Managing movements, ordering and transformations of resource flow processes in course of implementing development project life cycles

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Abstract. Based on previous research of theory and methodology, authors describe and systematize the triune process of motion, ordering and qualitative and quantitative transformations of the development process resource flows from the externally chaotic resource surrounding at macro-, meso, and micro-resource levels, to the organized project organizational and technological stages. Characteristics of different flows located at different resource levels and project stages of project life cycles from initiation through implementation, modernization and demolition of the assets were provided according to the “order of multipole various resource flow processes from their chaos” paradigm. Authors determined sources and ends of the unordered and ordered resource flow processes in course of project life cycles, defined conditions for process ordering and transformations at each resource level and project life cycle stage, and outlined goals, interests, tasks and areas of responsibility for development project stakeholders at different project life cycle stages. Authors perform analysis and forecasting of resource flow management processes for different project life cycle processes and resource levels based on the logistic relay model, and according to the proposed methodology of managing resource flow “triad” of flow motion, ordering, and transformations is a common spatial and temporal field of resource logistics.

1 Introduction

In [1] authors described theoretical and methodological approaches to organization and management of resource flow-related processes of different nature (i.e. material, financial, product, data, etc.) in course of implementing various stages of unique and changing development projects.

Moving force beneath these processes is the group of people and entities, referred to as stakeholders [2] that are interested in overcoming effects of uncertainty, and gaining success through positive synergy, organization, and efficient implementation of projects, and by mutual exchange of values, ideas, experience, and competences.

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While reviewing the practice of applying logistics for the industrial production sphere [3-9, 10-14], and developing theory, methodology, and concepts, the authors developed theoretical and methodological approach to formation of a united (macro- meso- and micro) resource logistics field of flow processes that exists in space and time and undergoes continuous transformations in course of implementing development project life cycle stages. The field is formed by project external and internal resource and logistic environment, represented by sources and ends of resource flows, through motion, ordering, and qualitative and quantitative transformations of the resource flows of different nature.

Previous research [1] demonstrated the point that resource flow processes of different nature in the area of development project implementation exist in the “source-end” and “end-source» system linked to development project life cycle stages. Motion of the flows, their ordering from the multitude and chaos of resources [15 -17], and stage-wise resource transformations occur through initiative and interest of multiple project stakeholders, aiming at obtaining goals, self-realization, and self-control.

Macro- meso- and microlevel resource flows appear from the resource sources and ends of a united resource-logistic field of a development project. These flows exist at global, national, regional, asset, and technological levels, and can be of different nature – i.e. material, energy, finances, products and services, rights, etc.

Through the processes of flow movements, organization and transformations from the chaotically excessive external environment, authors developed a model of a systematic “logistic relay” based on an “order from Chaos” paradigm, and connected with stages of a development project life cycle. Key participants of that relay are development project stakeholders with stage-related “interests relay”. Stakeholders create the resource flow triad – flow movements and ordering during the stages and transformations at project life cycle stage gates, by lowering the level of entropy.

2 Mechanism for managing resource flows by the stages of a development project

Based on the above, it is possible to systematize and forecast changes in flow processes for all stages of the long-term development project life cycles, and from the corresponding structure of subjects and objects [1], describing process flow organization and management for the sake of efficient project implementation. In general, the whole combination of flow process movements, ordering and transformations for resource flows of different nature comprising the “logistic relay” in space and time can be separated with regard to resource sources and ends described by project stakeholder interests [2], and presented as a sequence (figures 1 through 15).

As it was mentioned in [1], flow processes in the area of implementing development projects originate from an external global transcendent information and material environment – the so-called Vernadsky’s noosphere [18] being a resource end for multiple flows with high level of entropy [19]. External information variety and chaos of existing visions, ideas, concepts and projects, data exchanges, interactions and human knowledge about processes and results in various application areas (fig. 1, block 1, end) form an external macro- and mesologistic source of data on various ideas, concepts and projects related to development with high level of entropy (fig.1, block 1, source).
Stakeholders intimating development projects can use the source of resources to select global flows of project ideas and concepts (related to ideal or existing projects), and create ordered flows (with less entropy) of general ideas on certain combinations of material resources, energy, finances, and data, required to implement such projects (fig. 1, ordered sphere of flows A). These ordered global flows form the end of information flows related to multiple alternatives of project ideas and concepts (high entropy) that differ in terms of contents, location, time and financing required (fig. 2, block II, end). This endpoint becomes a source of data about resource types necessary to implement project alternatives on national and regional level (fig. 2, Block II, source).

Stakeholders ordering ideas of implementing development projects continue logistic relay by forming outgoing ordered information flows on national or regional level describing resources required for such projects (fig. 2, ordered sphere of flows B).
Fig. 2. Block II (end-source), ordered sphere of flows B.

Moving to the next stage of project lifecycle, developer stakeholders form a macro and mesologistic end with high level of entropy for resource-related flows on national and regional level (fig. 3, Block III, end). That creates a source of high-entropy flows of data on materials, energy and finances (fig. 3, Block III, source). Use of this source allows stakeholders generating outgoing unidirectional or bidirectional ordered flows with lower entropy. These flows describing material, energy, and financial resources exist on regional level, they are external with regards to development projects, and can exist in form of requests for information, data queries, data responses, data exchange, information message, etc.
At this stage developers also generate information flows concerning the land lots required to implement development projects. In these cases of land development participants generate flow processes related to selection and assessment of the land lots, and analysis of their suitability for further design, development etc. [20]

Region, where developers plan to implement the initiated projects, becomes an end of incoming external flows (fig. 4, Block IV, end) and uses them to create corresponding regional flows with high level of entropy (fig. 4, Block IV, source). Stakeholder interests are further transformed into an ordered sphere of accompanying reciprocal data flows (level I [1]), and into outgoing material, energy, and financial logistic flows with lowered entropy at regional level, (fig. 4, ordered sphere of flows D). These flow processes of Level I along with their order and transformations finalize conceptual phase of the project life cycle, and signify transition from virtual global level to the macro- and mesologistic levels in terms of project environment (territory) (see Blocks I-IV, and ordered spheres of flows A-Don figs 1-4).
Logistic relay continues at regional logistic hubs that terminate resource-related high entropy informational flows (fig. 5, Block V, end) describing material, energy, and financial resources necessary for development. These points become source of high-entropy object-related flows of materials, energy and finance (fig. 5, Block V, source).

Project contractors (as stakeholders) organize object level II flows (design and construction level [1]) with decreased level of entropy. They act on the base of their interests, and goals, in order to fulfill the interests of clients and developers (fig. 5, ordered sphere of flows E).
Ordered flows from sphere E are linked by client and contractor stakeholders with specific realty objects that become the long-term end-points for meso-logistic regional flows (fig. 6, block VI, end). Incoming flows transform into internal micrologistic and terminal object-related flows of materials, energy, finances and data with low level of entropy that are used to construct buildings.

When the objects are commissioned at this stage of a development project, the qualitative transformation of the object-specific terminal flows of materials, energy, finances and data occurs. They produce a high-entropy source of information flows on readiness of multiple objects for sale or rent (fig. 6, block VI, source).
Fig. 6. Block VI (end-source), ordered sphere of flows F.

In course of construction and after construction completion realty agents generate independent ordered reciprocal flows with lowered level of entropy describing commissioned objects, transfer of the related rights and actions necessary to purchase or rent this property objects (fig. 6, ordered sphere of flows F).

When property objects are created, clients and property owners or tenants form the resource flow end with high entropy in the external environment, terminating data on availability of property objects on corresponding markets (fig. 7, block VII, end). Multiple objects of different nature become a new macro- and mesologistic high-entropy source of data flows concerning market opportunities of obtaining property rights, and various opportunities of object rental and operation (fig. 7, Block VII, source).

Potential property buyers and tenants as stakeholders transform this source into ordered independent outgoing and bidirectional regional level flows of property rights for object buyers, where the level of entropy decreases (fig. 7, ordered sphere of flows G).
At next stages of the development project life cycle tenants and buyers form the demand for various property objects that ends market opportunities for alternative realty uses (fig. 8, Block VIII, end). A source for independent and bilateral consumer-related informational flows appears (fig. 8, Block VIII, source). Potential buyers possess their own interests, and concepts for the use of objects, so they gradually form the sphere of bilateral ordered flows in the area of object use (fig. 8, ordered sphere of flows H).

Further steps logistic relay featuring movements, ordering, and transformation of the flows, defined by the development project life cycle stages, creates the real estate market, which becomes an end of consumer data flows concerning real estate objects (fig. 9, Block IX, end). The rights for real property are implemented through the opportunities of selling, purchasing, renting objects, etc. (fig. 9, Block IX, source). Real estate buyers or tenants form unilateral financial flows with lower entropy, and related ordered informational flows with level III (rental rights level [1]) (fig. 9, ordered sphere of flows I).
At the next step of the logistic relay multiple property objects of different nature create an end of purchase and ownership opportunities (fig. 10, Block X, end) and form a source of flows related to opportunities of object use (high level of entropy) (fig. 10, Block X, source). Property owners and
tenants order independent incoming and outgoing flows describing objects’ availability and perspectives of use, lowering the level of entropy (fig. 10, ordered sphere of flows J).

Fig. 10. Block X (end-source), ordered sphere of flows J.

Following operation of the commissioned industrial, commercial, office and warehouse objects forms the resource flow end (high entropy) of the product and services flows related to possible production of goods and services, etc. (fig. 11, Block XI, end). That forms high-entropy source of data about goods and services actually produced (fig. 11, Block XI, source). Operators producing the said services and goods, generate ordered material, product, energy and financial flows of level IV (operational level [1]), accompanied by incoming and outgoing information flows, decreasing entropy (fig. 11, ordered sphere of flows K).
The created market for products and services becomes a high-entropy end for different goods and services (fig. 12, Block XII, end), that further forms macro- and mesologistic high-entropy source of information on goods and services aimed at end users (fig. 12, Block XII, source). At the same time, producer stakeholders pursue their own goals and interests, while end users through demand generate a sphere of independent ordered incoming and outgoing flows of data about consumer-requested products and services (fig. 12, ordered sphere of flows L).
End user market becomes an end for information flows with high level of entropy describing various goods and services (fig. 13, Block XIII, end), and produces a high-entropy source of data about supply (fig. 13, Block XIII, source). End users, being stakeholders and possessing their own interests, form consumer requests in form of independent ordered outgoing informational flows with low level of entropy (fig. 13, ordered sphere of flows M), and receive feedback.

Information flows describing end used demand for goods and services form the flow end with high level of entropy (fig. 14, Block XIV, end), and generates new set of high-entropy information flows, including new visions, ideas, concepts, projects, data exchanges and shareholder interactions, that exist on global, national and regional levels, and are related to repairs, maintenance and reconstruction of the existing property for production of new products and services (fig. 14, Block XIV, source).

As a result, end users and producers initiate new ideas and projects including maintenance, reconstruction and modernization of the property and production facilities, and again create ordered (new demand level V [1]) outgoing flows describing needs of materials, energy and finance, and receive feedback. These needs start a new turn of movements, ordering, and transformation of resource flows (fig. 14, ordered sphere of flows N), aimed at improving existing objects, modernization of the obsolete ones, or total liquidation of the existing objects followed by new construction that complies with increased consumer requirements.
The need to improve existing objects transforms new ideas, concepts, interactions and other factors (fig. 15, Block XV, end with high level of entropy) into new project ideas (fig. 15, Block XV, source), and new independent ordered information flows (with level VI) at global, national or regional levels. These flows describe necessary improvements, modernization and reconstruction of assets, and also define material, energy, and financial resources required for further development of the projects (fig. 15, ordered sphere of flows 0).

**Fig. 14.** Block XIV (end-source), ordered sphere of flows N.

Stakeholders – producers and end users of products

- New demands of end users as an of information flows related to new goods and services
- High level of entropy (chaos)
- Ordered by stakeholders incoming and outgoing (level V) information flows on demands for new goods and services
- Ordered incoming and outgoing (level V) information flows on demands for material resources required for production of new goods and services
- Ordered incoming and outgoing (level V) information flows on demands for energy required for production of new goods and services
- Ordered incoming and outgoing (level V) information flows on demands for financial resources required for production of new goods and services
- Low level of entropy
- Ordered sphere of flows N

Ordered sphere of flows N
As a result of implementing stages of development project life cycle stages including maintenance, reconstruction, and modernization, logistic relay of flow movements, ordering, and transformations repeats itself at new level of ideas and concepts of their implementation.

### 3 Conclusion

Research performed in the “resource logistic” field for the first time demonstrated the complete and interactive sequence of motions, ordering, and transformations of resource flow processes that occur in course of implementing development project life cycle stages. The sequence was presented as a model of “logistic relay” formed by different project stakeholders and reflecting changes in the stakeholder ideas, interests, and responsibilities that occur in course of development project stages. Authors systematized and developed a hierarchy of flow processes with regard to macro – meso- and micrologistic levels of project life cycle stage implementation.

In course of the research authors formulated several points related to organization and increasing efficiency of managing flow processes in course of implementing different stages of development project life cycles:

- Stages of development processes are убы and sources of flows with similar or different nature;
- Resource flows are generally unidirectional, and have start and end points in space and time corresponding with development project life cycle stages;
- Some flows terminate at certain stages of development project life cycle, while the following stages produce flows with nature of different quality;
- Some types of flow processes are finite, but nevertheless can be considered as part of an endless process of flow motions, organization and transformations that occur in course of development project life cycle;
- Information flows have a specific role [21] in resource management, and can be either independent, or accompany other resource flows;

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**Fig. 15.** Block XV (end-source), ordered sphere of flows O.
Information and financial flows can either have the same or opposite direction.

The proposed approach can be used during the whole life cycle of a development project by means of linking resource and logistic mechanisms with investment processes for the purpose of coordinating resource flows at key stages of developing, operating and improving property objects, and forecasting different scenarios of flow processes start and end at every stage of a development project.

Results also allow developing a system for structuring, analysis and forecasting resource flows at different life cycle stages describing forms and methods of stakeholder interactions and mutual impacts creating synergy, self-organization and self-management in a unified logistic field of resource flow processes.

The resulting stage-by-stage mechanism of arranging and managing resource flows includes ordering chaos of external resource environment by stakeholders through self-organization and self-management; transformation of flow processes by stakeholders, ordering and decreasing entropy of the resource flows in development projects; forecasting and managing flow process transformations at the boundaries of project stages.

Research demonstrated that the proposed methodological approach to management of resource flows at different stages of development project life cycle allows forecasting, planning, organization and management of the resource flows in course of development project life cycles.

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