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FUNCTIONAL DESIGN OF FOOTBALL CLUB INFORMATION SYSTEM USING IDEF METHODS

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Abstract—Causes of weaker results of Serbian soccer clubs and representation in the international competitions are numerous. The economic situation in the country is often a limiting factor in achievement the most noticed sporting results. Insufficient presentation of information technology in Serbia also is negatively reflected on the development of football and sports in general. In order to overcome the difficult situation in Serbian football in addition to the systematic training of squad of all ages and improvement of material working conditions, it is indispensable that further development to be based on the application of science and technology. It's primarily thought that the application of information technologies have become the basis of all scientific disciplines.

In the paper is presented a functional model of information system of the football club being created by using the CASE tool of BPwin (IDEF0), as part of a complete information system of the football club. Such a system is created on the basis of their own knowledge of football and understanding of modern organization of the work of club aimed at achieving the better results.

Keywords—Functional modelling, Activities, Context diagram, Decomposition diagram, Flow of data, Activity tree, Football club, Player, Match, Coach, Health Bulletin, Professional pedagogical work.

I. INTRODUCTORY DISCUSSION

IN modern sport, ***i****nformation* ***t****ehnologies* - ***IT*** have a major role in achievement of top sport results. Sport, as clearly valued activity is conducted through the highly organized and clearly defined activities based on the large amount of information. These activities are directed towards the achievement of best possible results. That's why in sport is of great importance the process of collection, analysis and exchange of information at all levels of sports activities: from the work of plans, preparation and competition until the management of sports activities. In the structure of sports activities and organization the clearly defined role has a club, as a basic organizational cell of modern sport. The club in an evolutionary aspect is transformed into a direct and executive organizational form of sports activities. It represents the primary source of top sports results. In it are united the interests of the majority of direct actors of sports activities: those who directly participate in sports events (sportists, coaches, professional collaboraters and others) and those who provide all the necessary conditions for the successful implementation of sports activities (management of clubs, sports associations, referees and others).

Sports clubs in Serbia are highly dependent on the financial and material basis which is such that often limits the reach of sports results. Therefore, it's of great significance the very organization of club's work, its efficiency and rationality, as well as enthusiasm. The importance of information in the system of sports club in Serbia has not been considered yet in accordance with the world events. Information is usually accepted and selected as insufficiently organized, and consequently is processed and used with insufficient quality. We are witnesses of remarkable sports achievements at the Olympic Games in London this year. Particularly are admirable the achieved results in athletics and swimming. For such extraordinary performances in addition to talent, will, great work, development strategy, long-term planning, provided optimum conditions for work and material basis is necessary the application of science and technology. In the function of top achievements are included the sports medicene, psychology, proper food and other branches of science. A special place belongs to IT that became the basis of each technology discipline.

Today, each individual sports discipline implies the selection and analysis of predisposition benefits, primarily, the body building of the sportmen. Requirements in terms of precision of defining certain parameters are such strict that in some disciplines, in proportin to the height of the sportsmen is determined their weight which must be exact in grams. In team sports, primary work is based on characteristics and failures of opponent players, education of coaches, their understanding of play and favorite tactical variants. Today it is considered that a good knowledge about the

opposing team is more than half of the done work to guarantee succeess.

The time of improvisation belongs to the past. Once was prevailing an attitude that „we need to improve our style of play and the opponent should take care about us, and not we about them". For example, the fifties and sixties of the last century, Yugoslav team was among the strongest in the world. At the Olympic Games in London 1948th, Melbourne 1952nd and Helsinki 1956th it won the silver medals, and in Rome 1960th the golden medal. Also it won the silver medals at the European Championships 1960th and 1968th, and its greatest success was the fourth place at the World Championships in Chile 1962th year. It was a time of improvisation, and then we, as a talented nation in football, achieved outstanding results and have had individuals who were considered among the best in the world. Today, the situation is quite opposite. Results of Serbian sportsmen in international competitions, especially at the Olympic games in London this year, were below expectations. Computerization in Serbia is at the lowest level in the environment [7]. This results in insufficient application of IT in the sport. In that ascertainment is one of the unsuccessful performance of Serbian sportmen.

The trend of football development in Europe is increasingly ascending. In Spain, England, Italy, Germany, France, the Nederlands and in other countries there are extraorinally powerful clubs. It can be said that in these countries football is one of the powerful industries. They play quality football, the world's best players are engaged in huge cash tranfers, have large and comfortable stadiums that are completely filled with the spectators, there is turning the huge sums of money and number of other qualities adorn them. In these countries, in the success of football are implemented the scientific and technological achievements, which, as noted, is based on IT.

From the point of view of events in the Serbian football this brief comparison indicates that one of the fundamental problem of work in our country is the lack of defining a consistent and comprehensive model of information system of the football club. The above-mentioned observations as well as the long-term monitoring of the football clubs' work opted the authors to initiate the preparation of an original solution of integrated ***I****nformation system of the football club* - ***ISFC*** that would include the most important segments of club's work.

The aim of this paper is to design a functional model of ISFC encompassing all activities and their optimal organization to achieve good competitve results on the basis of collected, processed and analysed all the relevant information essential for rational and efficient functioning of the *football club - FC.*

To achieve the desired objectives are designed the following tasks:

1. analysis of the degree of implementation of IT in football clubs;
2. defining the structure of ISFC;
3. defining the process of collection, processing and data analysis;
4. creating an appropriate rational data model;
5. development of a database as the basis for the implementation of ***i****nformation system* - ***IS***;
6. creation of application support of the ISFC.

This work includes the first four tasks, while the fifth and the sixth task are processed in other paper [9].

The importance of the work is to create a model in general form with the applicative possibility to particular football clubs with the certain modifications.

One of the directions of further development of this ISFC is its expansion to sports associations.

This paper presents the integration of all data that were available to authors of work with the desire to implement and put in use a completely new IS which is engaged in the processing of data in all segments of work of the FC. In the programme of ***BPwin*** *(****B****ussines* ***B****rocessing for* ***win****dows)* was performed a functional modeling of the process defining the model boundary, shown in the context diagram. Then, the context diagram is decomposed in depth to the sub-activities, thereby creating the conditions to form the tree activity and decomposition diagram. Vertical hierarchical relationship of activities and sub-activities is performed on the tree activity.

A special attention was paid to the development of decomposed diagram of the football club and decomposing diagram of the club's activity. The study presents the basis for the development of information model of the FC which is processed in the literature [9].

II. MODEL OF INFORMATION SYSTEM OF THE FOOTBALL CLUB

Setting up the hypothetical model of the ISFC and defining the methodology of its development are based on the analysis of current state of system structure, the state of system elements and information flows in the soccer club. Model defines an integrated development of the IS which should include all necessary subjects and activities for the successful work of the club. In this regard is made an initial diagram of system structure to identify the most important entities, their activities and the flows of data in the system (Figure 1). With further decomposition and elaboration of the structural elements and activities are defined the details of the model of ISFC, as well as the flows of information within a system, between the system and the external environmnet.

In graphical presentation of the initial model of ISFC, Figure 1, each part (subsystem) is represented in the form of ellipse. Organization of competitions (A) of the club is the principle organizational segment of the club and include all activities that are both directly or

indirectly associated with the competitive activities of the club. It takes a central place in the model of ISFC and within it is realized the basic functions of the club, especially competitive and training. Business and Management include all activities that are in function to the support of the Organizational competition. Business (B) includes activities, subjects and objects that provide a direct support to the competition of organization in organizational and business aspect. A well-organized and stable club must has a well-organized activities in this segment of IS. Management (C) is an organizational segment of a club who is responsible to achieve functions and activities associated to the defining of strategy and objectives of the Club and adoption of general and special laws of management and the work of the club.

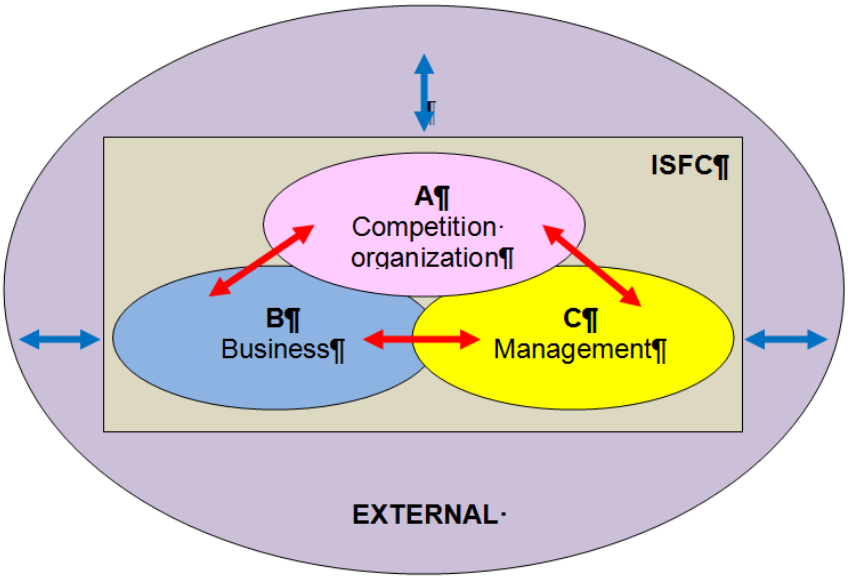

Fig. 1: A hypothetical model of information system of the football club

These parts are mutually overlapping (Figure 1), indicating that many of their functions are common. Between the parts of ISFC is carried out a constant exchange of information and each part echanges information with the external environment. The interaction of these three parts is to provide optimal conditions for the achievement of good results in sport with a constatnt exchange of information with an external environment and adaptation of IS to the requirements of the environment. The integration of these three parts (subsystems) at the level of FC is realized with the use of IT as a basis for building of information system, which provides the highest level of integration activities, information and their flows.

Availability of information in the system is fast, and adaptation of the system to the changes in the environment and within the system is constant. In the football club, the relations between the structural elements and the functions of subsystems are extremely numerous and interacting. There are no boundaries between the defined parts of the system and many of their elements are overlapping, which is a reflection of their functional unity. A hypothetical model of FC was described in detail and presented in Figure 2. In the figure is displayed in detail the organization of a football club, links and flows of data between the organizational units and activities [3, 4].

III. MODELING BASES ON THE BASIS OF IDEF TECHNIQUES

By definition, modeling is the simpiest representaion of the real system through the set of acitivities, objects (entities), relationship between objects and object attributes. The methods of modeling have become perfect over the time and each new method had the characteristics which featured when compared with the previous. Newly developed ***IDEF*** (***I****ntegration* ***DEF****inition*) technique enables experts to deal with the problem of improving business processes from different aspects and levels of abstraction. The set of IDEF method is the most advanced modeling technology, which is currently in the widespread use in the world. For example, the concept of IDEF methodology has been accepted by the U.S. government, the Pentagon and NATO. It is fully in comply with the ISO9000 standard [1, 2, 5, 11-13].

The development of information systems are largely developed on the standards of ***IDEF0*** for functional modeling and ***IDEF1X (eXtend)*** for informational modeling. IDEF0 is the modeling method based on a combination of graphics and text, presented in an organized and systematic way in order to increase an intelligibility and support the analysis of the system by the levels. Information model defines the logical data model using IDEF1X methods. In modeling the data is

using the techniques to describe the data structure and business rules titled as Model of data, Entity diagram or ***ER*** (***E**ntity **R**elationship*) [6, 9, 14].

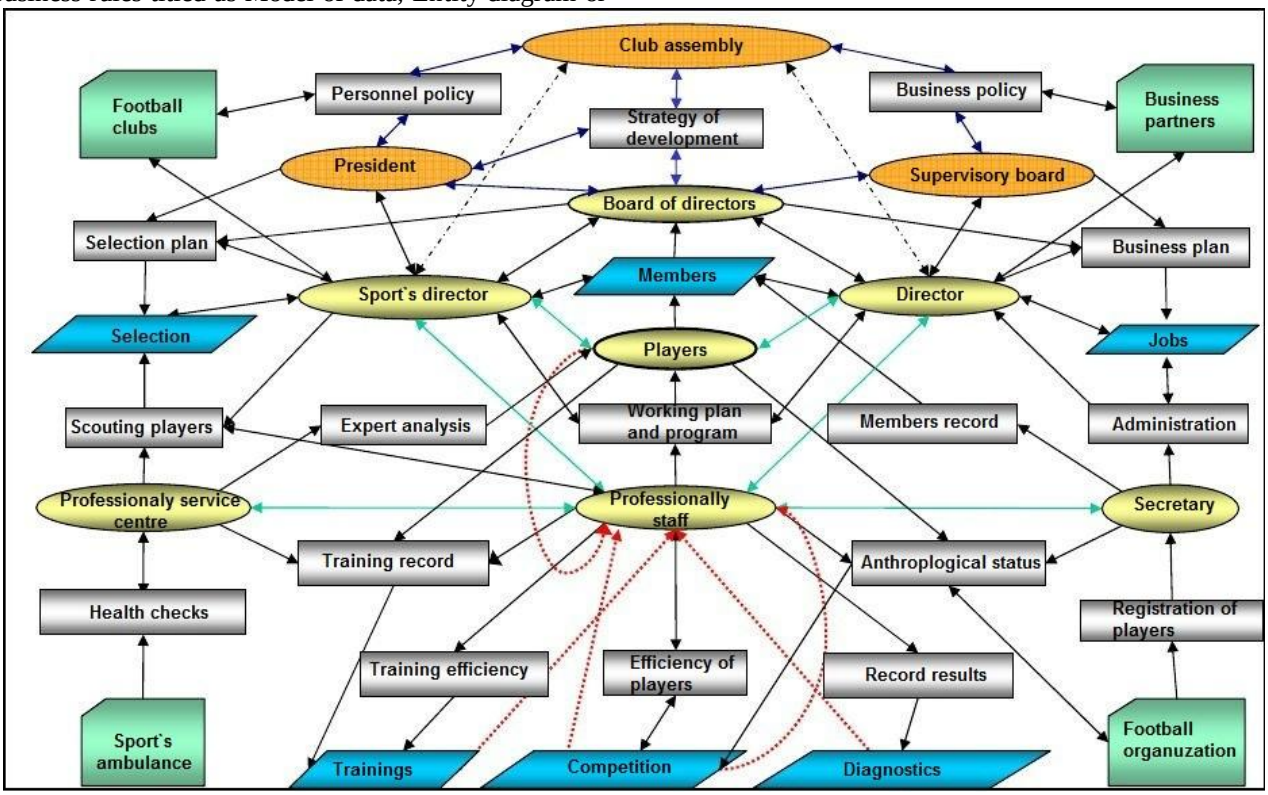

Fig. 2: A diagram of the organization and flow of data of the football club

In designing of ISFC, the first approach was made to the functional modeling, whereby the functional decomposition is identified the subsystems of the football club using the graphic language IDEF0, ie. BPwin tool. In this way is made the basis for information modeling system which is presented in the literature [9]. Functional decomposition involves defining the boundary of the model, a description of the context diagram and define the tree of activities, the demands of users and activities of decomposition diagram.

IV. CONTEXT DIAGRAM

The context diagram defines the framework of IDEFO model. It presents the IS model in its most general form and includes input and output data flows, as well as the control and mechanisms. The input data flows present the initial information which are necessary for the functioning of the IS. Mechanisms appear in the form of people, institutions and other systems which to some extent regulate and the flow of information in the system. Control activities appear in the form of regulation and legislation, technology work and scientific knowledge. The output informations are an essence of the functioning system and include the results of the functioning system defined by various documents, the reached stage or established processes [8, 10].

General view of the context diagram of the FC' organization of work with the associated data flows of input, output, control and mechanisms is shown in Figure 3. As stated, the goal of this study is to design a functional ISFC encompassing all activities and their optimum organization for achieving a good competitive results. Since the concepts and terms that are used in football are well-known to the general public, in further presentation will be described only some of the sub-activities and flows of data. In addition, as is the feature itself of IDEF0 method an easy understanding of the problematics through the visualisation, the additional text clarification of decomposition diagrams are not required. Therefore, in the continuation of the study are shown the decomposition diagrams of basic activities defining some of the characteristic flows of data.

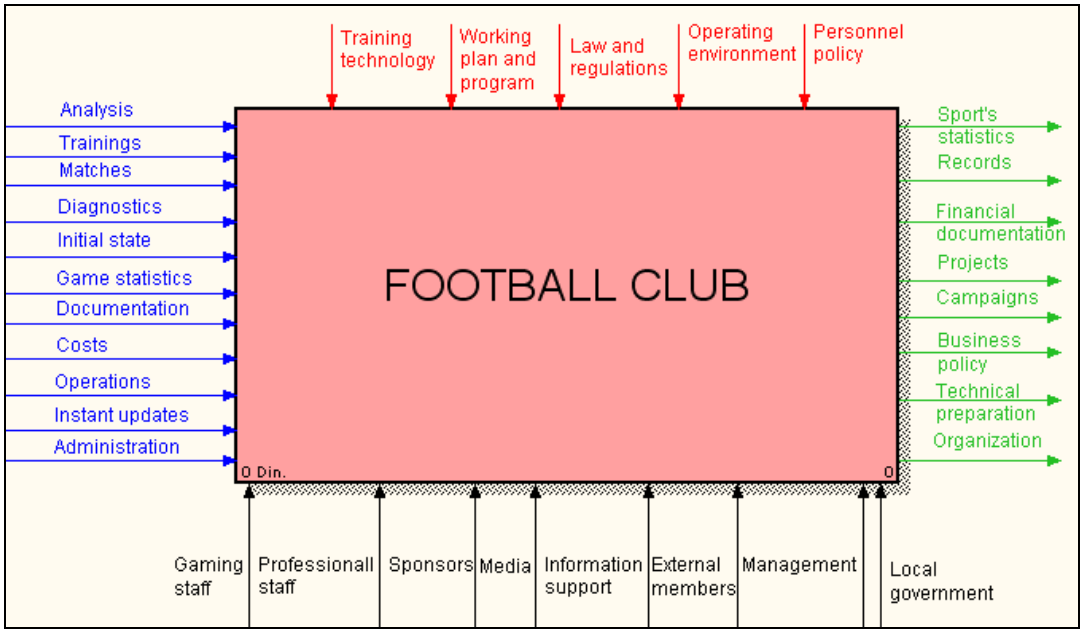

Fig. 3**:** Context diagram of activities A0 – FOOTBALL CLUB

Inputs:

- **Analysis** – includes competetion analysis**,** gaming staff analysis and professional work analysis;
- **Trainings** – information on physical training of a club for all competitve seasons. Training sessions are planned and implemented with available resources, equipment and stadiums. They are used to assess the form of players and predict their performance in the game;
- **Diagnostics** – input diagnostic information is collected on the basis of the carried out tests, the existing requisits, equipments and performed medical newsletter. With the processing of these information is obtained an overview in anthropometry and functional and motor status of players;
- **Matches** – information about the football for all the selection clubs;
- **Game statistics** – selection of players and their engagement is done based on predisposition and motivation of players and achieved technical and tactical demands that are required from them;

Outputs:

- **Sport's statistics** make up player's form, game analysis, updated diagnostics data and professional staff report;
- **Records** include agreements and lists, certificates and attests, incoming and outgoing correspondence;
- **Financial documentation** make up: payments and disbursement, financial plan and periodic report;
- **Technical preparation** is the result of professional pedagogical work that is carried out by gaming staff selection, motivation and tactical preparation;

Controls:

- **Personnel policy** – strategies in human resources needs of the club in gaming and professional segment;
- **Working plan and program** – plan and programme activities of the club by segments of structure of the club for the current competitiom season;
- **Operating environment** implies cooperation with city authorities, business partners, sponsors and banking institutions;
- **Training technology** – optimum use of technology training work for individual selection of the club;
- **Law and regulations** – applicable laws and legislation, rules and propositions of competitions in which the club participates.

Mechanisms**:**

- **Gaming staff** – players who are registered for the competition selection of the club;
- **Professionall staff** – coaches who are hired for the work with the selections of the club;
- **Government** - composition, competence and activities of all administrative bodies of the club;
- **Sponsors** – business entities who are sponsors or donors of the club, who are actively involved in business activities of the club, and often in the administrative functions of the club;
- **External members** – professional and other associates who are engaged in certain activities of the club;

Football organization leads competition, adopts general acts and regulations associated for the competitive and other activities of the club.

V. ACTIVITY TREE

Activity tree (fig. 4) is a hierarchy of defined activities and provides functional decomposition and insight into the depth of activities connection [1, 8, 11, 12, 13].

Activity A0 – FOOTBALL CLUB is decomposed into: Competition organization (1), Business (2) and

Management (3). The activity tree also shows the sub-activities into which the mentioned activities are divided. For example, activity of Competition organization is decomposed into sub- activities: Training work (11), Matches (12), Diagnostics (13) and Selection (14). Also, activity Business is decomposed into sub-activities: Administration (21), Finances (22), Marketing (23) and Public relations (24), etc.

VI. DECOMPOSITION DIAGRAMS

The context diagram is the highest level of apstraction which, with the decomposition diagram descends to a lower level of apstraction. With the defining of the decomposition diagrams, the activities of IDEF0 method create the horizontal linkages between the activities of the same level, ie. activities are associated with the flow diagrams into a functional unit. In Figure 5 is shown a decomposition diagram A0 – Football club, that involves the basic activities of the football club: Competition organization (1), Business (2) and Management (3).

In further view of the ISFC model, the mentioned activities are decomposed to sub-activities and there have been identified the flows of data with which they are associated. Then, there were presented the decomposition diagrams of these activities with their sub-activities and corresponding flows of data. From the foregoing mentioned reason only are described the most important subactivities.

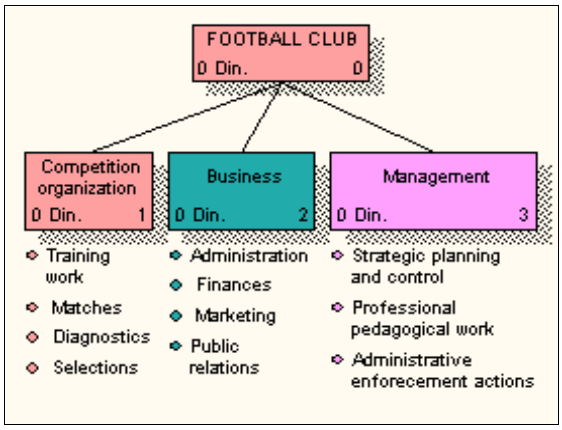

Fig. 4: Activity tree A0 – FOOTBALL CLUB

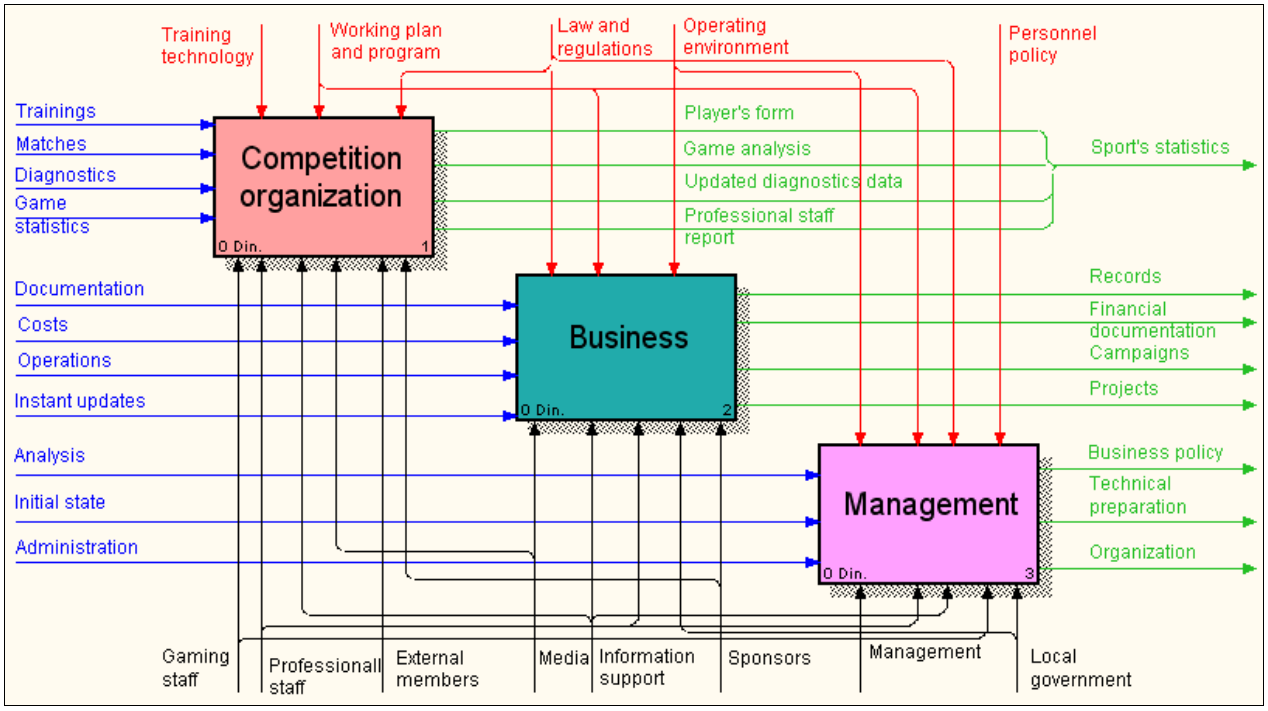

Fig. 5: Decomposition diagram A0 – FOOTBALL CLUB

Training work includes activities related to the preparation of all kinds od sports, ie. all forms of training work aimed to achieve the sports forms and planned competion results.

Diagnostics is the monitoring of the state and indicator of sports form, their analysis and preparation of feedback information for advancement of training work and efficiency of game. These involve control measurements, control of general and specific motor skills, monitoring of health bulletin and social relations in the club.

Selection implies making a plan and programme for selection of players, monitoring of progress in the development of the gaming staff in the club, direction and selection of players by functions in the game and analysis of training and competitive activities of players. Selection is carried out from the youngest age and special attention is paid to selection of junior team.

Marketing department of the club determines the busines position of the club, presents a club in the area and deals with its promotion. In marketing also are included the specialized agencies that are regularly or temporarily engaged for the acitivities of the club.

Strategic planning and control define the strategy and basic objectives of the club, create personnel policy, enact and adopt relevant documents. It is being implementd by the Assembly of the club as the highest authority in the organizational structure. Supervisory Board, as the body of the Assemly, controls the work of all structures of the club, primarily the financial operations.

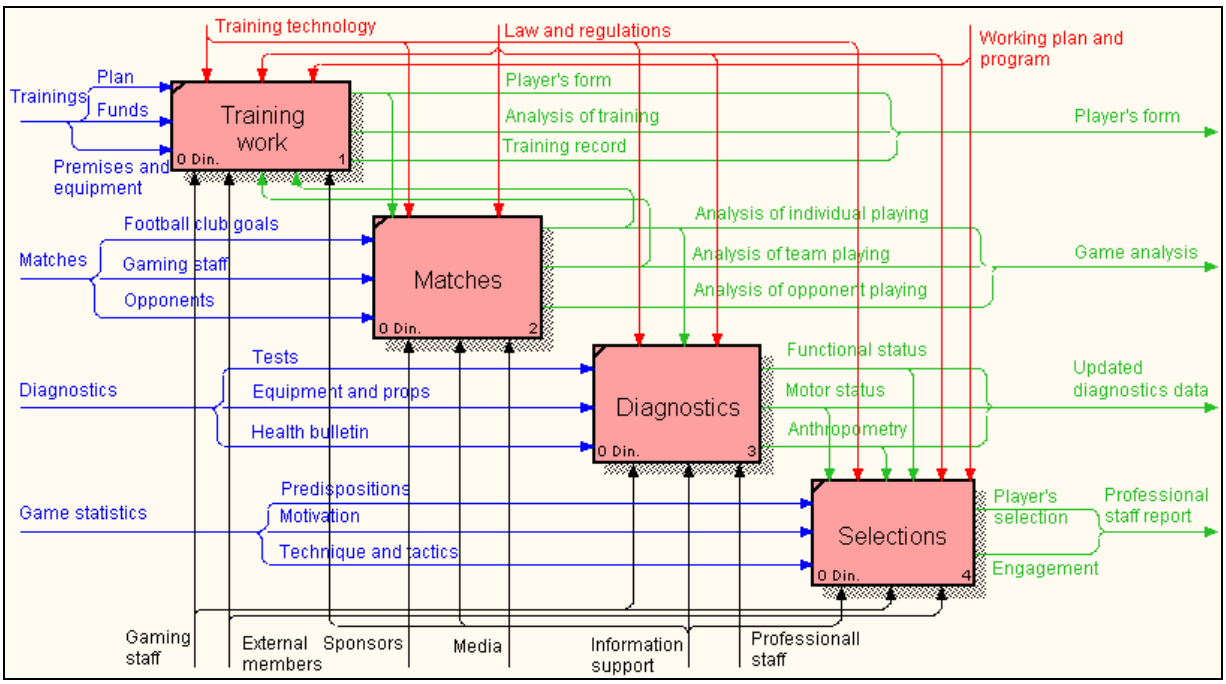

Fig. 6: Decomposition diagram A1 – Competition organnization

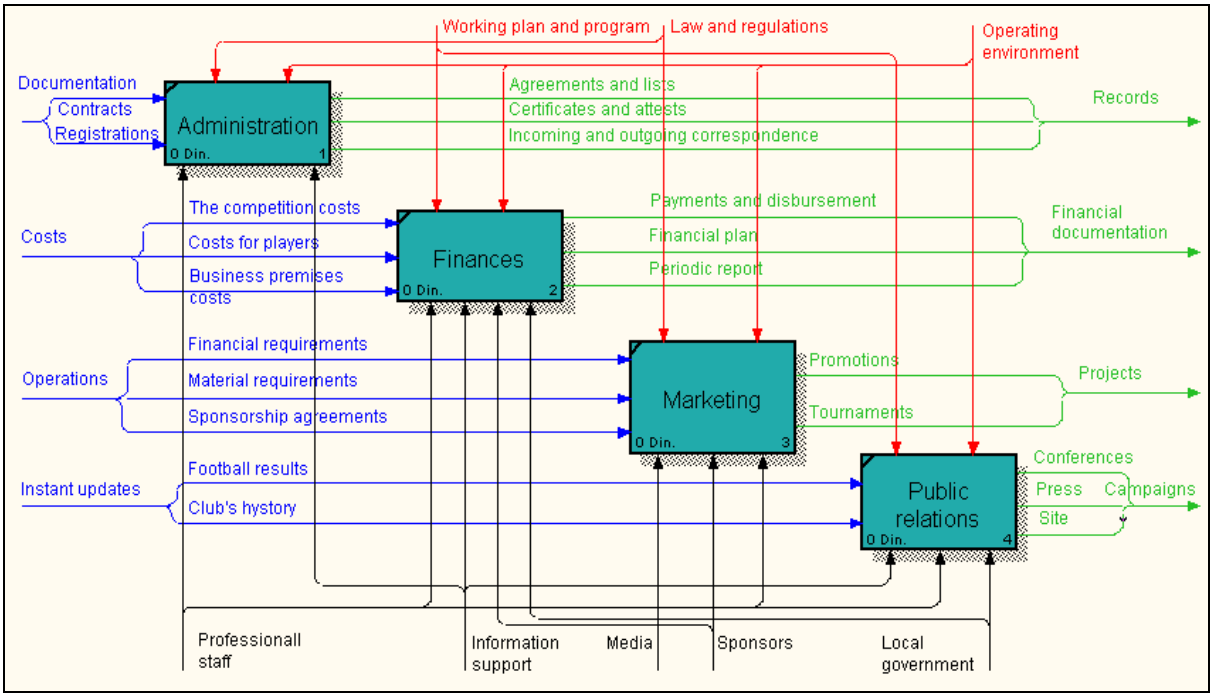

Fig. 7: Decomposition diagram A2 – Business

With the professional pedagogical work deals the professonal staff involving football coaches and other professionals engaged in the work of the players in trainings and competitions. Professional pedagogical

work is a part of the administraive sub-system that collects the largest amount of information. These informations are processed and analysed with the other administrative authorities and the appropriate actions are taken accordingly. This type of work is given a special attention, because only well-designed and implemented professional pedagogical work creates good preconditions for successful competition.

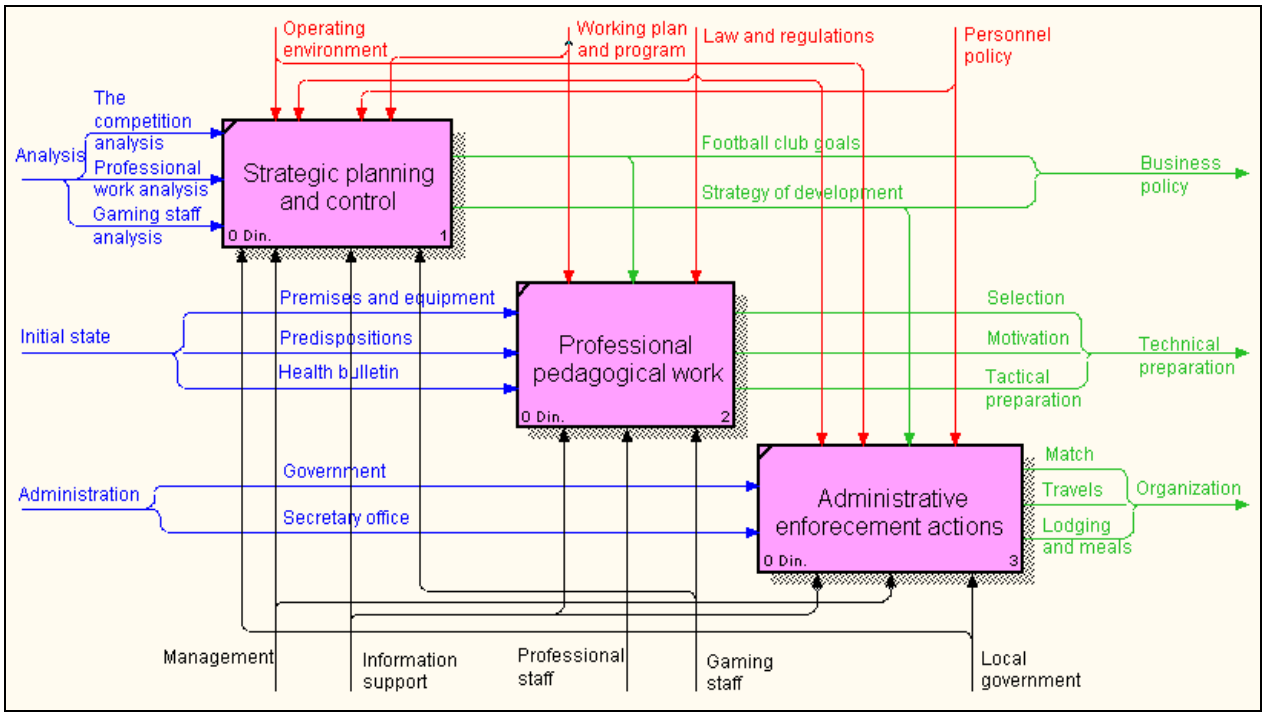

Fig. 8: Decomposition diagram A3 – Management

VII. Conclusion

In terms of stagnation of Serbian football at the international plan was made an attempt designing the ISFC to improve the situation in this sport. Functioning of football clubs in Serbia is burdened with a number of difficulties that are primarily of material and financial nature. In the literature sources that the authors were available were not found examples of specific methodology design and implementaion of integrated information systems in football clubs. Therefore, the design of ISFC was done on the basis of experienced knowledge, their own vision of efficient functioning of football clubs and the desire to ptovide a certain contribution in this regard.

The structure of model of the ISFC is defined in consistent with the hypothetical model and analysis of the level of IT use in football clubs of Serbia. Functional modeling is defined by the context diagram which shows a model of information system in its most general form. Then, the decomposition diagram was made. In the further process of basic activities (competitions of organizations, business and administrative) are decomposed in sub-activities. Thus are established all horizontal data flows in the system. The ISFC model is created with an optimal number of activities at all levels, in order to adapt the system to real conditions of application and further development.

The implemented functional model of ISFC represents the basis for creation of information and applicatin models which are presented in the literature [9].

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