

PAPER • OPEN ACCESS

Economic efficiency of management automation in educational organizations

To cite this article: T S Alenicheva *et al* 2019 *J. Phys.: Conf. Ser.* **1333** 072018

View the [article online](#) for updates and enhancements.



IOP | ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the [collection](#) - download the first chapter of every title for free.

Economic efficiency of management automation in educational organizations

T S Alenicheva¹, N A Mamaeva¹, O Yu Patlasov^{2,3}

¹ Omsk Armored Institute, 14 Military town, Omsk, 644098, Russia

² K.G. Razumovski Moscow State University of technologies and management, 79, Kujbysheva, Omsk, 644105, Russia

³ E-mail: opatlasov@mail.ru

Abstract. The problem of using management automation in digital educational organization environment is considered in the article. The purpose of research is calculation of management automation performance indicators and rationale of using them. The empirical method of comparison, theoretical methods for forming a structure, making a conclusion about the composition, such as study, synthesis, analysis, are used in the article. The article is based on domestic and foreign research about information technologies in educational service management problems. The results consist in calculation of management automation performance indicators and allow justifying the position about using management automation in an educational organization based on Omsk State Railway University. The authors believe that the result of the research can be used in science and pedagogical activity concerning informational systems in the educational process and management automation in educational organization problems and digital educational environment development.

1. Introduction

The relevance of the research topic is built up on the following facts. Firstly, the transition to digital economy in Russia imposes special conditions on the education sector automation. Secondly, it is influenced by the needs to create innovative scientific and educational infrastructure in educational institutions of higher education being able to adjust quickly to educational and professional standards changes, the labor market requirements, especially in the provision of paid education services in the field of additional professional education. Thirdly, the issues of choosing an implementation platform arise when using e-learning and distance learning technologies.

In addition, the trends of informatization and automation in education are due to scientific and technical progress, the principle of informatization of society, as well as the requirements of the Ministry of Science and Higher Education of the Russian Federation which established the creation of an information educational environment as a priority development project [1]. It should be specially noted that all educational standards i.e. 3+ and 3 ++ contain the requirement for having an access to the organization's electronic and information educational environment and the requirements for full-time students (clause 4.2.2 of the standards section "Requirements for the Master's program environment" [2]; clause 7.1.2 of the section "Requirements for the undergraduate program environment" [3]):

"Every student during the whole period of study should be provided with an individual unlimited access to one or several electronic library systems (electronic libraries) and to the organization's electronic information and educational environment. The electronic library system (electronic library) and the electronic information and educational environment must provide access for the student from



any place with the Internet access available, both within the organization and outside it. The organization's electronic information and educational environment should provide:"

- access to curricula, outline of academic disciplines (modules), practices, to publications of electronic library systems and electronic educational resources specified in the outline;
- record of the educational process development, the results of intermediate certification and the results of the undergraduate program mastering;
- conducting all types of classes, procedures for assessing academic outcomes, the implementation of those is provided for using e-learning, distance learning technologies;
- building a digital student's portfolio including the student's work, reviews and assessments of these works by any participants in the educational process;
- interaction between participants of the educational process including synchronous and (or) asynchronous interaction via the Internet.

The purpose of this article is to calculate economic effect of indicators when using automation in digital educational environment of an educational organization by the example of SunRav TestOfficePro.

The transition to digital and creative economies has set the task to create smart institutions, cities, homes, universities, etc. In the scientific work "Smart college establishment: best educational practices and faculties development", the authors describe various methods for a more intelligent university establishment. It is argued that hardware, software, systems, institutional policies, including admission policies, curriculum policies, and diploma policies, teacher training and information exchanges must be interconnected in a smarter university / college for effective functioning. A high evaluation of the authors' practices of innovative intellectual education expressed in financial support from the Ministry of Education, Culture, Sports, Science and Technology of Japan and the National Institute of Technology, Gifu College (NIT, Gifu College) is demonstrated. All teachers interact with each other, and active learning practiced in these colleges is characterized by the use of educational systems with ICT equipment [4].

Christopher Brooks, Jim Greer and Carl Gutwin provided a detailed description of the data-assisted approach to building intelligent technology-enhanced learning systems focused on helping to discover instructional experts' insight into the teaching and learning process, and leverages that insight as instructional interventions. Three different scenarios and related case studies have been provided: use of information visualization in online discussion forums, use of clustering for viewing and lectures and the ability to customize indices when playing downloaded lectures [5].

Individual blocks of education digitization are being studied in the scientific literature in relation to different age groups, levels of education and the field of study. So, the article "Is E-learning Really Flexible? Ideas for Building Effective Interactive Learning Environments for Cultural Heritage" examines the use of e-learning platforms in courses related to digital cultural heritage. The authors discuss their experience in using e-learning modules in the context of Erasmus + projects aimed at adult learning / VET on cultural heritage, and they offer an e-learning approach focused on personification, modularity and interactivity. According to the authors, the aforementioned three concepts are particularly important in order to help adult audiences understand and implement the basic concepts of cultural heritage management and improvement, as well as for their introduction into the world of digital cultural heritage. The article discusses the possibilities to use methodologies stimulating personalized and interactive knowledge necessary to build e-learning platforms for the digital cultural heritage, adapted to the needs of various target groups. Such e-learning platforms are becoming more and more required as analogous to several digitization projects, since many agents responsible for managing and improving cultural heritage do not always have all the skills necessary to implement such projects. Therefore, they must be diverse, adapted to different realities and include different levels, as well as stages of users' needs and achievements in self-assessment [6].

Peter Grootenboer and Leoni Rowan, relying on key ideas taken from the practice theory and using philosophical concepts developed by Parker Palmer, revealed different approaches to the development of mutual understanding between university students studying in different learning contexts. They describe factors that contribute to and limit the development of relational learning and learning practices.

They investigate the impact of collegial discussions on the development of mutual understanding between teachers and the positive impact it ultimately had on their teaching practice [7]

The work of interest is “Building Electronic Educational Environments: Why, What and How?” where it is argued that value added in new forms of education using information technologies lie in more interactivity and feedback, in the learning “process” reorientation and in the use of meta-structures. New computer devices contribute to this additional value providing dynamic modeling environments or virtual worlds. Tom J. van Weert and Bauke van der Wal suggest that higher education is aware of the need for educational innovations supported by information and communication technologies. The question is whether it can turn into a “new” learning organization, a student-oriented work environment with integrated ICT; ICT support should provide functionality suitable for this new learning situation. The authors have described the requirements for electronic learning environments, such as LearningSpace, and have made a comparison of the environments [8].

The Russian scientists’ article titled “Smart Innovations, Systems and Technologies” considers the possibility of using intelligent and electronic learning technologies to build flexible educational information environments. A method to combine modular learning technology and technology for constructing and applying mind maps (mind mapping), which is considered as an instrumental basis to create multidimensional information environments and as an instrumental basis for a modular system is proposed. A characteristic of the proposed format is the navigation system and it allows using cross-hyperlinks to direct students to heterogeneous information both inside and between blocks and modules, to use information sources provided on the Internet and on students’ personal computers, to develop common and personal information environments realized in basic environment created by the teacher [9].

In various models of organizing a learning progress and outcomes recording, different approaches are applied to the relationship between the students’ portfolio and Electronic Information and Educational Environment (EIEE). Scientists explore portfolio content practices characterizing and evaluating both individual and collective aspects of portfolio build-up, as well as their role in developing a conceptual understanding of students’ achievements. A key feature of the design is to encourage students to determine the approximate records structure in the database illustrating the joint portfolio construction guided by the four principles of building pedagogical knowledge [10].

The issue of the educational process informatization and management automation in the educational organizations was carried out by such national authors as M.F. Minyaev, N.A. Zhdankin, N.B. Kushcheva, V.I. Terekhova, T.N. Osinina, A.I. Kulichenko, D.V. Kozlov, E.A. Shpinko [11-13], as well as by foreign scientists as L. Hunt, L. Eagle, P.D. Kitsch [18]. As a rule, most authors agree that these facilities in educational organizations contribute to educational services quality improvement, students’ motivation and they save time spent on coordination processes. However, the studies reflecting the economic effect of the facilities introduction are not fully represented in the research literature. Therefore they require additional study and improvement.

2. Materials and methods

The main criteria for economic efficiency are the amount of investment, net present value, payback period, and other indicators allowing the authors to conclude about the impact of the information systems use on management in an educational organization.

A wide class of approaches used for research tasks provides a fairly deep description of the process of economic calculations, compliance with the real characteristics of educational organization’s performance indicators, and, as a result, obtaining an effective procedure to solve a complex and ambiguous problem of decision making theory.

Taking into account the goal and the limited length of the article, the authors did not set a task to conduct a comparative analysis of software products for educational institutions activities automation, taking into account the educational organization size and status, departmental affiliation, features of branches, private educational organizations, institutes of supplementary education, network universities, etc. Although other automation software may be of interest for practice and for analysts such as: 1C: Universitet PROF. It is a comprehensive solution for management automation in the educational institution of higher education, including the profiles: reception, educational process, schedule,

contingent, recruitment, tuition, scientific-research, postgraduate study, dissertation advice, pre-university and further education, university campus.

Hypothesis: In order to solve certain automation problems, it is possible to use effectively non-integrated (“patchwork”) information systems within a single solution, for example, building interactive training courses, presentations, etc. that are not integrated into a single 1C platform.

3. Results

In accordance with the Federal Law “On Education in the Russian Federation,” educational organizations of higher education (EOHE) have higher education activity and scientific activity as their goal. Management in the EOHE involves the basic management functions implementation such as control, organization, planning, motivation and coordination, as well as an intermediary function as management decision making and communication [14-16, 19].

These functions can be implemented using a digital educational environment, which provides many opportunities for management participants in an educational organization. For the purpose of the article, the information educational environment is understood as a set of information systems designed for various tasks of the educational process [1]. Digital educational environment ensures the unity of digital technologies, openness and accessibility of information, competitiveness of technologies, sufficiency and usefulness.

The use of information systems in the educational process and in educational organization management contributes to save time for the functions implementation, increasing the students’ motivation as well as reducing paper workflow. However, the increase in the effect of the automation equipment use was revealed with an increase in the volume and complexity of the document (the content of tables, formulas, figures, references). Based on the expert assessment of the time expenditures and the volume of work dependence, some zones of equal significance and effect increase have been revealed (time expenditures decrease due to volume increase), as illustrated in Figure 1 [15].

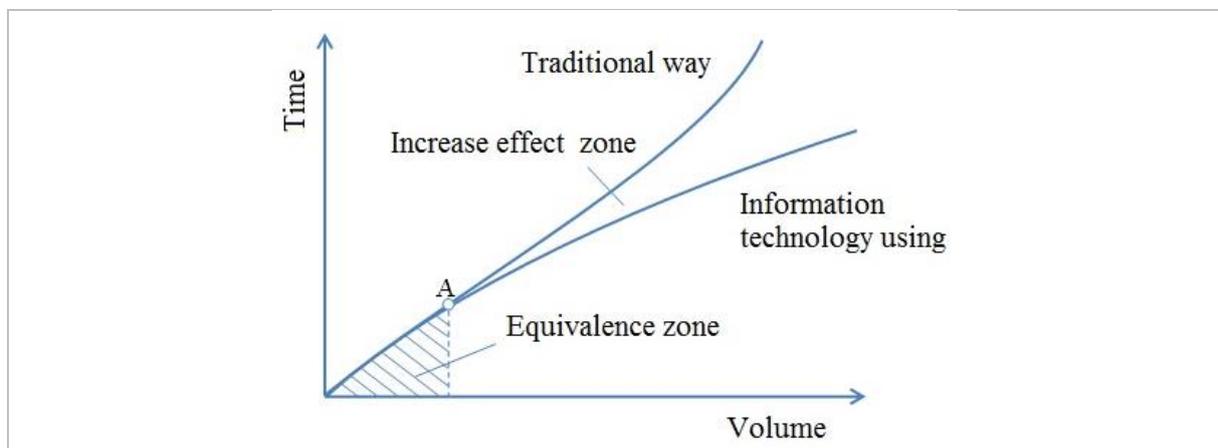


Figure 1. Expert assessment of the time expenditures and workload dependence

In this article, the authors investigated the effectiveness of using the SunRavTestOfficePro software package for the implementation of the control function in educational organizations (test building, iBT performance and its results processing). SunRavTestOfficePro is a tool for building up computer tests, developing e-books and tutorials, and also it allows to present test results in the form of a personalized report.

This software package is designed to work both in the local network and on personal computers being not connected to the network.

The main program features are:

- Questions and answers support using images, animation, sound tracks and videos.
- Adaptive test and tasks depending on the student’s knowledge level.
- Personalized reports building.

- Objective tests.

The amount of time spent at each stage of the control is presented in Table 1.

Table 1. Comparative indicators of time expenditure

Expenditure type	Without SunRavTestOfficePro use	Using SunRanTestOfficePro
Test development	8 hours	4 hours
Passing the test	30 minutes	30 minutes
Test scoring	5 minutes per student	0 minutes per student

Having 5 test controls of students' knowledge per year for one discipline due to the savings in working time, the annual economic effect of reducing the labor cost per teacher can be calculated as (formula 1):

$$E_{year}^t = 5 \times \frac{5}{60} \times 20 \times 230 = 1917 \text{ rub.} \quad (1)$$

If we take Omsk State Transport University as an example, its annual economic effect will be (formula 2):

$$E_{year} = 1917 \times 5 \times 150 = 1437750 \text{ rub.} \quad (2)$$

The calculation of the total investment, the full economic effect, payback period and discounted payback period are presented in table 2.

Table 2. Calculation of economic effect and payback period

Indicator	Numerical value
1. Total investment, K (rub.)	59000
2. Full economic effect from the implementation, E (rub / month), including:	1437750/12=119812
3. Payback period, T_p (year)	59000/119812=0.5
4. Discounted payback period, T_d	$-\ln(1-10 \cdot 0.5/100) / \ln(1+10/100)=0.5$

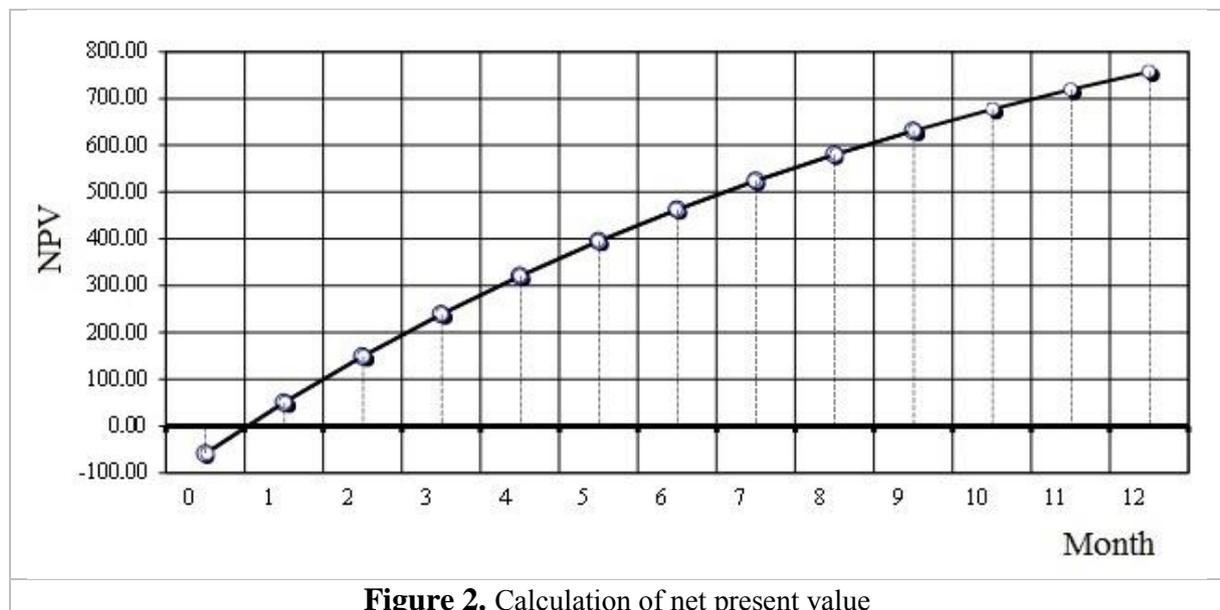
Table 2 illustrates that with a total investment of 59000 rubles for the purchase of software, the payback period will come in less than a month. At the same time, this software package allows providing an unlimited number of computers with access to the testing system.

Table 3 presents the calculation of discounting indicators.

Table 3. Calculation of discounting indicators

Indicator	Month (t)					
	0th	1st	2nd	3rd	4th	5th
E (rub/month)	0	119812	119812	119812	119812	119812
K (rub)	59000	0	0	0	0	0
NPV_t (rub)	-59000	108920	99020	90020	81830	74390
$\sum NPV$ (rub)	-59000	49920	148940	238950	320790	395180
Profitability Index (PI)	-1.00	0.85	2.52	4.05	5.44	6.70

The total investment amounted for the purchase of a software package allowing providing an unlimited number of computers for users testing, as well as working places for test developers and administrators was 59000 rubles.

**Figure 2.** Calculation of net present value

Thus, the use of systems automating the students' knowledge control (using the example of SunRav TestOfficePro) is appropriate, since the payback period is less than one month, and the annual economic effect for the whole university is about 1.5 million rubles.

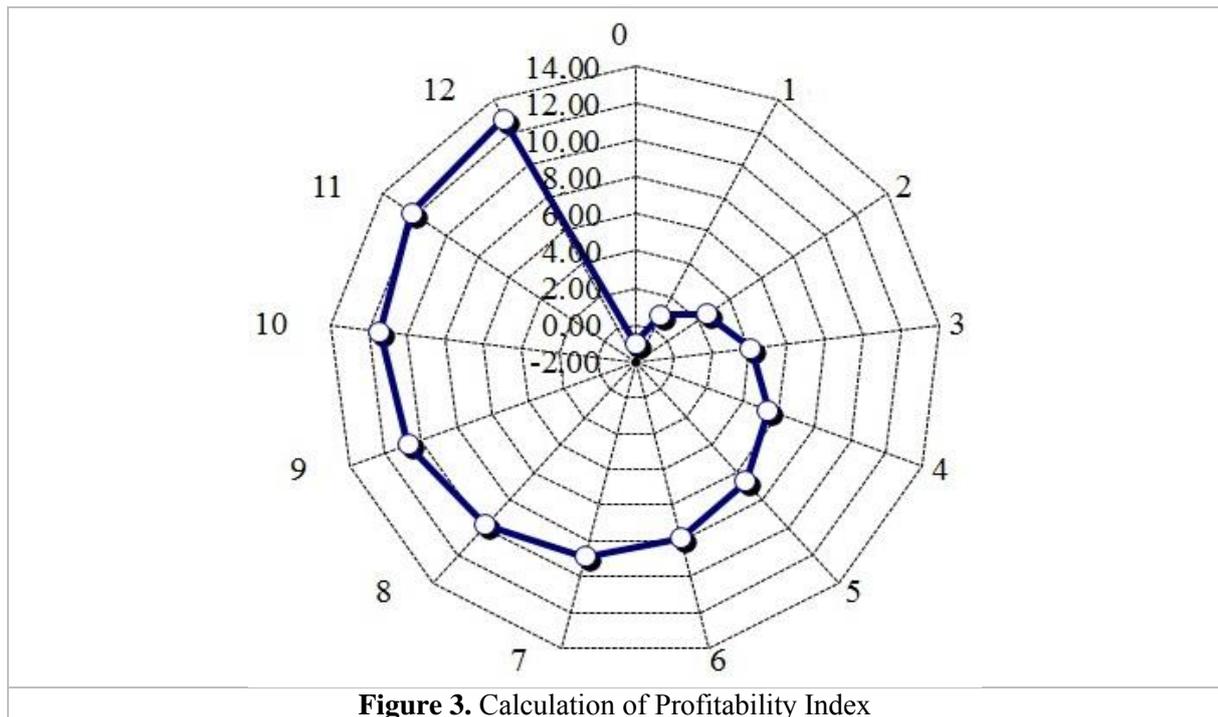


Figure 3. Calculation of Profitability Index

4. Conclusion

In the opinion of the authors, informational analysis, the calculations proposed in the paper have led to the following conclusions:

1. using information technologies is the main direction for educational organizations development;
2. the implementation of control function automation features using the example of the SunRav TestOfficePro package has revealed that if the total investment is 59000 rubles, the payback period is less than one month, and the annual economic effect for the organization is 1437750 rubles (using the example of Omsk State Transport University);
3. the calculated indicators of economic efficiency allow to justify the provision on the feasibility of using management automation tools in an educational organization.

The proposed aspects have practical significance and a further prospect to research the other control functions using automation tools, as well as to calculate the efficiency indicators of their use. At the same time during testing, the authors have adopted the limitations of this automation tool usage and presented the comparative characteristics of more complex software products.

References

- [1] Website of the Ministry of science and higher education of the Russian Federation 2018 Modern digital educational environment Retrieved from: <https://минобрнауки.рф/проекты/современная-цифровая-образовательная-среда>.
- [2] Minaev M F 2017 *Information management* (Moscow: MSTU. N.Uh. Bauman).
- [3] Textbook of the discipline "Information technologies in management". 2019 Retrieved from: <https://studfiles.net/preview/4431860>.
- [4] Ogawa N, Shimizu A 2018 Building a Smarter College: Best Educational Practices and Faculty Development. *Smart Innovation, Systems and Technologies* (Electronic Materials vol 70) ed: Uskov V., Bakken J., Howlett R., Jain L. (Springer, Cham)
- [5] Brooks C, Greer J, Gutwin C 2014 The Data-Assisted Approach to Building Intelligent Technology-Enhanced Learning Environments. Retrieved from: https://link.springer.com/chapter/10.1007/978-1-4614-3305-7_7.

- [6] Kamara A, Lampada D, Tzedopoulos Y, Ferla K 2018 Is E-learning Really Flexible? Ideas for Building Effective Interactive Learning Environments for Cultural Heritage. Retrieved from: https://link.springer.com/chapter/10.1007/978-3-030-01765-1_28.
- [7] Grootenboer P, Rowan L 2017 Building Rapport with University Students: Building Rapport Among University Teachers. *Student Engagement and Educational Rapport in Higher Education*. eds: Rowan L., Grootenboer P. Palgrave (Macmillan, Cham) pp 131-151.
- [8] Van Weert T J, van der Wal B 2000 Building Electronic Educational Environments: Why, What and How?. Retrieved from: https://link.springer.com/chapter/10.1007/978-0-387-35502-3_15#citeas.
- [9] Mamontova M, Starichenko B, Novoselov S, Kusova M. 2016 Use of Electronic Mind Maps for Creation of Flexible Educational Information Environments. Retrieved from: https://link.springer.com/chapter/10.1007/978-3-319-39690-3_54.
- [10] Chan C K K, van Aalst J 2003 Assessing and Scaffolding Knowledge Building: Pedagogical Knowledge Building Principles and Electronic Portfolios. Retrieved from: https://link.springer.com/chapter/10.1007/978-94-017-0195-2_5.
- [11] Kushnir M 2018 *The digital learning environment*. Retrieved from: <https://medium.com/direktoria-online/the-digital-learning-environment-f1255d06942a>.
- [12] Kuscheva N B Terekhov V I 2018 Modern digital educational environment in higher education in Russia *Problems of science and education* **1 (65)** 191-194.
- [13] Osinina T N 2018 Modern digital educational environment as a priority project of the Russian Federation *Pedagogical education and digital revolution: theoretical and practical aspects* (Orehovo-Zuyevo) pp 69-76.
- [14] Website Consultant 2018 Federal law on education in the Russian Federation No. 273-FZ of 29 December 2012 Retrieved from: <http://www.consultant.ru/document>.
- [15] Alenicheva T S, Kurshakova N B 2017 Implementation of management functions in educational institutions of higher education through electronic information and educational environment *Innovative technologies in modern education* (Korolev: publishing house of technological University) pp 23-28.
- [16] Alenicheva T S Mamaeva N A, Kurshakova N B 2018 Review of educational process management functions using electronic information and educational environment *Actual problems of teaching mathematics in educational organization of higher education* (Kostroma: publishing house "military Academy of radiation, chemical and biological protection named after Marshal of the Soviet Union S. K. Tymoshenko") pp 174-178.
- [17] Simak R S, Simak N Yu 2018 Tools to improve the efficiency of the *teacher Information technologies: actual problems of training of specialists taking into account the implementation requirements of the new standard* (Omsk: Publishing house OUBEI) pp 166-170.
- [18] Hunt L, Eagle L 2004 Balancing marketing education and information technology: Matching needs or needing a better match? *Journal of Marketing education* **1 (26)** 75-88.
- [19] Patlasov O Yu, Mikhailov, M N 2014 New trends in automobile network management technology: network, process, entrepreneurial approaches, technology platforms, foresight *Fundamental research* **3** 159-164.