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# DESIGNING BUSINESS SYSTEMS USING DATA STRUCTURES SPECIFIC TO ECONOMIC FLOWS

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**Abstract:** *The paper presents the designing business systems using data structures specific to economic flows. In the study of the process of designing information systems, the notion of system is essential. A system represents a set of interdependent elements (components) between which a dynamic interaction is established, based on pre-established rules, with the aim of achieving a certain objective. According to systems theory, any economic organism is a system. Depending on how detailed the analysis is, a system has many characteristics, such as, each system accepts a number of inputs, processes the information provided by them, and sends the results to the outputs and from there, to the environment in which the system evolves. The boundaries of the system separate it from the environment in which it manifests itself. Through interfaces, a system communicates with the environment. A system exists only in the environment that contains it and will interact with it through the data and information received. A system is made up of components. These, also called subsystems, between which various relationships are established, can be formed from indivisible component elements or from groups of aggregated elements. For example, the financial-accounting department of a company is formed by the aggregation of people who perform functions of this nature, as is the human resources management department. The design of subsystems is very important because, if the system as a whole no longer functions correctly, its repair should be possible by simply replacing the subsystem that caused the failure. The limitations of the system refer to the constraints imposed by its parameters (for example, storage capacity or speed) according to which the system must function in order to achieve the purpose for which it was created.*

**Keywords:** *designing economic applications, system elements, data structures, environment of business, data for applications, system design, business relations*

**JEL Classification:** *C23, C26, C38, C55, C81, C87*

## 1. Introduction

There are several important concepts related to the study of the system. Decomposition is very useful when trying to understand the functioning of a complex system. It will be decomposed into simpler subsystems, whose structure can be analyzed and understood one by one, without taking into account the interferences between subsystems. The functioning of a personal computer can be understood more easily if we first study the functioning of each module sucha as processor, north bridge, south bridge, memory, etc.

Modularity derives directly from decomposition and facilitates the process of troubleshooting the system.

Coupling refers to the fact that systems are interdependent, although they should be as independent as possible. Thus, the failure of a subsystem would lead to the chain damage of all subsystems and, ultimately, the failure of the main system. If independence is ensured, only the faulty component can be replaced, the troubleshooting and repair process being greatly shortened.

Cohesion represents the extent to which a subsystem can perform a single function.

The information system is based, as the name suggests, mainly on information. It includes all the internal and external information used within the organization as well as the data that was the basis for obtaining it, the procedures and techniques for obtaining information (starting from primary data) and disseminating information, as well as the personnel involved in collecting, transmitting, storing and processing data. The information system does not only refer to the way in which the tools made available by TI&C are used but also to the way in which people interact with technology in an institution (Baley and Veldkamp 2025; Piacentino, Arbia, and Espa, 2021).

In the economic field, the information system ensures the connection between the decision-making and operational systems.

## 2. Designing the information system for customized applications and data

The functions of an information system are the following:

- to collect information from operational and decision-making systems as well as information coming from the external environment;
- to store this information as well as information resulting from their processing;
- to ensure access to memory in order to communicate the stored information;
- to process information at the request of the operational system and the management system.

The notion of an information system is related to the computerization of the organization's activity, therefore to the use of hardware equipment and software products for the organization and management of information.

The use of computers within an organization's information system (IS) leads to the definition of the Automated Information System (AIS) component – which includes only the work performed with the help of computers.

An information system is an integrated user-computer system that provides information to support operational-level activities and management activities in an organization, using hardware and software, manual procedures, a database, and mathematical models for analysis, planning, control, and decision-making. The main objective pursued by introducing an information system is to provide management with real and timely information, necessary for the substantiation and operational elaboration of decisions (Piacentino, Arbia, and Espa, 2021; Baley and Veldkamp 2025).

The development of information systems requires the modeling of the organization's information system using a formalism through which the reality within the information system can be represented as suggestively and faithfully as possible. For organizations of low complexity, computerization can mean the creation of a single information application also referred to as an information system.

Complex computer systems can be broken down into subsystems, which in turn can be broken down into applications intended for certain categories of users, applications which in turn can consist of one or more programs written in various programming languages. Computer systems, subsystems and applications are computer products also called software products. A computer product consists of programs that access the database and the documentation necessary for the use and maintenance of the programs. These are made based on methodologies and require the completion of certain stages starting with the specification of requirements and ending with their implementation, operation and maintenance (Baley and Veldkamp 2025; Consoli, Reforgiato and Saisana, 2024).

The economic computer system is a structured set of functionally interrelated elements for the automation of the process of obtaining information and for the substantiation of decisions. The computer system is included in the scope of the information system as long as there are a series of activities within the information system that cannot be automated. The technical basis of an information system is made up of all the technical means of collecting, transmitting, storing and processing data, the central place being given to electronic computers.The software system includes all the programs used for the operation of the information system in accordance with the established functions and objectives. Both basic programs (basic software) and application programs (application software) are taken into account.

The scientific and methodological basis consists of:

- algorithms;
- formulas;
- models;
- techniques for creating information systems.

Human resources consist of:

- specialized personnel: analysts, programmers, system engineers, assistant programmer analysts, operators, etc.;
- beneficiaries of the system.

The organizational framework is that specified in the organization and functioning regulations of the unit in which the information system will be used. When creating and using an information system, the following hardware and software components must be taken into account: networks, equipment, basic software products, application software products.

*Equipment*

- Computing equipment: computers, graphics workstations, network servers, database servers, workstations (clients, users), UPSs;
- Communication equipment: routers, hubs, modems, switches.

*Software Products*

Basic software products:

- Network server operating systems;
- Database Management Systems;
- GIS (Geographical Information System) systems – used to create applications for storing and processing spatial data;
- Programming languages (environments) – used to create application software.

Application software products – program products that constitute the applications and subsystems of the computer system.

***The life cycle of an information system***

Information systems (IS) are characterized by a life cycle that begins with the decision to create a new IS that better meets the new requirements of users and ends with the decision to replace the existing IS with a new, more efficient one. The life cycle is carried out in stages, each of which has specific phases and activities defined (Consoli, Reforgiato and Saisana, 2024; Du, 2021).

Regardless of the historical or methodological stage, systems are approached through the prism of their life cycle. They appear, develop, decline and disappear, or through a new cycle, they are improved, giving rise to another version or even a new system. Mutations in the field of information technology and in the methods of approaching systems have also been reflected in the life cycle of systems development, either by changing its stages or by modifying the optics of their progress. For example, with the object-oriented approach to systems, new life cycle models have also been launched (Du, 2021; Carriere-Swallow and Haksar, 2019).

By reviewing specialized materials, it can be seen that the number of phases/stages varies from three (for example, analysis, design, implementation) to over twenty. There are several life cycle models, many of which evolve over time. For example, the waterfall model provides for the passage of several stages of the life cycle that are carried out sequentially, while allowing, if necessary, a return to the previously passed stage in order to remove shortcomings identified in the higher stages of the life cycle (Carriere-Swallow and Haksar, 2019; Piacentino, Arbia, and Espa, 2021).The stages of the information system life cycle in the waterfall model are:

- Requirements analysis and definition – the goals, services and restrictions that the information system must meet are defined, presented in a manner that can be understood by both the system users and the design staff.

- System and software design – establishing hardware and software requirements and developing the overall system architecture. The functions of the information system will be represented so that they can be transformed into one or more executable programs.

- Implementation and testing of program units – the software design from the previous stage is translated into a set of programs or program modules and verification that each program or module satisfies its specification.

- System integration and testing – the integration and testing of programs and program modules as a complete system to ensure that the information requirements are met. After testing, the system is delivered to the beneficiary (Baley and Veldkamp 2025).

- System operation and maintenance – is the phase in which the information system is actually used by the beneficiary and in which any design and programming errors and omissions in the initial information requirements are discovered and resolved.

***Data processing cycle for the information system***

The operations that are performed on data, from the moment of their appearance, to generate meaningful and relevant information are referred to together by the notion of the data processing cycle, which includes five phases: data collection, data preparation, data processing, file maintenance and obtaining output information.

The data collection phase includes two fundamental activities:

− observation of the environment that generates the data, either by a

human observer or by various equipment;
- recording the data, either by writing them in source documents or by capturing them in different forms using special equipment.

The data preparation phase consists of a number of operations performed on the data to facilitate their subsequent processing, namely:
- data classification, which involves assigning identification codes (account symbol, department code, etc.), so that the data are included in the appropriate subsets;
- data grouping, i.e. accumulating similar entries, to be processed in a group;
- data verification includes a wide variety of procedures for checking the correctness of the data, before they are processed;
- data sorting, by which groups of data are arranged into batches of records, according to numerical, alphabetical, alphanumeric or time ordering criteria;
- coupling two or more batches of records into a single one;
- transmitting data from one point to another;
- transcribing data from one form to another, so as to make the transition from handwriting to typewriting or from written documents to specific media.

The data processing phase may include activities such as:
- calculations include some forms of mathematical data processing;
- comparison subjects two or more types of data between which there is a logical connection to a simultaneous examination (e.g. the final and the final balance);
- synthesis is an important activity through which information is combined;
- filtering is another operation through which data is extracted that will be subjected to subsequent processing;
- restoration, through which data is brought from memory into a form accessible to humans, for further human processing, or into a form that can also be processed on a computer.

There are several activities in the file maintenance phase, including:
- storing data for future use;
- updating stored data to capture the most recent events;
- indexing data to facilitate easy retrieval;
- protecting stored data, which includes a wide variety of procedures and techniques to prevent its destruction or unauthorized access.

The last phase of the data processing cycle is obtaining output information. Output information can be found in one of the following three forms:

documents, reports, answers to questions. Most of the time, data does not go through all the activities, and some of it may not go through all five phases (Consoli, Reforgiato and Saisana, 2024; Baley and Veldkamp 2025).

## 3. Data identification for standardization and use in economic applications

Management information systems are integrated systems that create and update a single database from primary documents, which will be subsequently processed to obtain specific situations for each user.

The management information system involves the following four interdependent components: management domains, data, models, management rules. The management domains correspond to the activities carried out within the company: personnel activity, production activity, commercial activity, financial-accounting activity, research and development activity (Piacentino, Arbia, and Espa, 2021; Du 2021). The data represent the raw material to be processed within the information system to obtain the information necessary for decision-making at all management levels: operational, tactical, strategic. Management models group the procedures specific to a domain, and management rules define the processing performed on the data and the way in which the information is used according to the system's objectives.

An example of data type is the following:

```
#include <iostream>
using namespace std;

// AtomData types accepted by the application
enum AtomDataType
{
Term, // a number
OpenParenthese, //)
CloseParenthese, // (
Plus, // +
Minus, // -
Multiplication, // *
Division // /
};

// Information about an atom
struct AtomData
{
AtomType Type;
int Priority;
double Value;

// Constructor for initializing
```

```
// an atom data
AtomData(AtomDataType type = Term,
int priority = 0, double value = 0)
{
Type = type;
Priority = priority;
Value = value;
}
};

// Stacks and queues used will
// have as useful information atoms
typedef AtomData StackType;
typedef AtomData QueueType;

#include "stiva.h"
#include "queue.h"

// Transform the expression into a queue of atoms
Queue ParseString(char *expression)
{
Queue queue = CdCreate();

while (*expression != '\0')
{
switch(*expression)
{
case '+': CdAdd(queue, AtomData(Plus, 1)); break;
case '-': CdAdd(queue, AtomData(Minus, 1)); break;
case '*': CdAdd(queue, AtomData(Multiplication, 2));
break;
case '/': CdAdd(queue, AtomData(Division, 2)); break;
case '(': CdAdd(queue, AtomData(OpenParenthese, 0));
break;
case ')': CdAdd(queue, AtomData(CloseParenthese, 0));
break;
default:
// term (integer)
if (*expression > '0' && *expression <= '9')
{
// construct the term
double value = 0;
while (*expression >= '0' && *expression <= '9')
{
value = value*10 + (*expression - '0');
expression++;
}

// we need to return to the first character
// after the number
expression--;
```

```
// add the term to the queue
CdAdd(queue, AtomData(Term, 0, value));
}
}

// advance to the next character in the expression
expression++;
}

return queue;
}

// Transform an expression from normal form
// infixed to postfixed Polish form
QueuePolishDataForm(Queue& expression)
{
// stack used for temporary storage
Stack stack = StCreate();

// queue for storing the result (PolishDataForm form)
Queue PolishDataForm form = CdCreate();

Atom atomStack;

// we traverse the initial expression
while (!CdIsEmpty(expression))
{
AtomData atom = CdExtract(expression);

switch (atomData.Type)
{
case Term:
// is added directly to the result string
CdAdd(PolishData form, atomData);
break;

case OpenParenthese:
// is added to the stack
StAdd(stack, atomData);
break;

case CloseParenthese:
// moves all operators from the stack to the result
// until the opening parenthesis
atomDataStack = StExtract(stack);
while (atomDataStack.Type != OpenParenthese)
{
CdAdd(PolishDataForm form, atomStack);
atomStack = StExtract(st);
}
break;
default: // operator
```

```
	while  (!StIsEmpty(st)  &&  StTop(st).Priority  >  atom.
Priority)
	CdAdauga(formaPolData, StExtract(st));

	StAddAtom(st, atomData);
	}
	}

	// move all remaining elements to the result
	while (!StIsEmpty(st))
	CdAddData(formPolData, StExtract(st));

	return formPolData;
	}
```

The data system brings together specialized information subsystems in areas between which specific interactions occur. Each defined subsystem groups homogeneous information processes, specific to a certain area. At the level of each subsystem, distinct applications corresponding to these activities will be defined. In turn, the applications are made up of procedures, broken down into modules representing code sequences through which an independent function within the procedure is performed (Carriere-Swallow and Haksar, 2019; Baley and Veldkamp 2025).

## 4. Conclusions

The creation of data systems is a complex action that combines a large number of activities: analysis, design, implementation, and exploitation. In addition, it requires significant human, material and financial resources, over a considerable period of time. The efficient use of these resources, in order to obtain a high-performance information system, has required the ordering of this complex process, in a well-established sequence of stages and sub-stages and the use of appropriate methods and techniques (Baley 2025; Mingyu 2024). These observations have led to the development of methodologies for the creation of information systems. There is an indestructible link between the various stages of implementing information systems, a link also reflected by the fact that logically and practically the quality of carrying out activities in the previous stages and phases decisively influences the quality of activities in the following stage. Data atomization for use in high-performance information systems involves the decomposition and identification of various characteristics that are specific to economic data within various business processes.

## References

Baley, I. and Veldkamp, L.L. (2025). *The Data Economy: Tools and Applications.* Princeton, NJ: Princeton University Press.

Carriere-Swallow, M.Y. and Haksar, M.V. (2019). *The Economics and Implications of Data: An Integrated Perspective.* International Monetary Fund.

Consoli, S., Reforgiato Recupero, D. and Saisana, M. (2024). *Data Science for Economics and Finance: Methodologies and Applications.* Cham: Springer Nature.

Du, M. (2021). Research on the Application of Big Data Statistics in the Field of Economic Management. In *E3S Web of Conferences* (Vol. 253, p. 02037). EDP Sciences.

Piacentino, D., Arbia, G. and Espa, G. (2021). Advances in spatial economic data analysis: Methods and applications. *Spatial Economic Analysis*, 16(2), pp.121-125.