Список сокращений

АРМ — автоматизированное рабочее место;
АСУ ТП — автоматизированная система управления технологическим процессом;
ДПО — дискретный процесс обслуживания;
ДТИП — дискретный технологический или информационный процесс;
ИТ АУ ДТИП — информационная технология автоматизации управления дискретными технологическими и информационными процессами;
МСИС — многоязычная сетевая инструментальная система;
МСПИ — многоязычный сетевой программный инструментарий;
ОБМ — оптимизация бюджета министерства;
ОДЦ — оптимизация достижения цели;
ОЖ — объект жилья;
ОИ — оптимизация инвестиций;
ОИЖ — оптимизация инвестиции в жилье;
ОТП — оптимизация транспортных перевозок;
ПКВТ — производственная компания по внедрению Технологии;
СИС — сетевая инструментальная система;
СЦО — сетевой центр обработки;
ЦАУ — центр автоматизации управления;
ЦБ — ценные бумаги;
ЦРИС — центр разработки инструментальных средств.

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ABOUT SCIENCE-INTENSIVE TECHNOLOGY OF OPTIMAL CONTROLLING DISCRETE PROCESSES FOR VARIOUS PURPOSES

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Abstract. *The article presents the basic information about a new science-intensive technology entitled "Information technology of automation of control of discrete technological and information processes (in short — IT AC DTIP or just Technology)", which founder is the author. It allows to control discrete processes of many purposes in the best way (i.e. optimally). The topicality, purpose and brief description of Technology, strategy of its implementation to life, current results of its development, as well as prospects and problems of its practical introduction are given here.*

Keywords: *information technology, discrete technological and information processes, IT AC DTIP, effective control of discrete processes*

Introduction Nowadays there is a big problem of ineffective control of so-called discrete processes, which are processes with states clearly separated from each other. These processes occur in

a variety of fields of human activities, which include: business, manufacturing, design and construction, freight and passenger transportation, commerce, digital communication, investments and others. The reason for this problem is the absence of a functioning technology of effective controlling discrete processes for various purposes like the well-known and long existing technology on effective control of continuous processes, implemented in practice by creating automated systems of control of technological processes (ASC TP).

This problem can be successfully solved by the implementation to life of Technology, proposed by the author, which will be discussed here.

Purpose of Technology

IT AC DTIP allows you to find by numerical way the best (optimal) tabular strategies and close to them of controlling many real discrete processes which can be *infinite stationary, limited in time* and *instant processes* of selecting choices.

Here are three examples of the low efficiency of controlling specific discrete processes because of the absence of a similar functioning technology, with the confirmation that they can be controlled efficiently with the help of IT AC DTIP. For the first two of these examples have place instant processes of selecting choices, and for the third — a time-limited discrete process.

First example. When buying a housing object (HO) for living therein a buyer must not only choose from several variants a most appropriate for himself HO of required category, but also to estimate his future expenses on bringing it to the desired condition (its repair and purchase of necessary furnishing), to meet the amount of investment allocated by him. And this problem is usually solved intuitively by the buyer. This often leads to making a choice which is not the best one, and eventually is forced to seek additional funds to bring the acquired HO up to the level which matches his needs. Now, this problem of selection can be successfully solved with the help of the network optimizing software tool NIS HIO 1.1, created on the basis of IT AC DTIP (see "Portal 4. Optimization of investment in housing" of the website "Implementation center of IT AC DTIP", http://dtip-optim.com/en/main).

Second example. If you trade in securities (SC) on a stock market, you know how risky is this activity. The success in it depends on whether you can correctly forecast the change of SC quotations in the near future. This problem is solved by a SC trader intuitively, because until recently the software tools of optimizing the purchase and sale of SC were absent. Now, it can be successfully solved with the help of the network optimizing software tool NIS IO 2.1, created on the basis of IT AC DTIP (see "Portal 8. Optimization of investment in securities" of the website "Implementation center of IT AC DTIP").

Third example. There is a problem of choosing routes of cargo transportation in city by a vehicle. For small transport and trade companies this problem is solved now only by experience, i.e. without using any route selection software. The reason for this is that for such companies simply unprofitable to buy an expensive database of a city road network and a specialized program that allows to calculate best transportation routes (it can afford only large transport companies). Now, this problem can be successfully solved with the help of the network optimizing software tool NIS TO 1.5, created on the basis of IT AC DTIP (see "Portal 17. Optimization of transportation in city" of the website "Implementation center of IT AC DTIP").

IT AC DTIP allows to do the following:

1) to manage laboriousness of synthesis optimal strategies of controlling such processes by introduction of incrementing;

2) to find the *best* (optimal) control strategies at the *lowest* cost and time expenses compared with existing practice;

3) to provide mass network services on effective control of the widespread in practice discrete processes of narrow purposes.

Scientific methodology of Technology

In 1996, [1] was first put forward by the author of this article the idea of creating IT AC DTIP. A term "automation of control" in the name of Technology has a dual meaning. Firstly, it means that it contains many procedures that automate the process of developing effective strategies of controlling discrete processes. And secondly, it emphasizes the specifics of using synthesized tabular control strategies for quickly flowing processes. It consists in the fact that such strategies are realized through program-dispatchers, which control the process in an automatic mode without executing any computational operations.

IT AC DTIP is based on the methodology of numerical optimization of stationary discrete processes of service (DPSs) with additive quality criteria [2, 3], which provide a consistent fulfillment of the following three procedures:

- reduction of a real existing discrete technological or information process (DTIP) to an abstract stationary DPS with a finite number of phase states, which is reached through the application of *incrementing* (i.e. quantization) to the initial process and its subsequent regeneration (if necessary);
- numerical optimization of this DPS by applying thereto one of the known schemes of recurrent optimization based on dynamic programming [2, p. 61] (laboriousness of this procedure is regulated by selecting an increment value);
- applying the found tabular strategy to the initial DTIP (with its possible improvement in the case of synchronizing moments of control by means of incrementing).

Let us explain the essence of the above-mentioned methodology on three examples.

First example. Here is solved a task of optimizing passenger's delivery by city transport. In this case, the initial DTIP is a time-limited process. On its basis was constructed a stationary controlled DPS by its regeneration (the first procedure described above). Further to this DPS was applied the standard scheme of recurrent optimization [2], whereby there was found numerically an optimal tabular strategy of controlling it (the second procedure). Then the strategy was presented in terms of the original task in a user-friendly form of payroll (the third procedure). Incrementing was not used here.

Second example. Here is solved a task of optimizing expenses. In this case the initial DTIP presents an instant process of selecting choices. To construct on its basis a stationary controlled DPS, you should add to it one fictitious state with time of stay in it equal a unit time. As a result, this process became lasting in time, which allowed to form from it by regeneration a stationary DPS (the first procedure). Next were performed two remaining procedures in the same way as in the first case.

Third example. Here is solved a task of optimization of reforming a troop formation [3]. In this case, the initial DTIP is limited in time. On its basis was constructed a stationary controlled DPS by application of incrementing to the initial process and its subsequent regeneration (the first procedure). The incrementing is necessary here in order to firstly restrict the number of phase states of the DPS, and secondly to set moments of controlling this process. Further the standard scheme of recurrent optimization [2] was applied to the DPS, whereby there was found by numerical way an optimal tabular control strategy (the second procedure). Then this strategy was presented in user-friendly graphical form (the third procedure). At that happened the improvement of the found strategy at the stage of its application due to the fact that were eliminated downtimes that occurred in the controlled DPS between moments of completing service of demands (moments of completing reformation of separate military units of the troop formation) and the nearest moments of incrementing in which you can apply controls.

Application areas of Technology

The need of practice in IT AC DTIP is very high due to the fact that discrete processes occur in the most varied fields of human activity, at that they require effective control. Below are listed alphabetically possible areas of practical use of IT AC DTIP. Asterisks mark those of them, for which we have already created the software tools on optimizing discrete processes of relevant purposes. Those areas include:

1) * budgeting based on program-target planning;
2) * service of customers in catering (particularly, in restaurants);
3) * delivery of a passenger by public transport to his destination;
4) * expenditure of money for acquiring various goods and services;
5) service of impatient customers;
6) * investment of money in different sources of income;
7) loading and unloading operations;
8) maintenance of calls by emergency city services;
9) * maintenance of geographically distributed objects;
10) * network planning in project management;
11) * planning of business operations in production and business;
12) processing of workpieces on machines with changeover;
13) * purchase of housing;
14) reconstruction of existing facilities;
15) repair of process equipment;
16) storage and processing of perishable products;

17) * trade in real estate;
18) * trade online;
19) transmission of digital messages in communication networks;
20) * transportation.

Strategy of Technology implementation

IT AC DTIP is a science-intensive and network technology, where its final output products are not the developed software tools, but generated by them the effective (or more precisely — the best, i.e. optimal) strategies of controlling those or other DTIPs. This implies the obvious conclusion that such production company, which will deal with the widespread introduction to life of Technology, actually has all chances to become a world leader in the development of means of effectively controlling discrete processes for various purposes.

To start the implementation worldwide of IT AC DTIP, you must create multilingual network software tools (MNST) on optimizing control of narrow classes of most widespread DTIPs that occur in various areas of human activity. A mass online access to MNST will be provided through the Internet for interested network users to solve their specific tasks of optimizing control of particular discrete processes. All calculations will be performed in the network processing center (NPC). At that, the preparation of input data of tasks and output of their result will be provided using automated work places (AWPs), free distributed among users, which are software tools of access to NPC.

In fact we are talking about that in all those application areas, where widely occur discrete processes, should be created on basis of MNST *the international outsourcing services* of optimal controlling such processes. To realize such network services we propose to establish a specialized production company for implementation of Technology (in short — PCIT). It will consist of a Center of toolkit development (CTD) and a network of Centers of control automation (CCAs) on the directions of its implementation [1] (Fig. 1).

The purpose of functioning a separate CCA is the development and implementation of highly effective strategies of controlling DTIPs in a specific application area. CTD and CCAs will have the following interconnection between them: CTD develops optimizing tools, as well as mathematical models and algorithms of optimization, and CCA provides to CTD necessary information about the tasks to be solved, that allows to create new program systems and to develop mathematical support for those models of DTIPs, which optimization is impossible by using the existing program toolkit.

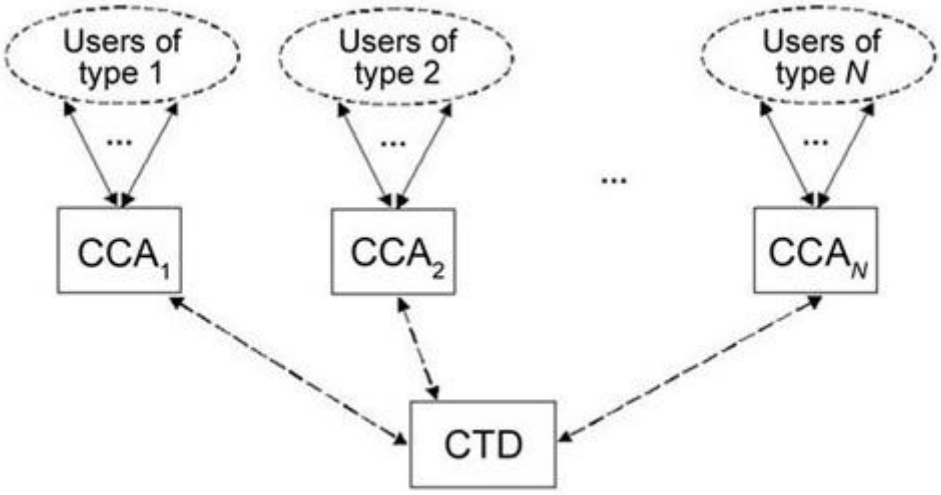

Fig. 1. Structure of PCIT

Such an approach in the organization of work of development and implementation of IT AC DTIP allows in the shortest possible time to master the market of all those tasks of ensuring the efficient control of DTIPs, for which solving is purposed Technology.

A necessary condition for the creation of the abovementioned company is to have a team of associates that will establish it. Each member of this team will be responsible for certain activities of the company. The presence of an investor here is highly desirable, but not necessary, because Technology is a network one and we have already created the required software tools for optimizing DTIPs of many purposes.

Results of Technology development

Currently this innovative project is ready for the wide practical implementation and is on the stage of its startup. This is confirmed by the following results received by us on the development of Technology:

- there has been created its scientific methodology [2, 3];
- there has been written and published a monograph on the fundamentals of IT AC DTIP [4], using which was prepared a training course on the basics of Technology, which was twice read by the author in Gorlovka Regional Institute of the University "Ukraine";
- there has been thoroughly worked out one direction of applying Technology, related to investments [5];
- there have been developed 11 software tools (four of them are already multilingual) to optimize discrete processes for different purposes in many application areas, which include:

- nine network instrumental systems (NISs), ready for mass use, which allow to solve tasks of optimizing control of discrete processes in the following application areas: 1) budgeting of a Ministry; 2) network planning; 3) standard investments; 4) expenses; 5) investment in housing; 6) investment in real estate; 7) online shopping; 8) transportation; 9) delivery of a passenger by public transport;
- two programs for optimizing remote and ordinary orders of customers in a restaurant;

- on the basis of IT AC DTIP there have been offered the concepts of creating four specific innovative technologies used in the following application areas: 1) online trade, 2) trade in real estate, 3) restaurant business and 4) project management (the first two of them are perfect), and have been created the key software tools for this technologies;
- there have been developed and published in Russian and English two websites: "Promotion center of IT AC DTIP" (http://dtip-burlakov.com/en) and "Implementation center of IT AC DTIP" (http://dtip-optim.com/en/main). The first of them intended for persons who wish to gain deep insight into Technology and into the optimizing software tools create on its basis. The second website is focused on 18 categories of persons who directly relate to discrete processes for various purposes and are interested in effective controlling them.

Prospects of Technology implementation

Currently the author develops multilingual interfaces for 11 existing optimizing software tools (see above). The follow four of them already have multilingual interfaces: MNIS MBO 1.0 (http://dtip-burlakov.com/en_pages/09.htm), MNIS GAO 2.2 (http://dtip-burlakov.com/en_pages/10.htm), MP OROR 1.1 (http://dtip-burlakov.com/en_pages/18.htm) и MP OOR 1.2 (http://dtip-burlakov.com/en_pages/19.htm). This will allow to gradually implement Technology in the respective application areas by realization through the Internet of international outsourcing services on finding optimal strategies of controlling those discrete processes that occur there. In particular, such international services can now be created in the following three areas: 1) program-target planning (MNIS MBO 1.0), 2) project management (MNIS GAO 2.2) and 3) restaurant business (MP OROR 1.1 and MP OOR 1.2). With the development of multilingual interfaces for other 9 existing software tools the list of such services will be expanded.

Problems of Technology implementation

Now there are all necessary preconditions for the worldwide implementation of IT AC DTIP. The only problem is that the author has not yet been able to find several interested business persons with high levels of ambition and professionalism to establish with them PCIT (see above Sec. "Strategy of Technology implementation"). Indeed, as practice has shown, the existing mechanism of venture investment turned out to be completely useless for the promotion of such large-scale and science-intensive project with many applications as this one. Suffice it to say that numerous appeals of the author to the leading technical universities of the world with the proposal of of business partnership on establishing such production company and on training specialists for future work in it remained unanswered. Exactly this failure in promoting such high-tech, which practical usefulness is obvious, prompted the author to write this article.

Conclusion

At the present time we, dear readers, have a real chance to implement worldwide the large-scale science-intensive innovation project with many applications under the name IT AC DTIP. If among you are ambitious entrepreneurs or high-class specialists in information technologies (first of all — programmers, marketers and managers), the author invites such persons to business cooperation (his e-mail address can be found on the above websites). You should agree that the chance to

participate in the promotion of such powerful information technology, that will make a significant impact on many spheres of human activity, falls quite rare.

List of abbreviations

AWP — automated work place;
ASC TP — automated system of control of technological processes;
DPS — discrete process of service;
DTIP — discrete technological or information process;
IT AC DTIP — information technology of automation of control of discrete technological and information processes;
MNIS — multilingual network instrumental system;
MNST — multilingual network software tools;
MBO — ministry's budget optimization;
GAO — goal achievement optimization;
HO — housing object;
IO — investments optimization;
HIO — housing investment optimization;
TO — transportation optimization;
PCIT — production company for implementation of Technology;
NIS — network instrumental system;
NPC — network processing center;
CCA — center of control automation;
SC — securities;
CTD — center of toolkit development.

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LOW-LEVEL DATA RECOVERY FROM FLASH MEMORY

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Abstract. *This paper suggests a low level approach for the examination of flash memories and describes low-level data acquisition methods for making full memory copies of flash memory devices. Artifacts, caused by flash specific operations likeblock erasing and wear leveling, are discussed and directions are given for enhanced data recovery and analysis on data originating from flash memory.*

Keywords: *NAND flash memory; bad-block management; flasher tools; level algorithm.*

Introduction. Over recent years, corporate end-users have increasingly needed to be fully mobile and connected, taking work home or out of the office to keep up their productivity. Staff needs to be able to