously unresolved parts of the general problem. Most existing studies focus on describing the practical aspects of font selection, illustrative materials, modular grid formation, and similar issues. However, the necessity of constructing a formalized ontological structure that unites all factors into a single knowledge base is not taken into account. The systemic interaction of dimensional parameters, typographic characteristics, compositional and layout solutions, as well as their combined influence on reader perception and printing quality, is not sufficiently investigated. Thus, the unresolved problem remains the creation of a universal ontology of prepress processing that ensures the formal representation of knowledge and can be integrated into modern information systems of the publishing industry.

Formulation of the research aim. The aim of the study is to develop an ontology-based model of prepress processing factors for newspaper and magazine publications and to design a corresponding algorithm for quality assessment grounded on this model.

Presentation of the main research material. The quality of prepress processing of newspaper and magazine editions is influenced by dimensional parameters, typographic design, illustrative design, compositional design, typesetting, and layout design.

Dimensional parameters determine the spatial organization of the edition. They ensure a balance between informational load and user convenience. The format of the edition influences the volume of information, the placement of textual and graphical elements, and the perception of the material by the reader. In publishing practice, the format is defined as the page size of the edition after trimming, which corresponds to standards.

Newspapers are traditionally divided into several main formats: large, medium, and small. The main newspaper formats are 420×594 mm, 450×598 mm, 420×630 mm, 420×598 mm, 420×578 mm, 420×550 mm, 350×540 mm. A number of derivative formats also exist. Journal formats are also regulated by standards, the most common of which are A4 (210×297 mm) and A5 (148×210 mm). A4 is applied to most periodicals and scientific journals. This format provides sufficient space for text and illustrations. A5 is used in specialized or narrowly thematic editions, where the information volume is smaller and compactness is prioritized. The choice of format is determined not only by aesthetic and ergonomic considerations but also by economic factors, particularly printing and logistics costs. The format determines the font size, line length, number of columns, and the proportions between text and image. Due to changes in the ways information is consumed and the aspiration to improve usability, a tendency toward smaller newspaper formats is observed in modern publishing practice. Journal formats remain stable, but experimental sizes appear in specialized segments to increase brand recognition of the edition.

The volume of a newspaper or magazine is one of the basic characteristics that determine information density and printing structure. It is set by the total number of pages. The volume of newspapers and journals is also indicated in printing sheets. In general, the volume depends on the type and format of the edition.

The page area is the space intended for the placement of text, illustrations, and other elements without external margins. This parameter directly depends on the overall page format after trimming but is always smaller by the total width and height of the margins. The size of the page area determines the capacity of the layout, the possibility of multi-column compositions, the choice of font size, and line length. For example, for newspapers of A2 format, the recommended page area is 386×540 mm, for A3 format — 260×386 mm, and for A4 format — 190×267 mm.

The number of columns determines the modular structure of the page and is chosen with regard to the balance between text density, readability, and requirements of visual composition. Large-format

newspapers traditionally apply 6–8 columns, sometimes 9. This ensures flexible material arrangement and convenient placement of advertising blocks. In tabloids, 4–6 columns are common. Journals usually have 2 or 3 main columns, sometimes with additional narrow columns for notes or quotations. The column format is determined by its width, height, and intercolumn spacing. Columns of 3 ems are considered optimal. The minimum permissible width is 2 ems. At the same time, the width of columns mainly depends on font size. The larger the font, the wider the columns can be. For narrow columns, smaller font sizes are appropriate. For example, a font size of 6 pt is considered optimal for columns from 2 to 2.25 ems wide, while 12 pt is suitable for columns from 5.5 to 6.25 ems wide. To maintain rhythm, intercolumn spacing is identical within an issue. In newspapers, they usually range from 3.5 to 4.2 mm. To create visual space between columns in journals, intercolumn spacing is somewhat larger. Column height is determined by page height but may vary within the page due to inserted illustrations, headings, or other layout elements.

Typographic design shapes the first impression of the edition and ensures convenience of text perception. The choice of typeface, style, and font size determines the stylistic level and cognitive load that the reader experiences during interaction with the text. In modern publishing systems, computer-based processing enables numerous variations in typographic solutions. This creates individual visual concepts. The classification of fonts by functional purpose makes it possible to distinguish body text, supplementary text, and service text. Their design must correspond to semantic significance. For children's periodicals, sans-serif fonts are the most convenient. They ensure simplicity of visual recognition. In editions for adult readers, serif fonts are more appropriate. Such fonts guide the eye movement along the line and stabilize the rhythm of perception.

Readability, that is, the quality and convenience of reading, directly depends on a number of typographic parameters. These include the thickness and contrast of font elements, the ratio between text color and background, line spacing and line length, the balance between the number of characters per line and the number of lines per page. Page format, margin width, and multi-column structure are also important. The presence of "widows" is considered unacceptable, since they disrupt the rhythm of perception.

Typography must also stylistically correspond to the content of the text. The use of several typefaces within one edition is possible only under the condition of visual harmony and functional justification. Means of emphasis include changes in font features (style, size, use of capitals or small capitals), graphic techniques (letter-spacing, indentation, reverse type, use of frames, rules, or color), and combined solutions. Such techniques must remain subordinate to the main principle — ease and convenience of reading. The most important criterion of typographic quality is the absence of noticeable visual fatigue during text interaction.

Illustrative design of newspapers and journals performs decorative and semantic functions. Images help to perceive information faster, emphasize key details, and make the material visually attractive. They can be photographic, graphic, or combined. The choice depends on the topic, genre, and purpose of the publication. Photographs are most often used for documentary recording of events. They are carefully selected and corrected before printing. Drawings, diagrams, and charts are suitable for data summarization. They help to show relationships or explain complex processes. Combined illustrations are usually used in large thematic materials.

The placement of images in the layout is determined by the logic of text presentation. Illustrations must not overload the page or distract from the main content. They are placed in a way that emphasizes semantic accents, helps to structure material, and facilitates reading. A balance between text and images must be maintained.

The quality of illustrations depends on proper technical preparation. For reproduction by printing, high resolution, correct color rendering, and accurate cropping are important. Vertical photos are more often used in portraits and reports, while horizontal photos are applied in panoramas and detailed scenes. Interaction with headings, captions, and other layout elements is taken into account during typesetting. Successful illustrative design strengthens the impact of textual material, helps to convey the atmosphere of an event, and makes the edition recognizable.

Layout design is the creation of a graphical scheme of the issue, which defines the logic of material placement and their visual hierarchy. Layout design is intended for the systematic organization of newspapers and journals. It precedes typesetting and serves as an organizational framework. The layout shows the exact placement of texts, illustrations, advertising blocks, and other visual elements.

In modern practice, layout design is almost completely carried out in a digital environment. Specialized software is used, which makes it possible to form page schemes and to assess the balance between images and texts. Modern computer layout design allows several variants of material arrangement

to be created and the page structure to be promptly changed. For example, with the help of interactive templates, a page is easily adapted to different volumes of information or to other formats of the edition. This significantly accelerates the work and ensures consistency between editorial, artistic, and technical groups of specialists.

Thus, the task of layout design is to construct the logic of the issue. A clear sequence of material presentation must be observed, which gives the reader the opportunity to navigate quickly and at the same time keeps attention. To ensure harmony and rhythm, the number of columns, margin width, and the size of headings and subheadings must be unified. The genre of articles, their volume, and significance are taken into account. Large texts are usually placed in the central parts of the page, while short messages are located on side strips. One of the key aspects is the determination of proportions.

Compositional design forms the architectonics of the page. Composition in prepress processing is regarded as a multidimensional structure that combines aesthetic, cognitive, and functional requirements. Layout design presupposes the creation of a graphical model of the edition that defines the placement and size of the main materials, while compositional design is directed toward forming the artistic integrity of the issue. Here the issues of visual harmony, balance of elements, expressiveness of headings, use of color, contrast, and rhythm are resolved. If layout design defines the spatial logic of information presentation, compositional design creates the emotional and aesthetic impression of the edition.

The peculiarity of the newspaper page structure is a defined scheme of textual and graphical material placement. Large texts and selections of notes are grouped into blocks. They can be arranged vertically or horizontally. The page may contain one large material or several smaller ones. Division into blocks consists not only in placement but also in tonal accents, color highlights, headings, rubrics, or illustrations. Each edition forms its own type of composition. It is characterized by a certain page structure and the assigned role and function of each page. Publications are placed taking into account material significance, genre features, and functional purpose.

Newspapers are characterized by stable forms of page organization, such as “selection,” “candle,” “window,” “footer,” “attic,” and others. A “selection” unites several texts on one topic. A “candle” is a narrow vertical block that occupies one or two columns. A “window” has a frame separation and is used for medium-sized materials. A “footer” is traditionally placed at the bottom of the page, and an “attic” at the top. The composition scheme of a journal is usually mixed: vertical and horizontal blocks are combined. The page may contain elements that in a newspaper would be considered “violations” of the structure, but in a journal they form the overall design concept.

Typesetting is the sequential arrangement of pages from ready-made elements: text blocks, headings, rubrics, and graphic means. It is carried out according to the layout of the issue. Typesetting is one of the final stages of prepress processing, at which structural and graphical project solutions are transformed into an integral composition. At this stage, the final appearance of the future edition is formed.

The quality of typesetting is regulated by a number of basic requirements aimed at eliminating technical and compositional defects. Violation of these norms leads to reduced readability, visual distortions, and the loss of harmony between page elements. Particular attention is paid to the uniformity of typesetting and structural consistency within the entire edition.

The key criteria include the absence of “widows” and ensuring text alignment in columns. Consistency in the number of lines in the main text is an important condition. Alignment of text arrays requires the avoidance of “rivers” that appear due to uneven word spacing. There are restrictions on the number of hyphenations; in particular, more than four consecutive hyphenations are considered unacceptable.

The system of publication arrangement must correspond to the composition of the entire edition. Style and accuracy of execution are obligatory requirements for newspaper and magazine typesetting. All pages must have the same format. Columns must be equal in length. During arrangement, text is always aligned horizontally. At the same time, the last lines of each column are aligned at the same level. Only exceptions are allowed: paragraphs on a strap, breaks, or illustrations occupying several columns.

Newspaper typesetting has a number of rules. Rules inside the material are aligned with the top and bottom lines of the column. They must reach the boundary of the column and the horizontal rules of the footer. Spacing between text, frames, and headings is performed in strict intervals. Footnotes are marked with asterisks and placed at the bottom of the column. Headings must contain at least three lines of text and be placed evenly. Multi-line headings are set taking into account standard intervals. If they are placed in a frame, identical distances on all sides are observed. When a heading is transferred, a hyphen is used, which

is included in the line width. Illustrations must correspond to the page format, must not extend beyond the text, and must have equal spacing. Captions are set in smaller font size.

Magazine typesetting has a different character. A newspaper is oriented toward efficiency and compact presentation of news, while a journal is characterized by visual expressiveness and design solutions. The journal page is often built not only according to a modular grid but also according to principles of artistic composition. Journals allow greater variability in column formats, the use of colored backgrounds, decorative elements, and more complex graphic combinations. Headings are set in several styles and typefaces. The contrast combination of fonts of different styles is common. Illustrations play a central role in magazine typesetting. They often occupy an entire page or spread, and the text is arranged around or integrated into them [7, 8].

On the basis of the presented theoretical exposition, an ontology of prepress processing quality of newspaper and magazine editions is developed and presented in Fig. 1. Ontology is a formalized representation of knowledge in a certain subject domain. It is an ordered set of concepts, attributes, and relations that reflect the structural and semantic characteristics of objects. Ontology ensures unified data interpretation, creates a common basis for their processing, exchange, and integration. The process of ontological modeling consists in identifying basic terms, establishing their hierarchy, defining properties, and formalizing relations with the use of specialized description languages, such as RDF(S) or OWL. Thus, the aim of ontological modeling is the creation of a clearly structured and formally defined knowledge representation suitable for reuse, extension, and integration in various software and hardware environments [1, 9].

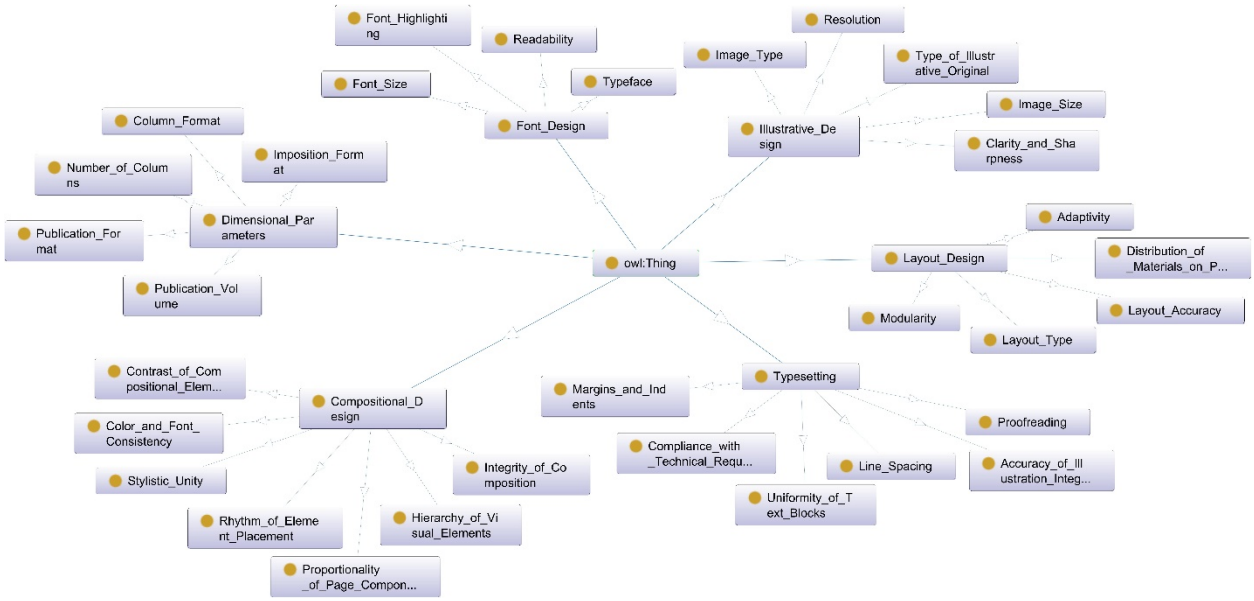

Fig. 1. Ontological graph of classes

The main classes of the developed ontology are the factors that influence the quality of prepress processing of newspaper and magazine editions. Each of the main classes contains second-level classes. For example, the class *Font_Design* includes the subclasses *Font_Sise*, *Font_Highlighting*, *Readability*, *Typeface*.

Despite the detailed classification of publishing parameters, they are predominantly presented in textual form, which complicates further automated interpretation. To address this limitation, elements of data formalization and computable relational links have been introduced into the ontological structure. The formalized representation of knowledge assumes modelling the properties of objects through parameter sets, their weighting coefficients, constraints, and functional dependencies.

Let us denote the set of prepress processing factors as follows:

$$F = \{f_1, f_2, ..., f_n\}. \quad (1)$$

Each factor is described by a parametric vector:

$$f_i = \{p_{i1}, p_{i2}, ..., p_{in}\}, \quad (2)$$

where p_{ij} is a formally defined attribute with a specified type (discrete, numerical, logical), an admissible range, and a semantic relation to other parameters.

For example, for the class *Font_Design*, we introduce a set of parameters that determine the quality of typographic layout:

$$f_1 = \{S, G, R, E\}, \tag{3}$$

where S — the font size, $S \in N$, i.e. S may take natural values (8 pt, 10 pt, 12 pt, etc.); G — the typeface (font type: Serif, Sans-serif, Display, etc.), $G \in \{g_1, g_2, ..., g_n\}$; R — text readability, $R \in [0,1]$; E — a quantitative measure of typographic highlighting, which makes it possible to evaluate the degree of emphasis and the potential increase in cognitive load on the reader, $E \in N$.

Other factors are described according to the same principle.

The integral quality indicator of prepress processing of newspaper and magazine publications is calculated as a weighted aggregated function:

$$Q = \sum_{i=1}^{n} w_i k(f_i), \tag{4}$$

where w_i — the weight coefficient of factor significance, $k(f_i)$ — the function of parameter conformity to the recommended design standards.

$$k(f_i) = \frac{\sum_{j=1}^{m} a_{ij} s_{ij}}{\sum_{j=1}^{m} a_{ij}}, \tag{5}$$

where s_{ij} — the score of the j-th parameter of the factor, normalized with respect to unity; a_{ij} — the local weight of the parameter (its importance relative to factor f_i).

Parameters that do not have a specific numerical value (for example, typeface) are converted into a discrete or scaled evaluation, where each category is assigned a numerical conformity coefficient according to the prescribed standards or application context. This enables qualitative attributes to be integrated into the mathematical assessment model on the same level as quantitative parameters.

Figure 2 presents the developed algorithm for quality assessment of prepress processing of newspaper and magazine publications.

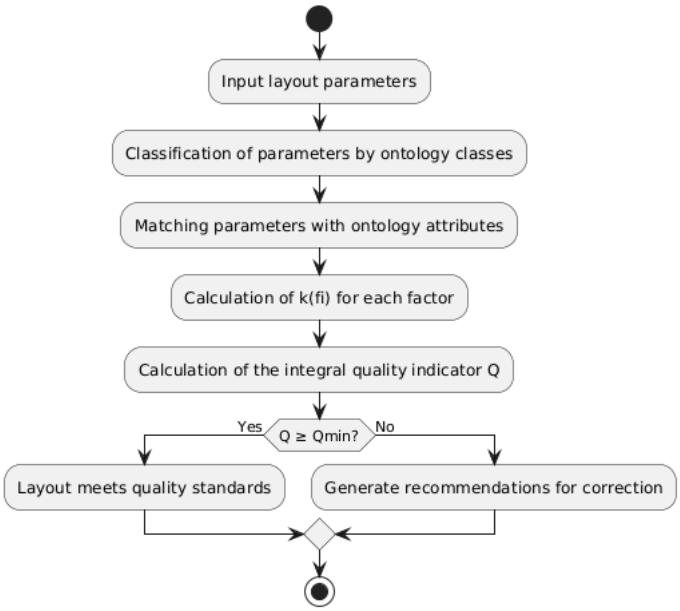

Fig. 2. Algorithm for assessing the quality of prepress processing of newspaper and magazine publications

At the first stage, the information system enables the user to enter layout data of the publication and performs their structuring according to the ontology classes. The parameters are matched with the corresponding classes and properties of the ontological model. Next, a semantic interpretation mechanism is initiated, within which the system verifies the compliance of parameters with normative thresholds. For each factor, a conformity coefficient is calculated, on the basis of which the aggregated quality indicator Q is formed. If Q exceeds the threshold value, the layout is considered compliant; otherwise, recommendations for parameter adjustment are generated. Thus, the ontological model ensures formalization, machine-readable knowledge representation, and the possibility of automated quality control of prepress processing.

Conclusions. The factors that determine the quality of prepress processing of newspaper and magazine publications have been systematized and described. An ontological model has been proposed, reflecting the structure and interrelations between the key parameters — dimensional characteristics, typographic, illustrative, and compositional design, layout and page composition. The developed algorithm enables the determination of the integral quality indicator of prepress processing for newspaper and magazine publications, ensuring reproducibility of assessment procedures and supporting automated decision-making. The obtained results serve as a foundation for the development of an expert evaluation system and for further integration of the model into applied IT solutions within the publishing domain. Future research is expected to focus on expanding the ontology through the inclusion of factors related to digital publication formats.

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