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Efficiency of Information Management and Analysis for Industrial Entrepreneurship

Irina Gontareva

*Corresponding author, Professor, Department of Marketing, Management, and Entrepreneurship, V.N. Karazin Kharkiv National University, Kharkiv, Ukraine. E-mail: ivgontareva@gmail.com

Vitalina Babenko

Professor, Department of International E-Commerce and Hotel & Restaurant Business, V.N. Karazin Kharkiv National University, Kharkiv, Ukraine. E-mail: vitalinababenko@karazin.ua

Viktoriia Yevtushenko

Head of Department of Marketing, Management and Entrepreneurship, V.N. Karazin Kharkiv National University, Kharkiv, Ukraine. E-mail: v.a.evtushenko@karazin.ua

Nataliia Voloshko

Associate Professor, Department of Economics and Management, Oles Honchar Dnipro National University, Dnipro, Ukraine. E-mail: voloshkonataly23@gmail.com

Yevgen Oliynyk

Associate Professor, Department of Management & Associate Professor of Department of Economics, Poltava State Agrarian Academy, Poltava, Ukraine. E-mail: psaa2011@i.ua

Abstract

Information Management and Analysis (IMA) implies the single data and knowledge base of the business organization whose algorithm and software complex is designed to solve functional problems of operating and dispatch management, marketing, financial arrangements, accounting, strategic planning and organizing e-document flow between the sources and users of information. The "information – communication - control" vector is directed at the achievement of corporate objectives. Assessment of IMA implementation efficiency is complicated by the fact that implementation of managerial (informational) solutions is possible indirectly, with the flows of material, financial and informational resources; the IMA algorithms are valid for a certain range of situations and modes, whose frequency and duration of action are not known in advance. The study is aimed at formalizing compatibility conditions for a set of economic and technical, actual, and probabilistic indicators

applied for justifying the IMA implementation efficiency for industrial entrepreneurship. The IMA effectiveness is expected to be calculated as a total of network (communication) effects per each block of IMA algorithms, factored the presentation of information operability; to calculate cost-effectiveness (recoupment of investment) it is supposed to modernize the structural capital evaluation procedure according to AcPulici The article contains an introduction, concept of IMA, application of system efficiency theory to IMA, building the structure of IMA efficiency indicators, and conclusion. The main method of study: system approach.

Keywords: Information; Management Algorithms; Communication; Efficiency; Effectiveness; Cost-effectiveness; Operability.

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Introduction

Important technological advancements for the development of INDUSTRY 4.0 are computer-integrated systems (CIS), computer-integrated manufacturing, application systems: CAD, CAE, CAM, CAPP, and others. Other important issues include industry digitalization, strategists, criterion, and principles of creating intellectualized and integrated systems. The necessity of using intelligent information technologies (IT) in organizing modern knowledge-intensive manufacturing is unquestioned nowadays.

An analysis of the use of modern information technologies in the industry shows that one of their development areas is an increasing application of these technologies at all stages of the life cycle (LC) of complex, knowledge-intensive products, in particular, transport engineering products, within the framework of an integrated information environment (Cimoli M., Dosi G. & Stiglitz J. E. (2009).

Materials and Methods: Background of Business Processes Assessment

Target setting

The study is aimed at formalizing the compatibility conditions for the complex of economic and technical, actual, and probabilistic indicators applied for justifying the efficiency of IAS implementation for industrial entrepreneurship.

The article contains an introduction, concept of IAS, application of system efficiency theory to IAS, building the structure of IAS efficiency indicators, and conclusion.

Literature Review

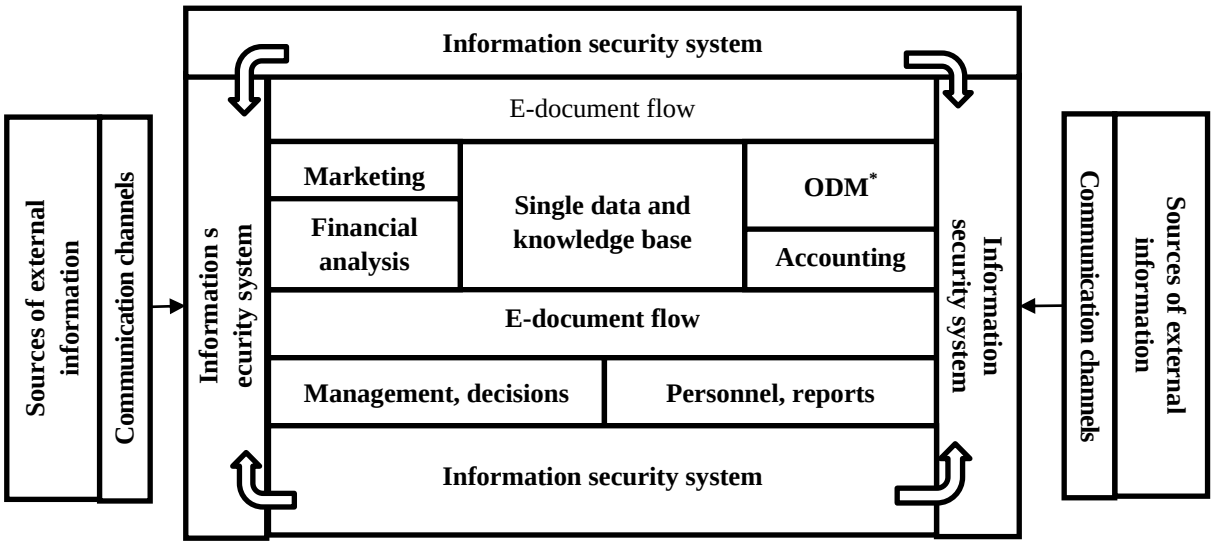
Modern industrial entrepreneurship cannot function effectively without developed Information Analytical Support (hereinafter referred to as IAS) of managerial decision-making processes and communication with external and internal stakeholders. Rapid and continuous improvement of Information and Communication Technologies (ICT) makes the problem of adapting the IAS of an enterprise to the global and regional information structure actual. L. Cretu (2014) and M. Lakhorst (2017) make note of the global information space development and its penetration to all the spheres of economic and public activities but they do not reveal the problems of justification of IAS implementation for production processes management at the industrial enterprises.

The final output of the machine-building enterprise may include hundreds and thousands of assembly units manufactured by its producing departments and external vendors. At the same time, industrial management has to provide continuous interaction of the entire major, auxiliary and service units; even and rhythmic distribution of load in time among particular working places, units, and manufacturing lines. The efficiency of all types of cooperation and integration of the production entities and facilities into a single system is largely determined by the quality of IAS operational control that in turn has to be integrated into the system of medium-term (aggregate) and strategic planning.

Results and discussion

Definition of IAS

The term of Information Analytical Support was introduced long time ago and it defined the body of document forms, regulatory framework and information processing techniques. That definition is obsolete since the authors had reduced IAS to its characteristics or functions such as: compiling the database of particular analytical units; establishing e-document flow; availability of software and hardware to collect and process information; application of network ICT (http://www.itstan.ru/it-i-is/klassifikacija-informacionnyh-sistem-is.html-0). Synthesizing the existing interpretations to some extent, our understanding of IAS for industrial entrepreneurship was developed. The Information Analytical Support implies the single data and knowledge base of the business organization whose algorithm and software complex is designed to solve functional problems of operating and dispatch management, marketing, financial arrangements, accounting, strategic planning, and organizing e-document flow between the sources and users of information. Figure 1 represents the generic structural model of IAS.



*ODM – Operating and dispatch management

Figure 1. Generic structural model of IAS for an industrial enterprise [Designed by the authors]

The entire body of the functional information and analytical subsystems, through diverse communication channels, is integrated into the "information – communication - control" vector. It is directed at achieving the corporate target function that combineselocal indicators of efficiency for all the processes of commercial and production activities. The target function also has to consider social and motivational factors (Jensen, 2010). Timely communication of organizational, regulatory, and methodological information, including regulations, rules, and procedures of methodology for a general assessment of enterprise activity to the personnel is one of such factors.

Ultimately, improving the communication of information creates conditions for building partnership relations between the participants of manufacturing processes. Large global companies use internal social networks to exchange views, comments, and knowledge among numerous personnel located in the different corners of the globe (Korneyev et al., 2019; Varney, C., 2014).

On the whole, IAS has to include: timeliness of providing the required information, simultaneously with the production and commercial processes and operations; targeting, sequencing and required level of detail, under the information destination; verification of information on accuracy and validity; univocacy and improved readability for all users; pick up of all the information entering the registration, accounting, and distribution per contractors; executing control over terms of compliance with the decisions and identification of possible failures causes; execution of situation analysis and forecasting the development of operational

events; differentiation of access areas to information for different users; removal of out-of-date and invalid information and also verification of suspect data.

For practical implementation of IAS algorithmic and mathematical tools, software and technical equipment are used. Taken as a whole they build the specific technical and processing base of IAS (Figure 2).

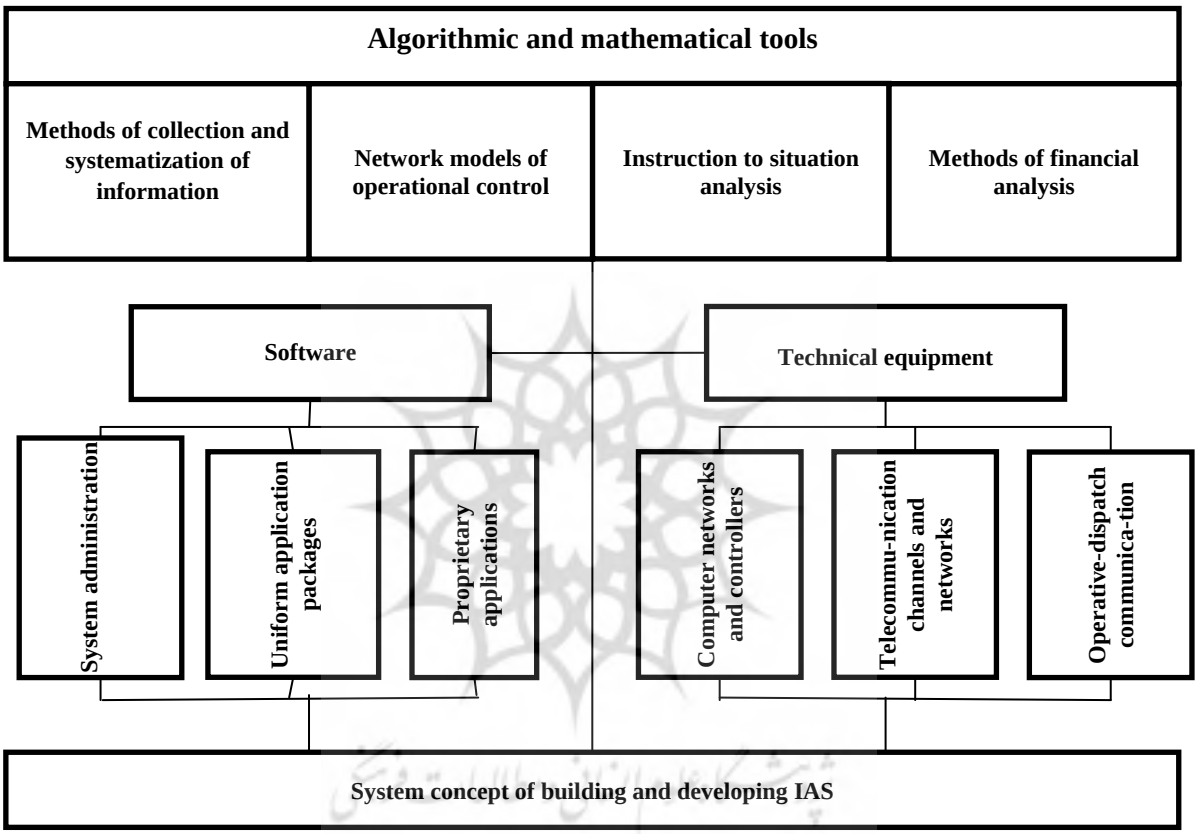


Figure 2. Structural model of technical and processing base of IAS [Designed by the authors]

The models, methods, procedures, and instructions on collecting, keeping, processing, analysis, and providing information represent algorithmic and mathematical tools. This is an analytical component of IAS that was applied to the terms of use in an automated fashion. At the industrial enterprises, the algorithmic tools are predominantly based on practical knowledge accumulated over the years of manufacturing and commercial activities. Such knowledge may be in a form of the project, engineering, processing, accounting, financial and managerial documentation as well as represented as a complex of peer inspections, which happened to be before or still happen. Such the inspections require structuring, and as the complexity of problem-solving increases, the situational algorithmic tools are subdivided into classifying that solves the problems of situation recognition; identifying that identifies the

direction of additional information search; transformational that generates and statistically tests hypotheses; multiagent that is based on the integration of different versatile sources of knowledge.

The applied software packages based on OLAP technologies, Date mining или Knowledge Discovery are used to implement the expert systems. For operational control one may use the uniform application packages of the following types: MPP-II for operational planning and control over the manufacturing processes; ERP – for the inventory control; CRM – for automation of communication with customers, etc.

Application of system efficiency theory to IAS

Traditionally, the main efficiency indicator of the informatization projects is the return on investment as a ratio of profit results and expenditures for its achievement. Thus, the principle of the so-called "black box" is implemented, where there is an "input" – expenditures and an "output" – results but no mechanism of achieving the result. To paraphrase the famous saying of P. Drucker: it is not clear if we do the right things and if we do them right? Not in vain this saying is used in ISO standards 9001:2015 and 9004:2010 to explain efficiency. Many scientists pointed out that it was not sufficient to use only return on investment to identify the efficiency of the complicated social and economic processes. We note, in particular, Stiglitz J. E., Sen A., Fitoussi J.-P. (2009), Cimoli M., Dosi G. & Stiglitz J. E. (2009).

According to the principle of requisite variety by W.R. Ashbi the complexity of efficiency assessment has to be not lower than the complexity of the study object. Meanwhile, considering the limited organizational intellectual resources (principle of bounded rationality by G.Simon), it is necessary to switch from calculation of specific indicators to the interrelated complex of indicators, which integrally provide accuracy of decision-making within the taken risk (Ponomarenko & Gontareva, 2017).

According to the theory of system efficiency (Murray, 2010; Ponomarenko & Gontareva, 2017), the assessment of functioning quality has to comprise at least: а) effectiveness as the extent to which the objectives are achieved; б) cost-effectiveness as a ratio of all the positive and negative results to direct, indirect and prescribed expenditures; в) operability, timeliness and the rhythm of achieving the result. The development of the system occurs due to the generation of quantity and quality of opportunities and the functional organization.

As it follows from the definition above, para. 2, IAS can affect all three groups of indicators through increasing quantity and quality of algorithms in use, a bigger quantity of users, and operational information representation in the required place, at the required amount

and in the prescribed time. A functional relationship between these characteristics will reflect, with the specific accuracy, the effectiveness of IAS, adjusted for the operability coefficient.

The main issue in the calculation of IAS cost-effectiveness is related to turning indirect useful effects into measuring rod of money. Moreover, such the effects in their nature are difficult to detect and measure in some other units. Among indirect useful effects of IAS one may distinguish achieving sustainable quality of products or services, increasing satisfaction from their work on the side of personnel, improving coordination of interacting units and production departments, more rapid and quality decision-making process, and also improving technological and administrative discipline.

In order not to distinguish and assess any of the indirect effects, it is suggested for future researches to represent the algorithmic and mathematical component of IAS as an intangible asset and calculate its value using the proven techniques, adjusted to all the necessary modifications. In particular, A. Pulic (2000) assesses the cost of structural capital according to the actual financial results of economic activity. IAS is a basic element of the structural capital and this enables by expertise or through empirical inquiry to identify its share in the total value of the structural capital.

Structure of the IAS efficiency indicators

In IAS the information is something retrieved from the data flows out of the state of the internal and external environment in the course of shaping them with situational pragmatic sense related to the necessity of managerial decisions. Through classification algorithms the collected data get re-distributed per functional problems, the current situation is modeled, based on regulatory information, problems, and their solutions are stated and communicated to the stakeholders involved. Each stage has its indicators of entrepreneurial efficiency. Initially, they are local, situational, and functional, and later they are more integrated and comprehensive (Figure 3).

The higher variety of situations and recommendations is built by IAS for the bigger number of information exchange participants, the higher its efficiency is. Network communicative effect (result) is produced and it can be represented as:

$$CR = \sum_{i=1}^{I} KT\ (N_i^2 - N_i) \quad (1)$$

where CR – communicative effectiveness of IAS;
i – number of functional problems implemented by IAS
Ni – number of staff involved in solving i-th functional problem;

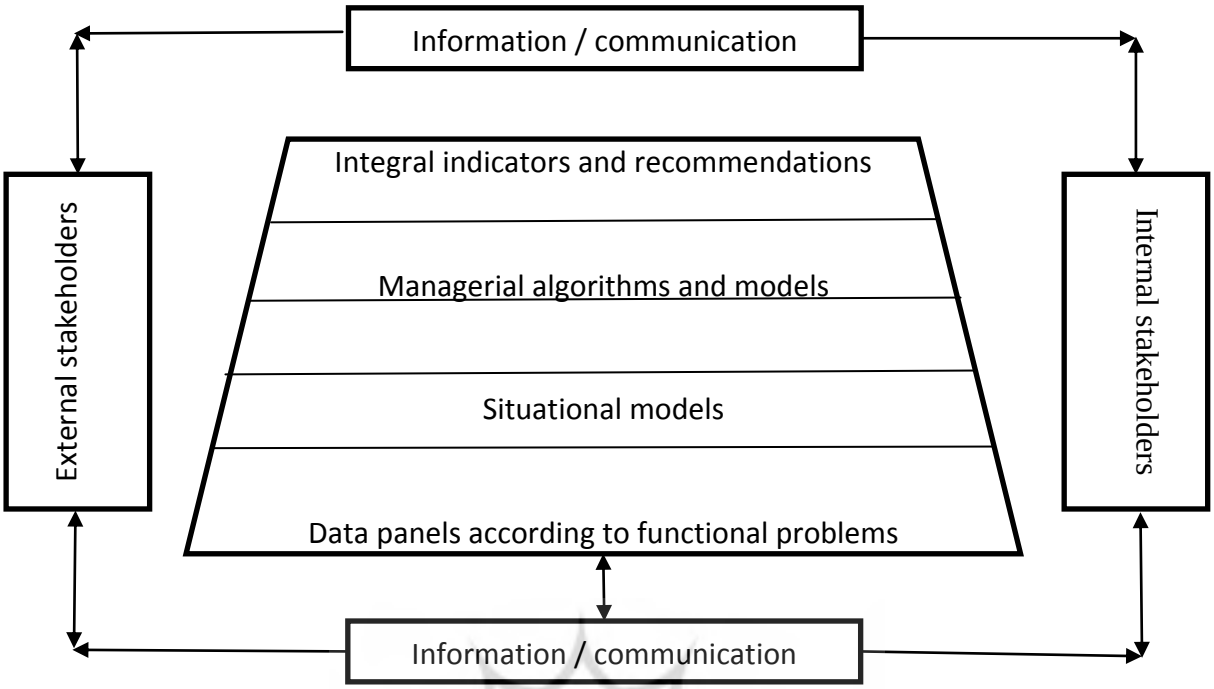


Figure 3. The hierarchical structure of building integral indicators of system efficiency [Designed by the authors]

KT – coefficient of timely information:

$$KT = \frac{T_{SR}}{T_d + T_{im}} \quad (2)$$

where TSR – time from detection to implementation of managerial decisions;
Td – a time of problem detection;
Tim – decision time.

In the formula (1) effectiveness and operability of IAS are integrated. To identify its cost-effectiveness the cost of IAS as an intangible asset (see para. 3) has to be divided by the total of all IAS development and operation expenditures.

Conclusion

The selection of assessment criteria for entrepreneurial activity and identification of impact drivers on their basis, method of organization, and implementation of the control procedures is the general manager of integrated computer systems development. Information Management and Analysis of such the systems implies the single data and knowledge base of the entrepreneurial structure whose algorithmic and software complex is designed to solve functional problems of operating and dispatch management, marketing, financial arrangements, accounting, strategic planning and organizing e-document flow between the

sources and users of information. The "information – communication - control" vector is directed at the achievement of corporate objectives.

Assessment of IAS implementation efficiency is complicated by the fact that implementation of managerial (informational) solutions is possible indirectly, with the flows of material, financial and informational resources; the IAS algorithms are valid for a certain range of situations and modes, whose frequency and duration of action are not known in advance.

Effectiveness of IAS is expected to be calculated as a total of network (communication) effects per each IAS algorithm blocks, factored the operability of information presentation. To calculate cost-effectiveness (recoupment of investment) modernization of the structural capital assessment procedure by A.Pulic was suggested.

Direction for future research is experiential verification of identification technique for network communication effect under uncertainty and risk.

References

Benner, M. J., & Tushman, M. L. (2003). Exploitation, exploration, and process management: The productivity dilemma revisited. *Academy of management review*, 28(2), 238-256.

Cimoli, M., Dosi, G. & Stiglitz, J. E. (2009). *Institutions and Policies Shaping Industrial Development: An Introductory Note. Industrial Policy and Development: The Political Economy of Capabilities Accumulation*. New York, Oxford: Oxford Scholarship. 19-38. DOI:10.1093/acprof:oso/9780199235261.003.0002

Cretu, L.G. (2014). *Designing enterprise architecture frameworks: Integrating business processes with IT infrastructure*. Toronto: Apple Academic Press, CRC Press. 360 p.

Gontareva, I. V. (2011). Influence of timeliness in reproduction processes upon system efficiency of enterprise development. *Actual Problems of Economics*, 2(116), 69-76. (in Ukr.)

Hrabovskyi, Y., Babenko, V., Al'boschiy, O., Gerasimenko, V. (2020). Development of a Technology for Automation of Work with Sources of Information on the Internet. *WSEAS Transactions on Business and Economics*, Vol. 17, Art. #25, pp. 231-240. doi: 10.37394/23207.2020.17.25

Information technology and information systems. Retrieved from http://www.itstan.ru/it-i-is/klassifikacija-informacionnyh-sistem-is.html-0 [accessed January 10, 2020]

Jensen, M. (2010). The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems. *Journal of Applied Corporate Finance*. Vol. 22, No. 1, 43-58.

Korneyev M., Pylypenko A., Popov O., Shmatko N. (2019). Organized management of decentralized economic production systems with joint implementation of development projects. *Eastern-European Journal of Enterprise Technologies*, 4/3 (100), 22– 35. https://doi.org/10.15587/1729-4061.2019.175765

Lankhorst, V. et al. (2017). *Architecture at Work: Modelling, Communication and Analysis (The Enterprise Engineering Series)* 4th Edition, Kindle Edition. Springer. 360 p.

Malyarets, L., Draskovic, M., Babenko, V., Kochuyeva, Z. & Dorokhov, O. (2017). Theory and practice of controlling at enterprises in international business. *Economic annals-XXI*, 165, 90-96.

Murray, M. (2010). Total System Efficiency. In Power Transmission Engineering. *Randall Publications LLC: Elk Grove Village, IL*, Vol. 4, 1. 16-23.

Ponomarenko, V. & Gontareva, I. (2017). The system of causal connections between entrepreneurial activity and economic development. *Economic annals-XXI*. 165(5-6), 4-7. https://doi.org/10.21003/ea.V165-01

Pulic, A. (2000). VAIC™ an accounting tool for IC management. *International Journal of Technology Management*, Vol.20, No.5/6/7/8, 702-714. https://doi.org/10.1504/IJTM.2000.002891

Stiglitz, J. E., Sen, A. & Fitoussi, J.-P. (2009). Report by the Commission on the Measurement of Economic Performance and Social Progress: Reflections and Overview. Retrieved from https://hal-sciencespo.archives-ouvertes.fr/hal-01069384/document [accessed January 10, 2020]

Varney, C. (2014). Using Social Media for Internal Communications. URL: https://www.brandwatch.com/blog/internal-communications-a-look-at-the-untold-story-of-marketing.

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