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Articles

Geoinformatics as a Science of Space

Gospodinov Slaveyko Gospodinov [a, *]

[a] University of Architecture, Civil Engineering and Geodesy, Sofia, Bulgaria

Abstract

The article explores geoinformatics taking into account its evolution. The article analyzes new tasks of geoinformatics. The article notes the trend in the development of the Earth sciences, which is the integration of different sciences in geoinformatics. The article analyzes the place of geoinformatics in geosciences and information sciences. The article explores the interaction of geoinformatics with other sciences. It is revealed that geoinformatics is a system of sciences. Geoinformatics connects two areas: information sciences; earth sciences. The construction of spatial models in geoinformatics has been studied. Geoinformatics is considered from different aspects. It is considered as a system that solves applied problems. It is considered as a system for obtaining knowledge and forming a picture of the world. The interaction of geoinformatics with different types of spaces has been studied. Geoinformatics interacts with different real spaces: outer space, ground space, near-Earth space, underground space. Geoinformatics interacts with different abstract spaces: logical space, topological space, geometric space, parametric space and cognitive space. It is shown that geoinformatics solves the problems of information processing and spatial analysis in any space. The analogy of the development of geodesy and geoinformatics is considered. Geoinformatics processes various spatial and information flows. The analysis allows us to conclude that modern geoinformatics is a science of space.

Keywords: geoinformatics, real space, abstract space, earth sciences, informatics, spatial modeling, spatial analysis, system of sciences.

1. Introduction

Currently, in the field of sciences there is a tendency to transfer ideas enriching the ideas of one science into another science. There is a concept that geodesy is the science of space (Savinykh, 2019). The evolution of geoinformatics shows that in this science there is also work with different spaces. Geoinformatics interacts with physical space. Geoinformatics uses topological space and geometric space. Geoinformatics integrates the methods and ideas of other sciences. Such integration of sciences exists in space research. It led to the emergence of space geoinformatics (Bondur, Tsvetkov, 2015) and geodetic astronomy (Gospodinov, 2018) It can be argued that geoinformatics has gone beyond earth's space. Photogrammetric information, geodetic information, cartographic information, satellite information are combined in geoinformatics into common models. Geoinformatics combines different types of information into geoinformation

* Corresponding author
E-mail addresses: sgospodinov@mail.bg (G.S. Gospodinov)

Computer science connects different sciences by methods of information processing. Geoinformatics connects sciences with spatial models and spatial relations. Geoinformatics uses different information systems. The main information system in geoinformatics is a geographic information system. Previously, the basis for processing spatial information was computer-aided design systems. They contributed to the emergence of GIS. The ideology of computer-aided design systems served as the basis for the ideology of GIS (Tsvetkov, 1998). Geoinformatics is widely related to other sciences. Therefore, it is advisable to consider its modern connections and relations with other sciences.

2. Results and discussion

Connection of geoinformatics with scientific directions

There is a concept of a system of sciences. Geoinformatics as a science is in the system of sciences. The systematic approach allows us to consider geoinformatics as a system of sciences associated with other scientific areas. These connections determine the place of geoinformatics in the system of sciences. One of the classifications of sciences is carried out by the Higher Attestation Commission of Russia. Fig.1 shows the place of geoinformatics with similar scientific areas in the system of sciences of the Higher Attestation Commission.

In Figure 1, the symbol E indicates the Earth sciences, and the symbol I denotes the information sciences. The classification of sciences in Figure 1 is chosen in accordance with the designations of the Higher Attestation Commission (HAC). It is possible to distinguish some specialties that have explicit or implicit connections with geoinformatics. These specialties have a common number (the first four digits) as the number 25.00. We will give the full names of these sciences. Specialty 25.00.35 denotes geoinformatics. Geodesy has a number of 25.00. 32. Cartography has the number 25.00.33 Specialty with the number 25.00.34 denotes aerospace studies of the Earth, photogrammetry. Specialty with number 25.00.26 denotes land management, cadastre and monitoring of land. Specialty with code 25.00.23 is physical geography and biogeography, soil geography and geochemistry of landscapes. Specialty economic, social and political geography has the code 25.00.24.

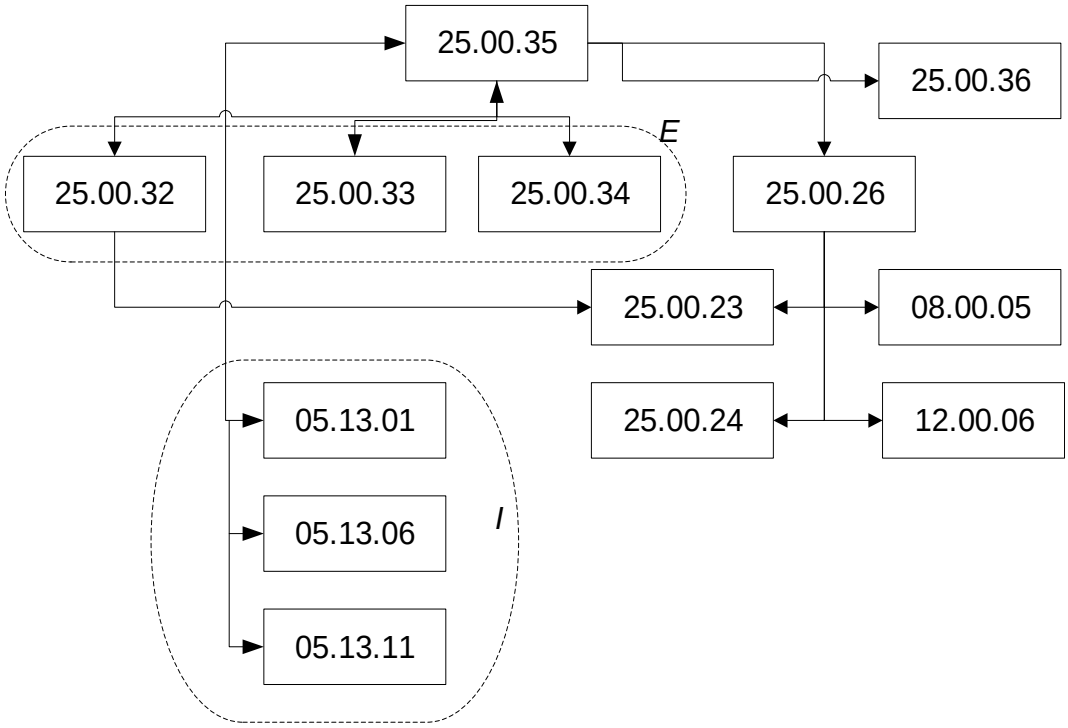

Fig. 1. Connection of geoinformatics with scientific directions

Specialties of information sciences (informatics) are allocated in a separate block. These are specialties under the general number 05.13. According to the classification of the Higher

Attestation Commission, it follows that geoinformatics and informatics are distant sciences. Figure 1 does not highlight all, but only the main or characteristic ones. The specialty with the number 05.13.01 denotes system analysis, management and information processing (by industry). In geoinformatics, system analysis and spatial analysis based on it are used. Specialty 05.13.06 – automation and control of technological processes and industries (by industry). Geoinformation systems solve automation problems, and geoinformation technologies contribute to automation. Specialty 05.13.11 – mathematical support of computers, complexes and computer networks. In geoinformatics, applied information processing programs are used. In geoinformatics, special processing programs are used in geoinformatics information using GIS. Specialty 08.00.05 – economics and management of the national economy. GIS is used as a management system. Geoinformation technologies also solve the problems of management and sustainable development of territories. De facto geoinformatics is related to geoecology, although according to the classification scheme of the Higher Attestation Commission, it is connected through aerospace studies of the earth and photogrammetry. The classification of the Higher Attestation Commission distinguishes between the Earth sciences and information sciences. Information sciences support the Earth sciences and geoinformatics. Based on the analysis, it is possible to define geoinformatics in the system of sciences. The main conclusion: geoinformatics is associated with the Earth sciences and, to a lesser extent, with the sciences of the Earth. Information. Computer science has an interdisciplinary significance. But it is an abstract science. Geoinformatics is an applied science and a science that creates new knowledge.

Geoinformatics can be defined. Geoinformatics is a science that uses methods of collecting spatial information for: information processing, integrated information analysis, obtaining new knowledge based on the use of databases, geographic information systems and computer systems.

Geoinformatics is one of the sciences that contributes to the construction of a picture of the world. The object of fundamental study of geoinformatics is various spaces: space, terrestrial, near-Earth, physical, topological, geometric, parametric.

The main principle of geoinformatics research is a systematic approach (Tsvetkov, 2018).

The object of applied research of geoinformatics are spatial processes; spatial objects; spatial phenomena, geotechnical systems, spatial relations, objects of transport infrastructure.

The main method of geoinformatics is modeling. The result of modeling in geoinformatics are: spatial models of the earth's surface and spatial objects; digital terrain models, cartographic compositions.

Additional methods of geoinformatics are: systems engineering, cognitive modeling, programming, spatial logic and system analysis.

Geoinformatics can be considered as a field of production activity. In this area, it includes the following activities:

- support for the spatial data infrastructure;
- obtaining, accumulating, processing, presenting, disseminating and using spatial information and geodata;
- provision of electronic information services to consumers of spatial and cartographic information;
- development and operation of geographic information systems and software products.

The main advantage of geoinformatics is the use of integrated technologies and integrated data. Geoinformatics allows you to process a wide range of data. Analysis shows that the term "spatial data" is mentioned in the field of geoinformatics more often than the term "geoinformation data" or "geodata" (Savinykh, Tsvetkov, 2014). This gives grounds to consider geoinformatics as a spatial science or a science of space.

Spatial information and spatial models

Spatial information in geoinformatics is stored digitally in databases. The information after processing has a visual form of presentation. Visual information is processed by interactive methods, as well as using cognitive methods. The work (Savinykh, 2016) shows that the Earth sciences create different information flows: graphic, analytical and digital. These information flows are spatial. They require the use of geoinformatics and GIS methods for processing. The use of geographic information systems requires the use of integrated models.

Geoinformatics explores dynamic processes and dynamic spatial models. For example, moving object models are both spatial and dynamic. Investigating dynamic processes requires

creating a support environment. Spatial modeling requires the use of information models and information resources (Tsvetkov, 2016a). At the same time, geoinformatics creates new information models and new information resources.

Geoinformatics uses two types of spatial modeling. The first kind of modeling is not related to geoinformation and geodata. For example, it is spatial logic. This type of modeling is related to topology and geometry.

The second type of spatial modeling uses geoinformation modeling (Tsvetkov, 1999; Bulgakov, 2013). Geoinformation modeling serves as the basis for decision support. Both types of spatial modeling use the methodology of information units (Tsvetkov, 2014).

Updating of spatial models occurs through the use of geomonitoring (Hohensinn et al., 2021).

Complex spatial modeling uses models of information situations (Tsvetkov, 2012). The information situation model describes the totality of objects connected by relationships and relationships. in which spatial objects are located.

The use of models of information situations in geoinformatics entails the use of situational modeling.

The result of spatial modeling is the acquisition of spatial knowledge (Lin at al., 2020) and geoscience (Tsvetkov, 2016b).

Computer-aided design systems in geoinformatics have created a visual processing system.

There is a difference between the application of computer science and the application of geoinformatics. Informatics is used as a tool of specialization, and geoinformatics is used as an integration tool. Informatics specializes in processing, and geoinformatics integrates methods for processing various information. Data collection in computer science is carried out by methods and means of the subject area. In informatics, data is specialized data. For example, informatics in geodesy is designed to solve problems in the field of geodesy. It does not solve problems in the field of cartography, photogrammetry. Informatics in photogrammetry solves problems in the field of photogrammetry and does not solve the problems of geodesy.

Geoinformatics solves the problems of cartography, photogrammetry, geodesy and remote sensing of the Earth. Geoinformatics data is integrated geodata (Savinykh, Tsvetkov, 2014). Geoinformatics data collection is carried out by a set of different technologies. Datageoinformaticians are used in different fields. Integrated data in geographic information systems solve problems in the field of cartography, photogrammetry, space surveying, cadastre, land monitoring, etc. That is, there is a complete opposite of informatics in geoinformatics.

Applied aspect of geoinformatics

The applied aspect of geoinformatics reflects its application for solving applied problems. Geoinformatics can be described as an applied system for solving applied problems. For example, it is used in the study of global processes. Geoinformatics is used in the study of climate change (Singh, 2020). Geoinformatics is used to overcome information barriers (Tsvetkov, 2004) and the use of geotechnical systems. Geoinformatics is used to study geodynamic processes (Gvishiani et al., 2019). Geoinformatics has specialized applications. For example, transport geoinformatics is a specialized area of geoinformatics. Geoinformatics is used to preserve cultural heritage (Xiao et al., 2018). Geoinformatics is used to study landslides (Pirasteh, Li, 2017). Geoinformatics is used to study the spatial growth of cities. Geoinformatics is used to study the quality of groundwater. Geoinformatics is used to study the level of settlement of tourists (Hardy et al., 2020). Such diversity emphasizes the belonging of geoinformatics to various spaces, including social space.

Spatial aspect of geoinformatics

The spatial aspect of geoinformatics is associated with the study of real spaces. Different types of spaces are the object of geoinformatics research. Along with geoinformatics, space is being studied by geodesy, geometry, photogrammetry, and artificial intelligence. All these sciences are united by spatial logic. Geoinformatics is closely related to geodesy, photogrammetry and geometry. Geodesy makes it possible to collect information with geodetic instruments and process it using geodetic methods. Geometry makes it possible to perform spatial modeling using abstract mathematical figures. Artificial intelligence in geoinformatics makes it possible to form spatial knowledge.

It is necessary to distinguish the language of spatial aggregation (Yip, Zhao, 1996), which describes the mutual arrangement of bodies, which is expressed in touching or adjacent to each other, the arrangement "between", "inside", "outside".

Geometry theory is based on abstractions and abstract forms. In real space, point, linear, area and volumetric bodies are distinguished. This division takes place in geoinformatics and serves as the basis for the classification, stratification and analysis of geographic information models. The ideas of geometry are developed in geoinformatics.

Methods of spatial analysis are transferred to geoinformatics. Geoinformatics solves the problems of information processing and spatial analysis in any space. This spatial information can be obtained: on the Moon, on Venus, on Mars, or on Earth. Geoinformatics processes any spatial information. There is a branch of space geoinformatics that processes space information.

These features of geoinformatics expand its concept to the concept of space science. Common in geoinformatics, geometry and geodesy is: the study of space, the study of spatial relations, the study of spatial forms, the study of the mutual arrangement of bodies.

There are differences between geoinformatics and these sciences. Geometry explores abstract spaces, geodesy explores real space, geoinformatics explores abstract and real spaces. Geodetic measurements contain errors. Information in geoinformatics also contains errors+. This poses an additional task in geodesy and geoinformatics – data processing taking into account errors. Geodesy includes Euclidean geometry as a mathematical basis. Geoinformatics includes Euclidean geometry as a mathematical basis, and also includes differential geometry and differential topology. Geoinformatics includes Riemann geometry and makes calculations based on it (Tsvetkov, 2021). Processing measurement errors is a branch of probability theory. Probability theory is included in geodesy and geoinformatics.

Geodesy can be considered as a rigorous science that is based on geometric constructions and works mainly with clear data. Data in geodesy are aggregates of the results of independent measurements or the results of equalization of measurements. Uncertainty in geodesy occurs during coordinate transformations in curvilinear coordinate systems. Uncertainty in geodesy is spatial or geometric character. Processing of measurement results is the completion of geodetic constructions.

Geoinformatics, unlike geodesy, uses spatial logic and works with situations of uncertainty. In geoinformatics, cognitive modeling is used. Geoinformatics mainly works with models and with spatial situations. Uncertainty in geoinformatics includes information uncertainty, semantic uncertainty and uncertainty of the mutual position of spatial objects, that is, it is spatial and geometric in nature. Obtaining spatial knowledge is the completion of processing in geoinformatics.

3. Conclusion

Geoinformatics explores and interacts with different real spaces: outer space, terrestrial space, near-Earth space, underground space. Geoinformatics interacts with different abstract spaces: logical, topological, geometric, parametric, cognitive. Geoinformatics uses different spatial information flows. The analysis allows us to conclude that modern geoinformatics is a science of space. It must be seen as a science of space. Geoinformatics has gone beyond the terrestrial sciences. Geoinformatics as a fundamental science is used as a method of cognition and as a method of constructing a picture of the world. Geoinformatics uses spatial constructions to obtain new knowledge. The development of geoinformatics allows us to state the following. Geoinformatics methods are applicable on the natural satellite of the Earth – the Moon and on any planet. The field of application of geoinformatics is much wider than the surface of the Earth. It is applicable on all celestial bodies, and the Earth is one of such bodies. Consequently, there is no reason to associate geoinformatics only with the Earth. The field of application of geoinformatics is a real space. Geoinformatics should be considered the science of space.

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Effect of Bid Shopping on Public Building Project Delivery in Bauchi Metropolis

Maria Musa Mukaddas [a, *], Hassan Umar Mohammed [a], Ismaila Isah Suleiman [a]

[a] School of Environmental Technology, Abubakar Tatari Ali Polytechnic Bauchi, Nigeria

Abstract

The menace of the unethical practice in which a contractor discloses the bid price of one contractor or subcontractor to another, in order to obtain a lower bid price, otherwise known as bid shopping has been a major bane of the construction industry. This blight is responsible for a myriad of problems for the industry. This study examines these practices and their effects on the public sector of the construction industry. Thirty-six (36) questionnaires were administered to experts in the area of construction to understand their perspectives on the anomaly and its effect on project delivery in Bauchi metropolis, Nigeria. Findings of the study showed that some that 25.0 % of the respondents were Architects, 36.1 % quantity surveyors, 22.2 % were builders, 11.1 % project managers and 5.6 % were structural engineers. The highest educational qualification of respondents in the quantity surveying profession observed were, 41.7% of the respondents had earned B.sc, 27.8 % had HND, and 8.3 % had PGD, while 22.2 %, had MSc. In terms of experience 47.2 % had 5-10 years of experience, 30.6 % had less than 5 years of experience, 19.4 % have 11-15 years of experience and 2.8 % have 16-20 years of experience. 36.1 % of the respondents were consultants, 38.9 % were contractors while 25.0% were clients. Findings further some of the techniques used for bid shopping include post-award bid shopping technique ranked first, pre-award bid shopping technique was ranked second and bidding via an electronic reverse auction technique was ranked third. Effect of bid shopping on project delivery shows that "Promotes lower work quality was ranked first, Delays project completion was ranked second, creates an adverse work environment was ranked third, Increased life costs on a project was ranked third and General inefficient prosecution of work was ranked fifth". Possible implications of bid shopping indicates that vulnerability to frequent maintenance work was ranked first, High maintenance cost was ranked second, poor workmanship was ranked third, poor value for money was ranked forth, poor aesthetics value was ranked fifth and Collapse of buildings was ranked sixth. Penalties that should be taken against contractors who practice bid shopping, the respondents observed that imposing liquidated damages or fines was ranked first, disqualifying winning bidders who are immediately found guilty of bid shopping was ranked second, no any action was ranked third, suspension of licenses or permit was ranked fourth and eventual punishment by lack of competitive bidding was ranked fifth.

Keywords: bidding, competitive bidding, peddling, shopping, pre-award, subcontractor, aesthetics.

1. Introduction

Bid shopping is an unethical practice in which a contractor discloses the bid price of one subcontractor to another in an attempt to obtain a lower bid price (Deneckere, Quint, 2022).

* Corresponding author
E-mail addresses: mariamukaddasm@yahoo.com (M.M. Mukaddas)

Included in bid shopping is "bid peddling", in which subcontractors themselves offer to undercut the known bid of another subcontractor (Nawaz, Ikram, 2013). Bid shopping can occur both before and after the project owner awards the prime contract to the contractor (Arditi, 2016; Maseko, 2018). Bid shopping is an unethical practice that hinders progress in construction and hurts the construction industry (Reginato, Alves, 2012).

All construction players must be monitored to generate a standard scheme to measure the quality of work achieved by contractors (Adnan et al., 2012). Consultants should exercise their duty of care in performing their works and not resort to unethical behavior for approving any sub-standard (Rofifah, 2020; The White House, 2021). The contractors should not earn profit in unethical ways. Construction parties should always be alert and try to avoid any unethical behavior among the construction players from happening (Omotayo et al., 2022).

Bid shopping currently is not illegal, but it certainly is unethical (Smith Currie, 2013). Organizations such as the Associated General Contractors of America (AGC), Fails Management Institute (FMI) and the American Subcontractors Association (ASA) have had much influence in raising the image of the constructor to a position of near professionalism (Motaleb, Kishk, 2010).

Bid shopping is currently not illegal but certainly unethical which can hurt business reputations and those of its employees, especially key personnel such as estimators, contract administrators and project managers (Faculty, E-mail, 2021).The aim of the study is to determine the effect of bid shopping on public building project delivery in Bauchi metropolis with the view of reducing bid shopping from occurrence.

2. Materials and methods

Research Design

This study was conducted through Surveys, an oriented methodology used to investigate populations by selecting samples to analyze and discover occurrences. The design provides numeric descriptions of some part of the population. It was adopted in this study because it considers issues such as economy of design, rapid data collection and ability to understand a population from a part of it.

Study Area

The study covers selected contractors, consulting firms and clients in Bauchi metropolis.

Target population

For the purpose of this study, the populations were clients, consultants and contractors operating within the capital city of Bauchi. The client is the employer of all other parties in the building industry.

Sampling techniques

The technique used for this study was simple random sampling. This technique selects a sample without bias from the target/accessible population.

Method of Data collection

Primary Sources

This is the raw and unprocessed data which was received directly from the target respondents where structured response questionnaire such as Likert Scale, was used and the format used was basically ticking of the appropriate options to make ease of response.

Questionnaire Survey

A questionnaire survey was undertaken to assess the effect of bid shopping, various techniques, possible implications, penalties legislation should be taken. The questionnaire was divided in to two parts:

First part captures the relevant information from the respondents. While the second part focused on the effect of bid shopping, implications, penalties legislation should be taken. The respondents were asked to highlight their recommendations through a close-ended matrix form questions which ranges from 1-5 Likert scale. Respondents were asked to indicate their views on the degree of importance of the listed effect, implications and etc.

5 = Strongly agreed
4 = Agreed
3 = Undecided
2 = Disagreed
1 = Strongly disagreed

Secondary Sources

These include textbooks, journals, magazines, newspapers, etc.

In using the technique, all documents related to the issue under study were carefully reviewed.

Method of Data Analysis

The first set of data collated was nominal in nature as such; frequencies and simple percentages were used in analyzing them. Subsequently, they were presented in tables. However, the second set of the collated data was ordinal in nature which justified the use of the following technique, Relative Importance Index.

Analysis

The Formulae used in carrying the analysis is given below,

RII= ∑W/A×N

Where:

W = weighting given to each factor by the respondents (ranging from 1 to 5).

A = highest weight (that is 5 in this case).

N = total number of questionnaires returned.

The Microsoft Excel word Package program was used to analyze all sections and assisted in the presentation and layout. The respondents' data was finally presented using descriptive methods for easy interpretation and to enable comparisons.

3. Results

Table 1. Profession of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Architect	9	25.0	25.0	25.0
	Quantity surveyor	13	36.1	36.1	61.1
	Builder	8	22.2	22.2	83.3
	project manager	4	11.1	11.1	94.4
	Structural engineer	2	5.6	5.6	100.0
	Total	36	100.0	100.0	

Table 1 shows that 25.0 % of the respondents are Architects, 36.1 % are quantity surveyors, 22.2 % are Builders, 11.1 % are Project Managers and 5.6 % are Structural Engineers.

Table 2. Qualification of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	HND	10	27.8	27.8	27.8
	BSc	15	41.7	41.7	69.5
	PGD	3	8.3	8.3	77.8

	MSc	8	22.2	22.2	100.0
	Total	36	100.0	100.0	

Table 2 above provides information relating to the qualifications of the respondents in the quantity surveying profession. As shown in this Table, 41.7 % of the respondents had earned B.sc, 27.8 % had HND, and 8.3 % had PGD, and 22.2 %, had MSc.

Table 3. Experience of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 5 years	11	30.6	30.6	30.6
	5-10 years	17	47.2	47.2	77.8
	11-15 years	7	19.4	19.4	97.2
	16-20 years	1	2.8	2.8	100.0
	Total	36	100.0	100.0	

Table 3 shows the experience of respondents 47.2 % have 5-10 years of experience, 30.6 % have less than 5 years of experience, 19.4 % have 11-15 years of experience and 2.8 % have 16-20 years of experience.

Table 4. Type of Organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Client	9	25.0	25.0	25.0
	Consultant	13	36.1	36.1	61.1
	Contractor	14	38.9	38.9	100.0
	Total	36	100.0	100.0	

Table 4 shows the type of organization, 36.1 % of the respondents are consultant, 38.9 % of the respondents are contractor and 25.0 % are clients.

Table 5. Techniques used in bid shopping

S/N	Techniques used in bid shopping	SA	A	U	D	SD	∑W	A×N	Rll Index	RANK
1.	Pre-Award Bid Shopping techniques	19	12	3	2	0	156	180	0.86	2
2.	Post-Award Bid Shopping techniques	27	8	0	1	0	169	180	0.94	1
3.	bidding via an electronic reverse auction technique	13	13	5	2	3	139	180	0.77	3

The table above indicates that post-award bid shopping technique was ranked first, pre-award bid shopping technique was ranked second and bidding via an electronic reverse auction technique was ranked third.

Table 6. Effects of bid shopping on public building project delivery

S/N	Effects of bid shopping on public building project delivery	SA	A	U	D	SD	∑W	A×N	Rll Index	RANK
1	Promotes lower work quality	26	9	1	0	0	169	180	0.94	1
2	Delays project completion	22	10	2	2	0	160	180	0.88	2
3	Creates an adverse work environment	14	12	5	1	4	139	180	0.77	3
4	General-inefficient prosecution work	5	8	4	8	11	96	180	0.53	5
5	Increased life costs on a project	10	12	4	5	5	125	180	0.69	4

The table above indicated that "Promotes lower work quality was ranked first, Delays project completion was ranked second, creates an adverse work environment was ranked third, Increased life costs on a project was ranked third and General inefficient prosecution of work was ranked fifth".

Table 7. Possible implications

S/N	Possible implications	SA	A	U	D	SD	∑W	A×N	Rll Index	RANK
1	Poor aesthetic value	7	3	0	8	17	80	180	0.44	5
2	Collapse of buildings	6	3	2	5	20	78	180	0.43	6

3	Poor value for money	12	11	1	3	9	122	180	0.67	4
4	Poor workmanship	12	13	2	4	5	131	180	0.72	3
5	High maintenance cost	18	8	3	2	5	140	180	0.77	2
6	Vulnerability to frequent maintenance work	20	10	1	3	2	151	180	0.84	1

The table above indicates that vulnerability to frequent maintenance work was ranked first, High maintenance cost was ranked second, poor workmanship was ranked third, poor value for money was ranked forth, poor aesthetics value was ranked fifth and Collapse of buildings was ranked sixth.

Table 8. Penalties that should be taken against contractors who practice bid shopping

S/N	Penalties that should be taken against contractors who practice bid shopping	SA	A	U	D	SD	∑W	A×N	Rll Index	RANK
1	Imposing liquidated damages or fines	17	14	2	2	1	166	180	0.92	1
2	Suspension of licenses or permit	14	6	0	6	10	116	180	0.64	4
3	Eventual punishment by lack of competitive bidding	3	1	0	10	22	61	180	0.34	5
4	Disqualifying winning bidders who are immediately found guilty of bid shopping	15	9	3	4	5	133	180	0.74	2
5	None. No any action	11	14	0	1	10	123	180	0.68	3

The table above indicates that imposing liquidated damages or fines was ranked first, disqualifying winning bidders who are immediately found guilty of bid shopping was ranked second, no any action was ranked third, Suspension of licenses or permit was ranked fourth and eventual punishment by lack of competitive bidding was ranked fifth.

4. Discussion

The current study observed that unethical professional practices in construction have severe effects on the management of projects which was corroborated by Ibrahim (2020). Nawaz and Ikram (2013), expounded that lack of training in ethics, corruption and bribery, bid shopping, and fraud and unfair conduct were factors effecting construction projects which is totally in agreement with the current effort. In his study, Maseko (2017) agrees totally with the findings of this study that the most dominant unethical practices are corruption, bribery and collusive tendering, lack of safety, overstatement of capacity and falsification of experience affects construction projects significantly. Adnan et al (2012) acknowledges that the most common unethical conduct evidenced by the contractors are cover pricing, bid cutting, poor documentation, late and short payments, subcontractors' lack of safety ethics, unfair treatment of contractors in tender/final account negotiations, competitors' overstatement of capacity and qualifications to secure work, competitors' falsification of experience and qualifications and bureaucratic, government policy these were some of the findings observed in the current research. Vulnerability to frequent maintenance work, delays and cost overruns as the extremely severe effects of unethical practices on projects performance and adherence to professional ethics, transparency and accountability in contract administration, the use of approved construction designs from certified professionals as highly effective remedies for curbing unethical professional practices. In their study Inuwa, Usman and Dantong (2015), discovered that vulnerability to frequent maintenance work, delays and cost

overruns as the extremely severe effects of unethical practices on projects performance and adherence to professional ethics, transparency and accountability in contract administration, the use of approved construction designs from certified professionals as highly effective remedies for curbing unethical professional practices which is in concordance with current findings.

5. Conclusion

Post-award bid shopping is considered the most harmful to the public building projects. In post-award bid shopping, the contractor seeks to obtain a lower price from a second subcontractor, after having already been awarded the prime contract through the original subcontractors bid. And has been considered by respondents as the major technique of bid shopping used by contractors. Bid shopping forces a subcontractor to reduce the costs in an effort to break even or make up for lost profits. One way in which a subcontractor can do this is by reducing the crew size. Obviously, by reducing the size of the crew, the odds of finishing the project on time are less likely than they would have been if the original crew size been kept. Bid shopping destroys team spirit and cooperation by creating a spirit of distrust and self-interest among project team members. The penalties that should be taken against contractors who practice bid shopping are: Imposing liquidated damages or fines, disqualifying winning bidders who are immediately found guilty of bid shopping and Suspension of licenses or permit.

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Influences Upsetting Excellent Performance of Building Projects in North-Eastern Nigeria

Maria Musa Mukaddas [a, *], Ismaila Isah Suleiman [a], Hassan Umar Mohammed [a]

[a] School of Environmental Technology, Abubakar Tatari Ali Polytechnic Bauchi, Nigeria

Abstract

This research focuses on appraising the excellent performance of building projects and in particularits importance especially in developing countries where building construction works are basically manual. The principal aim of this research is to identify the influences upsetting excellent performance of building projects, to evaluate the sternness indices of the factors, and to determine the relationship between the two and recommend measures to reduce its significance on project outcome. Fifty (50) questionnaires were administered to professional staff comprising of Architects, Quantity Surveyors, Builders, Project Managers and Structural Engineers engaged in building projects but only thirty-six (36) of them were returned.T-Test was used to compute factors for the analysis. The study identified: quality training/meeting, conformance to plan and specification, unavailability of competent staff, quality of equipment and raw materials, client interference, slow decision making by client, improper planning, shortage of labour and technical personnel, improper designing, inadequate contractor experience, poor site management and supervision, lack of coordination to solve problem, poor financial control on site, inadequate consultant experience, inadequate site investigation, and inadequacy of design and specification were identified as the factors that affected the quality of performance of building projects and related to clients, consultants and contractors. It is therefore recommended that policy makers, researchers and practitioners look at improving the human resource base through continuous professional and skill development. Again, monitoring systems should be improved at various district offices for the implementation of good construction procedure with the aim of ensuring quality practices. More importantly, design should be re-evaluated before the actual construction through pre-construction conference in order to do away with unnecessary design that will not ensure quality.

Keywords: quality performance (QP), T-Test, Factors affecting quality performance, building project.

1. Introduction

Great achievements attained by societies can be attributed to the roles played by the construction industries (Jin et al., 2017; Boadu et al., 2020).

the activities of the construction industries (Ofori, 2015; Ejohwomu et al., 2017). Several variables affect the performance of the construction industry (Aliyu et al., 2015;Oni et al., 2019). Poor workmanship during site operation and negligence were identified as some of the unethical

* Corresponding author
E-mail addresses: mariamukaddasm@yahoo.com (M.M. Mukaddas)

practices at construction stage while compromising of final accounts, employee re-assignment, covering up project failure are some of the ethical issues at the closure of a project (Windapo, Cattell, 2013; Oluwatosin, Amos, 2016; UNCTAD, 2020). Studies have shown that the most important factors affecting project quality performance are: delays because of materials shortage; unavailability of resources; low level ofproject leadership skills; escalation of material prices; unavailability of highly experienced and qualified personnel; and poor quality of available equipment and raw materials (Adnan et al., 2012; Deneckere, Quint, 2022). Hence the requirement for recognizing the crucial measures of performance that are used commonly in the field of building construction and that construction organizations need to develop systems and processes to measure in order to satisfy a wide variety of clienteles (Jin et al., 2017; Maseko, 2018; Omotayo et al., 2022).

The aim of this research is to evaluate the factors affecting quality performance of building projects in Bauchi metropolis with the view to providing solutions to the glitch.

2. Materials and methods

Research Design

This study was conducted through Surveys, an oriented methodology used to investigate populations by selecting samples to analyze and discover occurrences. The design provides numeric descriptions of some part of the population. It was adopted in this study because it considers issues such as economy of design, rapid data collection and ability to understand a population from a part of it.

Study Area

The study covers selected contractors, consulting firms and clients in Bauchi metropolis.

Target population

For the purpose of this study, the populations were clients, consultants and contractors operating within the capital city of Bauchi. The client is the employer of all other parties in the building industry.

Sampling techniques

The technique used for this study was simple random sampling. This technique selects a sample without bias from the target/accessible population.

Method of Data collection

Primary Sources

This is the raw and unprocessed data which was received directly from the target respondents where structured response questionnaire such as Likert Scale, was used and the format used was basically ticking of the appropriate options to make ease of response.

Secondary Sources

These include textbooks, journals, magazines, newspapers etc

In using the technique, all documents related to the issue under study were carefully reviewed.

Method of Data Analysis

The first set of data collated was nominal in nature as such; frequencies and simple percentages were used in analyzing them. Subsequently, they were presented in tables and charts. However, the second set of the collated data was ordinal in nature which justified the use of the following techniques.

Analysis T-Test was the method used to determine the level of importance for each criterion. The higher the value, the higher the level of criteria and consequently the higher being a factor affecting quality performance.

T-Test was used for the computation. The respondents were asked to give their perceptions in group of questions on five-point scale (1 for the strongly agree to 5 for the strongly disagree), which reflects their assessment regarding the factors in the questionnaire. The weighted average score has been widely used in construction research for measuring attitudes with respect to surveyed variables. The weighted average score was calculated for each factor by the use of T-test.

Where:

1. For the "Strongly Agree" response;
2. For the "Agree" response;
3. For the "Undecide" response;

4. For the "Disagree" response;
5. For the "Strongly Disagree" response.

The Statistical Package for Social Sciences (SPSS) program was used to analyze all sections and assisted in the presentation and layout. The respondents' data was finally presented using descriptive methods for easy interpretation and to enable comparisons

3. Results

Table 1. Result of the Administered Questionnaires

		Profession ofQualification ofExperience of theType of the respondents respondents Respondents Organization			
N	Valid	36	36	36	36
	Missing	14	14	14	14

A total of fifty (50) questionnaires were administered and thirty-six (36) of them were returned completed.

Table 2. Respondents Demographics Data

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Architect	11	30.6	30.6	30.6
	Quantity surveyor	14	38.9	38.9	69.4
	Builder	10	27.8	27.8	97.2
	project manager	1	2.8	2.8	100.0
	Total	36	100.0	100.0	

Demographic information of each respondent has been collected in the survey questionnaire. The information includes profession, qualification, level of experience, and type of organization.

Table 4 shows that 30.6 % of the respondents are architects, 38.9 % are quantity surveyors, 27.8 % are builders and 2.8 % are project managers10

Table 3. Qualification of Respondents

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	HND	9	25.0	25.0	25.0
	BSc	13	36.1	36.1	61.1
	PGD	8	22.2	22.2	83.3

	MSc	6	16.7	16.7	100.0
	Total	36	100.0	100.0	

Table 3 above provides information relating to the qualifications of the respondents in the quantity surveying profession. As shown in this Table, 36.1 % of the respondents had earned B.sc, 25 % had HND, and 22 % had PGD, while only 16.7 %, had MSc.

Table 4. Experience of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 5 years	11	30.6	30.6	30.6
	5-10 years	17	47.2	47.2	77.8
	11-15 years	8	22.2	22.2	100.0
	Total	36	100.0	100.0	

Table 4 shows the experience of respondents 47.2 % have 5-10 years of experience, 30.6 % have less than 5 years of experience and 22.2 % have 11-15 years of experience.

Table 5. Type of Organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Client	10	27.8	27.8	27.8
	Consultant	13	36.1	36.1	63.9
	Contractor	13	36.1	36.1	100.0
	Total	36	100.0	100.0	

Table 5 shows the type of organization, 36.1 % of the respondents are consultant, again 36.1 % of the respondents are contractor and 27.8 % are clients.

Table 6. Project Related Factors

Factors	Mean	Rank	T	significant
Quality Training /Meeting	2.194	1	11.286	.000
Conformance to plan and specification	1.750	4	13.024	.000
Unavailability of Competence Staff	1.917	3	11.888	.000
Quality of Equipment and raw materials	1.944	2	9.232	.000

The table indicates that quality training/meeting was ranked first, quality of equipment and raw materials was ranked second, unavailability of competent staff ranked third and then conformance to plan and specification was ranked fourth.

Table 7. Client Related Factors

Factors	Mean	Rank	T	significant
Client Interference	2.500	1	12.677	.000
Slow decision making by clients	2.389	2	13.656	.000
Improper Planning	1.889	4	8.996	.000
Shortage of Labour and Technical Personnel	2.194	3	10.443	.000

Table 8. Contractor Related Factors

Factors	Mean	Rank	T	significant
Improper design	1.583	4	9.534	.000
Inadequate contractor experience	1.861	3	12.417	.000
Poor site management and supervision	2.000	2	12.550	.000
Poor financial control on site	2.222	1	8.919	.000

The table indicates that poor financial control on site was ranked first, poor site management supervision was ranked second, inadequate contractor experience ranked third and then improper design was ranked fourth.

Table 9. Consultant Related Factors

Factors	Mean	Rank	T	significant
Lack of cooperation to solve problem	1.806	4	9.487	.000
Inadequate consultant experience	1.861	3	10.964	.000
Inadequate site investigation	2.000	2	15.875	.000
Inadequacy of design and specification	2.139	1	10.498	.000

The table indicates that inadequacy of design and specification was ranked first, inadequate site investigation was ranked second, inadequate consultant experience ranked third and then lack of cooperation to solve problem was ranked fourth.

4. Discussion

The findings indicates that delay in honoring payment progressively, underestimation or overestimation of the project cost, and delay in the approval of major changes in the work scope were among the three major causes of delays in construction projects which is corroborated by Fashina et al, (2021). Other observations were lack of adequate sanction by the standard assurance organization, non-implementation of National Building Code were among the topmost factors affecting quality management on construction sites in Oyo State as expounded by Oni et al (2019), were equally observed by the current effort. Labour, building materials, construction methods, equipment, site management greatly influences performance, Aliyu (2015), these factors were also observed as deterrents in construction projects. The research also agrees with the findings of Ibironke and Elamah (2011), when they observed that planning and scheduling deficiencies, fraudulent practice and kickback and absence of clear evaluation standards are the major factors affecting time, cost and quality in construction project.

5. Conclusion

Data for the research was collected using questionnaire. The information collected covered

perception of clients, consultants and contractors regarding the factors affecting quality performance of building projects and ways to improve them. Data obtained from the survey was analyzed using the T-test. The major factors affecting quality performance of building projects were identified and ranked. The top four most important factors affecting quality performance are: quality training/meeting, conformance to plan and specification, unavailability of competent staff, quality of equipment and raw materials. To improve the quality performance of building projects, effective planning, progress payments, minimizing change orders and early review and approval of designs among others are some of the essential factors to be considered by clients, consultants and contractors.

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Information Morphism, Information Correspondence and Proportionality

Viktor Ya. Tsvetkov [a, *]

[a] Research and Design Institute of design information, automation and communication on railway transport, Moscow, Russian Federation

Abstract

The article explores information morphism. Information morphism is considered as a generalization of information transformations with information sets. The article introduces the concepts of direct and inverse morphism. The article introduces the concepts of symmetric and asymmetric morphism. The article introduces the concepts of compositional and non-compositional morphism. The concepts introduced are illustrated by examples from photogrammetry and geoinformatics. Implication and morphism have the same arrow notation. The substantive difference between implication and morphism is shown. Information morphism is considered as categorical modeling. The content of categorical modeling is described. A morphological morphism is described. The semantic and morphological morphism is described. It is shown that the compositional morphism requires the fulfillment of the complementarity condition for the input sets. A symmetric morphism preserves information correspondence. Non-symmetric morphism provides only commensurability. To assess compliance, it is necessary to select a criterion or parameter of informational compliance. A comparative description of information compliance and proportionality is given. Information correspondence is a strict condition between sets. Proportionality is a mild condition between sets. Morphism is not only a generalization of the patterns of the information field, but a method of identifying patterns. Compositional morphism is an example of such a morphism. The use of morphism for metamodeling is noted. Information morphism generalizes information processes and allows their comparative analysis. Information morphism reveals latent factors and extracts implicit knowledge from them.

Keywords: morphism, information morphism, information process, symmetric morphism, compositional morphism, categorical modeling, information correspondence, proportionality, complementarity.

1. Введение

Понятие морфизма применяют в теории множеств (Математика, 2000), в теории категорий (Математика, 2000) и в теории информационного поля (Цветков, 2016, Кудж, 2017, Раев, 2021). В теории множеств морфизм обозначает отображения множеств. В теории категорий морфизм обозначает отношения между категориями (Болбаков, 2021). В теории информационного поля морфизм обозначает информационные процессы в информационном поле. Чаще всего они обозначают преобразования или вычисления (Цветков, 2021). Понятие «морфизм» есть общее понятие. В силу этого существует много

* Corresponding author
E-mail addresses: cvj2@mail.ru (V.Ya. Tsvetkov)

уточняющих определений. Например. «информационный морфизм» введен В.А. Мордвиновым (Мордвинов, 2004) и его последователями. Существует ряд сложных определений информационного морфизма. Объяснительное определение «информационный морфизм – это морфизм в информационном поле». Информационное поле содержит результаты сбора информации и последующей ее обработки. В информационном поле существуют разные отношения и разные процессы. Анализ информационное поля позволил выявить в нем новое информационное отношение – «отношение комплементарности». Оно является важным для многих процессов и взаимодействий. Отношение комплементарности рассматривалось в ряде работ (Потапов, 2020). Но оно рассмотрено как независимое отношение. В данной работе комплементарность рассматривается как отношение в информационном поле. Другим важным отношением является отношение соразмерности. Оба отношения связаны с информационным морфизмом и представляют предмет исследования данной статьи.

2. Обсуждение и результаты

Информационный морфизм как преобразование координат.

Морфизм означает общее определение преобразования. Довольно часто требуется перенести координаты снимка в плоскость объекта. Для этого применяют процедуру, называемую трансформированием координат. Различают фотограмметрическое аналоговое и цифровое трансформирование, аналитическое фотограмметрическое и проективное трансформирование.

Простым примером морфизма является трансформирование координат снимка в плоскость объекта. Формулы аналитического трансформирования получают из на основе проективных преобразований. Часто плоскость объекта вертикальна (Y= const)

Для морфизма, описывающего преобразование координат объекта (X, Z) в координаты снимка (x, z) существуют формулы преобразования

$$x = \frac{A_1 X + A_2 Z + A_3}{A_7 X + A_8 Z + 1} \qquad (1)$$

$$z = \frac{A_4 X + A_5 Z + A_6}{A_7 X + A_8 Z + 1} \qquad (2)$$

Выражения (1-2) можно назвать «прямым» морфизмом. В выражения (1-2) входят 8 постоянных коэффициентов A_i. Они задают однозначную связь между координатами плоскости объекта и снимка. Они линейно разрешимы относительно коэффициентов Ai при известных координатах объекта и снимка.

$$\begin{aligned} A_1 X + A_2 Z + A_3 - A_7 X x - A_8 Z x = x \\ A_4 X + A_5 Z + A_6 - A_7 X z - A_8 Z z = z \end{aligned} \qquad (3)$$

Пару уравнений (3) задает одна точка, координаты которой на местности и на снимке известны. Следовательно, для определения 8 коэффициентов A_i необходимо минимум 4 точки с известными координатами на снимке и объекте. С учетом погрешностей измерения число таких точек должно быть больше. Аналитическое проективное трансформирование инвариантно относительно замены координат снимка и объекта. Для процедуры, обратной (1-2) или для «обратного» морфизма структура формул не меняется. Она включает замену коэффициентов A_i на B_i.

$$X = \frac{B_1 x + B_2 z + B_3}{B_7 x + B_8 z + 1} \qquad (4)$$

$$Z = \frac{B_4\, x + B_5\, z + B_6}{B_7\, X + B_8\, z + 1} \qquad (5)$$

Можно констатировать наличие прямого и обратного информационного морфизма. Для прямого и обратного морфизма существует отношение информационного соответствия. Наличие прямого и обратного морфизма является признаком информационного соответствия. Можно ввести понятие «симметричный морфизм». Симметричный морфизм – это преобразование для которого существует прямой и обратный морфизм. Понятия прямого и обратного морфизма являются условными.

Существует информационный морфизм, для которого соответствие не выполняется, а выполняется отношение соразмерности. Рассмотренные выше морфизм прямой и обратны реализует процедуру 2D-2D. Существует процедура 3D-2D, которая обратного морфизма не имеет. Она связывает координаты местности *X, Y, Z*, с координатами снимка (*x ,z*). Эта зависимость имеет вид.

$$x = \frac{A_1 X + A_2 Y + A_3 Z + A_4}{A_9 X + A_{10} Y + A_{11} Z + 1} \qquad (6)$$

$$z = \frac{A_5 X + A_6 Y + A_7 Z + A_8}{A_9 X + A_{10} Y + A_{11} Z + 1} \qquad (7)$$

Постоянные коэффициенты A_i в выражениях (6-7) связывают пространственные координаты *X, Y, Z*, с координатами снимка (*x, z*) и задают преобразование морфизма 3D-2D. Выражения (6-7) приводятся к линейному виду относительно коэффициентов A_i. Нахождение коэффициентов А и есть процедура реализации морфизма 3D-2D. Эти коэффициенты можно определить, если имеется 6 и более точек с известными координатами на местности и снимке.

Морфизмы (6, 7) имеют место для каждой точки снимка и местности. Для 6 точек с известными координатами на местности будет 12 линейных уравнений, которые дают возможность найти одиннадцать постоянных коэффициентов А и тем самым определить морфизм пространственного преобразования.

Морфизм 3D-2D является асимметричным. Он является прямым, но обратного не имеет. Он создает информационную неопределенность. Например, на снимке два объекта, имеющие разные размеры на местности могут быть соразмерны, то есть иметь примерно одинаковые или почти одинаковые размеры. Если большой объект удален, а небольшой объект приближен к камере, то они могут иметь одинаковые размеры на снимке. В этом случае речь идет о геометрической соразмерности. Соразмерность применяют в разных направлениях. Например, в судопроизводстве говорят «наказание соразмерно правонарушению». Для соответствия, соразмерности и несоответствия можно использовать математические символы. Для соответствия можно использовать символ «=», для несоответствия можно использовать символ «≠», для соразмерности можно использовать символ «≈».

Подобный асимметричный морфизм имеет место в картографических преобразованиях. Одна и та же территория на местности может по-разному изображаться на карте. Например, это зависит от выбора картографической проекции. При использовании конических, цилиндрических или азимутальных картографических преобразований (Бородко и др., 2008) получают разные визуальные модели местности на карте. Картографические преобразования вносят информационное несоответствие в модель или картографические искажения. Это вид искажения по проекционным преобразованиям. Второй вид картографических искажений возникает из-за масштабных преобразований. Дополнительно к проекционным преобразованиям на карте существуют масштабные преобразования. Карты бывают: эквидистантыми, равновеликими или равноугольными (Бородко и др., 2008). Это задает дополнительное информационное несоответствие на

картах. Возникает вопрос: для чего же нужны карты как модели, содержащее геометрическое несоответствие и информационную неопределенность? Ответ заключается в топологии. Карты обеспечивают топологическое соответствие между объектами земной поверхности и картографической композицией. Измерения по картам особенно средних и мелких масштабов содержат большие погрешности.

Информационный морфизм как категориальное моделирование

Информационный морфизм в информационном поле можно рассматривать как моделирование. Такое моделирование разнообразно: концептуальное моделирование, информационное моделирование, цифровое моделирование, мета моделирование (Tsvetkov et al., 2020), моделирование категорий (Zheng et al., 2019). Категориальное моделирование включает: составление описания модели; изменение модели, анализ состояний объекта на основе модели, анализ переходов между состояниями объекта, выводы.

Моделирование категорий имеет корни в логике и в математике (Хелемский, 2017). Его применяют в логике, информатике и в геоинформатике. Категория близка к понятию класс. Для классов характерна классификация. Для категорий характерна систематизация и обобщение.

Категории используют в программировании (Barr, Wells, 1990). Принципы категорий в информационном поле соответствуют общим принципам, но имеет специфические отличия. Основой категориального подхода служит ориентированный граф. Этот граф есть сложная модель, называемая категорией. Иногда его называют картой. Узлы категории принято называть объектами, Ориентированные ребра называют морфизмами. Отсюда следует, что категория в информационном поле задает информационный морфизм, который обозначается ориентированной дугой. При переходе к логике возникает двойственная трактовка морфизма. В логике стрелкой обозначают импликацию. Импликация может выражать отношение или процесс. Поэтому информационный морфизм может выражать отношение или процесс, в зависимости от контекста. Отсюда следует, что информационный морфизм является контекстуальным параметром. В аспекте сложности информационный морфизм описывает простые процессы, мета процессы и мета отношения. Разделение между этими объектами определяется контекстуально.

Импликация и морфизм.

Выше обосновано применение стрелки для обозначения морфизма. Импликация и морфизм имеют одинаковое обозначение в виде стрелки. Но импликация обозначает отношение, а морфизм описывает процесс. Описание простого морфизма имеет вид

$$A \rightarrow B. \quad (8).$$

Выражение (8) в категориальном анализе означает, что морфизм (стрелка) преобразует исходное множество (А) в выходное множество (*B*). Выражение (8) описывает простое преобразование без учета содержимого элементов множеств. Главным в нем является стрелка как описание некого преобразования. Выражение (8) есть обобщение выражений (1-2), (4-5), (7-8).

Если выражение (8) перенести в область логики и рассматривать как импликацию, то оно описывает отношение следования. Из А следует В, или А влечет В. Главным в нем является отношение между входным множеством А и выходным множеством В. В этом выражение стрелка есть констатация факта отношений между множествами.

Информационные множества, элементы которых имеют семантику, требуют применения сложного (семантического) информационного морфизма. При этом возможны два варианта: морфологическое преобразование; морфологическое и семантическое преобразование. Описание только морфологического информационного морфизма имеет вид.

$$A\ (sa) \rightarrow B\ (sa)\ (9)$$

Выражение (9) означает, что условно входное информационное множество *A*, имеющее общую содержательность *(sa)* преобразуется в условно выходное информационное множество *B* с общей содержательностью *(sb)*. При этом содержательность элементов может отличаться. Примером такого морфизма может служит преобразование треугольника в круг, при котором обе фигуры имеют равную площадь. Это выражение описывает информационное соответствие между содержательностью множества А и содержательностью множества В. Морфология множеств меняется, но содержательность

(в данном случае площадь) сохраняется. Можно говорить об информационном соответствии между площадью A и B. Следует сделать вывод о том, что существует параметр или параметры информационного соответствия. Для топографических карт таким параметром соответствия является топология.

Морфологический морфизм имеет место при измерениях и геомониторинге (Маркелов, Цветков, 2015). Измеренная вторичная информация *B (sa*) должна находится в информационном соответствии с первичной или исходной информацией об исследуемом объекте *A (sa)*. Выражение (9) описывает изменение морфологии при сохранении содержательности (семантики)

Более сложный информационный морфизм связан с изменением морфологии и семантики множеств.

$$A\ (sa) \rightarrow B\ (sb)\ (10)$$

Морфизм (10) описывает семантическое преобразование. Для выражения (10) $(sa) \neq (sb)$, что означает информационное несоответствие. Морфизм (10) преобразует и изменяет семантику исходного множества. Примером такого морфизма является обновление карт или обновление или регенерация баз данных.

Композиционный и не композиционный морфизм.

Существует композиционный и не композиционный морфизм. не композиционный морфизм называют также декомпозиционным. Этот морфизм связан с преобразованием качеств элементов множеств. Декомпозиционный морфизм, например, связан с процессом преобразовании трехмерных объектов в двухмерные проекции фотоизображений. Его примеры показаны в выражениях (6), (7).

$$(D3 \cup Hi) \rightarrow DHi\ (11)$$

$$(DHi \cup M_{32}) \rightarrow G2i\ (12)$$

Выражение (11) описывает композицию трехмерного множества D3 с множеством условий Hi в промежуточное множество DHi. На практике это означает выбор условий съемки, технических средств съемки и объекта съемки в единое параметрическое пространство.

Выражение (12) описывает декомпозицию промежуточного множества DHi в двухмерное множество точек снимка G2i. В выражение (12) входит метод преобразования M_{32}. На Рисунке 1 приведена тринитарная схема не композиционного морфизма.

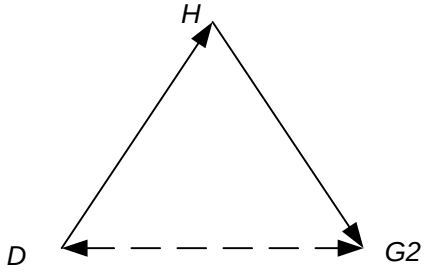

Рис. 1. Декомпозиционный морфизм

Декомпозиционный морфизм есть последовательность морфизмов DH, HG2 при наличии отношения между D и G2. Отношение между D и G2 должно быть для мягких условий отношением соразмерности. Для жестких условий это отношение информационного соответствия. Отношение показано пунктиром, морфизм показан стрелкой.

Композиционный морфизм связан с композицией множеств и процессом преобразовании композиции в множество другого качества.

$$(A+B)\ M_{23} \rightarrow C3\ (13)$$

Выражение (13) описывает преобразование композиции двух плоских множеств (A, B) на основе метода преобразования M_{23} в трехмерное множество C3. На рис.2 приведена тринтарная схема композиционного морфизма, соответствующая выражению (12). Отношение AB показано пунктиром, морфизмы показаны стрелками.

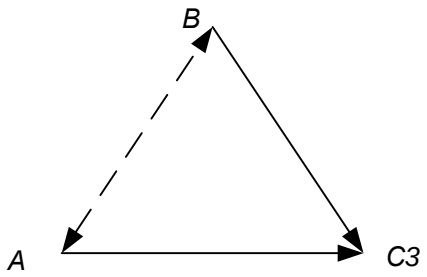

Рис. 2. Композиционный морфизм

Композиционный морфизм есть совместное действие морфизмов B-C3 и A-C3 Отношение между A и B должно быть только соразмерным. Совместное действие морфизмов возможно только при наличии комплементарности между ними. Следовательно, композиционный морфизм требует наличия отношения комплементарности между множествами, участвующими в этом морфизме. На практике это означает, что два снимка A и B должны содержать изображение общего объекта или общего участка местности. В аэрофотосъемке условие комплементарности реализуется через перекрытие снимков [энц].

3. Заключение

Информационный морфизм есть обобщение преобразований над информационными множествами. Морфизм может быть прямым и обратным. Морфизм может быть симметричным и асимметричным. Морфизм может быть композиционным и декомпозиционным. Для композиционного морфизма требуется выполнение условия комплементарности для входных множеств. Симметричный морфизм сохраняет информационное соответствие. Несимметричный морфизм обеспечивает только соразмерность. Для оценки соответствия необходимо выбирать критерий или параметр информационного соответствия. Информационное соответствие есть жесткое условие между множествами. Соразмерность есть мягкое условие между множествами. Морфизм есть не только обобщение закономерностей информационного поля, но метод выявления закономерностей. Композиционный морфизм служит примером такого морфизма. За рамками данной статьи осталось применение морфизма для метамоделирования. Следует отметить его применение для формирования постфиксных (выражения 6, 7), инфиксных (выражения 1, 2 и 4.5) и префиксных моделей. Информационный морфизм обобщает информационные процессы и позволяет проводить их сравнительный анализ. Информационный морфизм выявляет латентные процессы и извлекает неявное знание (Цветков, 2014, Bolbakov, 2016).

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Информационный морфизм, соответствие и соразмерность.

Виктор Яковлевич Цветков [a, *]

[a] Научно-исследовательский и проектно конструкторский институт информатизации, автоматизации и связи на железнодорожном транспорте (НИИАС), Москва, Российская Федерация

Аннотация. Статья исследует информационный морфизм. Информационный морфизм рассмотрен как обобщение информационных преобразований с информационными множествами. Статья вводит понятия прямой и обратный морфизм. Статья вводит понятия симметричный и асимметричный морфизм. Статья вводит понятия композиционный и не композиционный морфизм. Введенные понятия иллюстрируются примерами из фотограмметрии и геоинформатики. Импликация и морфизм имеют одинаковое обозначение в виде стрелки. Показано содержательное различие между импликацией и морфизмом. Информационный морфизм рассмотрен как категориальное моделирование. Описано содержание категориального моделирования. Описан морфологический морфизм. Описан семантический и морфологический морфизм. Показано, что для композиционного морфизма требуется выполнение условия комплементарности для входных множеств. Симметричный морфизм сохраняет информационное соответствие. Несимметричный морфизм обеспечивает только соразмерность. Для оценки соответствия необходимо выбирать критерий или параметр информационного соответствия. Дано сравнительное описание информационного соответствия и соразмерности. Информационное соответствие есть жесткое условие между множествами. Соразмерность есть мягкое условие между множествами. Морфизм есть не только обобщение закономерностей информационного поля, но метод выявления закономерностей. Композиционный морфизм служит примером такого морфизма. Отмечено применение морфизма для метамоделирования. Информационный морфизм обобщает информационные процессы и позволяет проводить их сравнительный анализ. Информационный морфизм выявляет латентные факторы и извлекает из них неявное знание.

Ключевые слова: морфизм, информационный морфизм, информационный процесс, симметрический морфизм, композиционный морфизм, категориальное моделирование, информационное соответствие, соразмерность, комплементарность.

[*] Корреспондирующий автор
Адреса электронной почты: cvj2@mail.ru (В.Я. Цветков)