University of „Dunărea de Jos” din Galaţi
Doctoral School of socio-Human Sciences

SUMMARY
DOCTORAL THESIS
TECHNOLOGICAL MANAGEMENT AND SPECIALIZATION OF THE HUMAN RESOURCES FO R THE EFFICIENT DEVELOPMENT OF THE CONSTRUCTION INDUSTRY

Phd
NIȚU F. Marilena Cristina

Scientific leader, Associate Prof. Gasparotti Carmen Marilena
Scientific leader in co-tutelage Prof. dr. eng. D.H.C. Bratu Polidor

Public Support Commission Prof. univ. dr. Emil Marian Năstase
Associate Prof. Solomia Andreş
Associate Prof. Radu Constantin Lixăndroiu

Seria E 2 Management Nr.2
GALAŢI
2020

Annex 2 - Inner cover/back side

The public doctoral series in the UDJG from 1 October 2013 are:

Engineering **SCIENCE**

I Series 1**: Biotechnologies**
I Series 2**: Computers and information Technology**
I Series 3**. Electrical engineering**
I Series 4**: Industrial engineering**
I 5 Series: **Materials engineering**
I Series 6**: Mechanical engineering**
I Series 7**: Food engineering**
I 8 Series: **Systems Engineering**
I Series 9**: Engineering and management in agiculture and rural development**

Economic **SCIENCE**

The E 1 series: **Economy**
E 2 Series: **Management**

HUMANITIES

U Series 1: **Filrology- English**
U Series 2: **Philology- English**
U 3 series**: History**
U 4 Series: **Philology - French**

MATHEMATICS AND SCIENCE OF NATURE

C Series: **Chemistry**

CONTENTS

Keyword: integrated technology management, human resources, construction, product compliance, training, digitization, motivational factors, job satisfaction

INTRODUCTION

On the basis of the development of technologies for the production of building materials, the development of new materials with superior physical and mechanical characteristics as compared to traditional materials, taking into account the full development of construction technology equipment, both during processing and, when they are put into operation by providing them with computer and electronic control and monitoring systems, a gap has been observed over the last 10 years, involving vulnerabilities and risks in both the economic and the quality of the construction works. The gap between the performance of construction materials, technology equipment with smart features, the quality requirements regulated on the one hand, and the professional technical management staff together with the quality assurance infrastructure in construction, has highlighted the need to change the traditional way of thinking so that, a new concept combining all the necessary requirements and the action of the determinants in order to achieve the economic efficiency and the final quality set by the project's objectives for building a construction can be established.

In this connection, in all economically developed countries there is a strong trend toward the digitalisation of construction works by developing and implementing the first stage of development of the concept, namely the foundation of integrated technology management in construction.

This doctoral thesis sets out the main objectives, directions of action, basic technical requirements for ensuring the quality of the work, as well as the specific requirements for improving the workforce and its impact on quality and productivity on the site. In this context, the work is structured around three areas of analysis developing the theoretical and practical aspects of an integrated technical management, namely:

- The first area addressed is that of the quality requirements for construction which are reflected in the sentence through the quality management in the regulated area objectively covering the three aspects, namely: The attestation of conformity of products, the attestation of conformity of technological equipment and the technical inspections of materials and equipment on site;
- the second area addressed is the analysis of the performance of real-time processing technologies with control and monitoring of the parameters of the processed material, based on the use of technology equipment with adequate electronic and it equipment to enable them at a future stage to move toward technological digitalisation;
- The third area is the management of the human resource efficiency and preparedness, so that the training of specialized staff can reach the technological level of automation, informalization and digitization with integration into the digital system industry 4.0.

The concept of integrated management has been defined, established and based on the field of building materials processing, which are put into operation on the site “insinuit”. In this context, it refers to the processing of mineral aggregates for cement and asphalt concrete, the processing of asphalt mixtures, the processing of fresh concrete and the processing of asphalt on the placing in service on the road layers.

Some chapters have been developed in the course of the work, which are in the form of personal contributions such as:

- the process of sorting mineral aggregates on the basis of a program that provides the correlation between vibration amplitude and pulsation on the one hand, the energy required and the degree of sieving on the other;
- Ensuring the control of parameters in the process of preparation of the asphaltic mix for a upgraded station in Romania where specially provided, electronic and computer devices and systems with command in a central server for real-time tracking and the transfer of parametric values into a defined technological platform;
- establishing training requirements through "continuous training" so that specialized staff, at all levels of qualification, can operate and effectively conduct automated and computerized construction technologies and equipment.

The technical data, information specific to quality management and human resources, the correlation of response parameters to ensure integrated technological management, as a result of the permanent interaction of determinants in the production process, have been obtained from the relevant technical documentation, European and national legislation in force, The documentation and participation in the research programs within ICECCON Bucharest, as well as the carrying out of case studies that correspond to concrete situations of practical interest contained in the paper.

***

The work was carried out with the help of colleagues and researchers from the University “the lower Danube” in Galati, the Faculty of Economics and Business Administration, in the field of Management, ICECON – Research Institute for construction equipment and technologies, IMSAR – the solid Mechanical Institute of the Romanian Academy.

I would like to thank **Mrs Conf.Dr. Hil in particular. Gasparotti Carmen, the scientific leader**, for increased attention and competence guidance, for kindness, closeness and understanding, and for the entirely favorable results achieved together. I also thank you for the close and special cooperation, for honesty and timeliness, and not least for the particularly parental way in which she has often explained to me how to do and what to do. Thank you Lord Professor for your professionalism, for the warmth with which you surrounded me and for your kindness.

I would also like to thank **Prof. dr. eng. D.H.C. Bratu Polidor** as a co-tutor, primarily for humanity, discernment, balance, and for the trust he has given me, for the way he has led my footsteps in a world where it is difficult to believe and hope, for highly competent, close and very useful advice, for his involvement and for the courage and support he gave me. I also thank you for serious and close cooperation, for understanding, for the outstanding professional and moral support, for the open and family vision with which she has always treated me.

I also thank Mrs **Conf. Dr. David Sofia, Prof. dr. ing. hil. Debeleac Carmen** for all the support given during the preparation of the work, for the suggestions made in support of the research reports and references in the preparation plan.

I thank my family, my parents who believed in me and who have invested everything in me. Sometimes we forget parents and, in general, loved ones, and it is not good, but the important thing is to realize that it is parents who created us, taught us, supported us, and we can tell us they have formed people.

CHAPTER I - STATE OF PLAY ON TECHNOLOGICAL MANAGEMENT AND SPECIALIZATION HUMAN RESOURCES IN THE CONSTRUCTION INDUSTRY

1.The current state of technological management in construction

1.1.Technological management of materials processing at the operat construction site

The current state of technological management in construction is due to the European and global concerns, on the other hand, to the concerns of the Romanian constructors, as well as to the integration of works contracts for road works, both in Romania and in the EU countries.

The work[1][2] [3]points out that the drivers for carrying out a good quality construction work at the level of the design parameters must be ensured specific performance criteria of the technological components, namely: the amount of assigned revenue in accordance with article 3(3) of the basic regulation is limited to the amount of revenue in accordance with article 10(3) of the basic regulation.

As a result of the trends in the development of working technologies in construction, in Romania it is noted that integrated technology management is applied at a lower level of complexity than in the Member States of the European Union, which is why at the level of entrepreneurs, equipment owners, A coherent and unified approach has been imposed on the designers and research institutes, so that based on the normative documents in force, a qualitative leap can be made on a higher level of construction works in Romania, based on an integrated technological management with the design and requirements of the client.

For this, a common point of view was adopted within the employers of construction companies, research institutes, public works Ministry and the national Road Administration Company, in order to base the requirements of efficient technological management in construction.

---

[1] E A Okunkova et al. (2020), *Development of personnel as a factor in increasing production efficiency in construction,* IOP Conf. Series: Materials Science and Engineering 775

[2] Sugiharto Alwi et al. (2004), *Training field personnel for small to medium construction companies: an alternative tool to increase,* In Proceedings The 12thof the International Group of Lean Construction Conference, Copenhagen, Denmark

[3] Major Virender Singh Phogat et al. (2013), *Selection of Equipment for Construction of a Hilly Road using Multi Criteria Approach,* 2nd Conference of Transportation Research Group of India (2nd CTRG)

The key elements underpinning new technology management approaches are primarily the following:

- establishing the general and specific framework of the concept of integrated technology management which shall include the drivers of the realization of the works, namely: the beneficiary, the contractor, the owner and suppliers of materials and equipment;
- the development of software for the transmission and use of data in a defined consortium comprising decision-makers and operational actors from the beneficiary, the contractor, the designer and the service and material provider;
- improvement of the system of foundation, control and decision making to ensure effective technical management by category of construction works, such as: earthworks, concrete works, mineral aggregates works, asphaltic mixed works, investment works for buildings and office building, road works, bridges, viaducts, ports and airports;

the improvement and optimization of the technological management in the construction depends on the quality of materials, equipment, the training of specialized personnel, the level of automation and it of the processes, and the level of application of quality procedures.

1.2.Digitalisation of the activities and processes in construction

The current global and European state of digitization of construction activities is reflected in the developed countries through the development of technologies and equipment with smart systems, sensors, transducers, memory chips and links to GPS systems so that data transfer, their processing and display in certain situations can be translated into closed circuit internet systems for defined technological platforms.

The evolution of electronic and it systems has made it possible to digitize and ensure the conditions for integration into the industry 4.0 system. In this context, the work[4][5][6][7][8] is mentioned.

In Romania, the technological processes of building materials preparation and on-site operation are 70-80% automated and 10-20% computerized. In this context, for the purpose of setting up specialist technical platforms, entrepreneurs and equipment owners are integrated into a digitization process so that production, performance, execution times and quality levels can be effectively greased by the members of the Technology Platform Consortium.

In this work, based on technological research carried out within ICECCON, the provision of sensors and automatic data control and processing systems, as well as the possibility of GPS transmission with internet connection, can be mentioned as an own contribution. This application refers to a Romanian production asphalt mixer station, built at Nicolina-iasi, type of LPX 200 equipment, which has been upgraded by a digitizing system, suitable with connection to users.

In this case, it is noted that the advantages highlighted are the increase in the quality of the process of the asphaltic mix, the size of the execution accuracy of the component

[4] Natalia Safronova (2018), *Application of digital technologies to increase business activity in construction,* MATEC Web of Conferences 170, 01113 (2018)

[5] *Industry 4.0 for the Construction Industry: Review of Management Perspective,* DOI: 10.3390/economies7030068

[6] Patric Dallasega et al. (2018), *Industry 4.0 as an enabler of proximity for construction supply chain: A systematic literature review*, Computer in Industry 99

[7] Silvia Parusheva (2019), *Digitalization and digital transformation in construction – benefits and challenges,* Conferences of the department Informatics, Publishing house Science and Economics Varna, issue 1, pages 126-134.

[8] Stewart Worrall et al. (2007), *Automated Process for Generating Digitised Maps through GPS Data Compression,*

equipment and the real-time control of all parameters characterizing the intermediate technological processes for each equipment.

Digitizing technological processes effectively facilitates real-time control of the parametric measurement system with lab-specific data.

1.3. The timeliness and importance of the thesis

This doctoral thesis is drawn up on the basis of research carried out with the principal analytical and synthesis directions human resources management in construction, technological management of the processing of building materials, quality management of construction works, requirements in the area covered by the design and integration of the quality system, so that the work carried out ensures the efficiency and quality set at the level of predictable parameters.

The timeliness of the thesis is to correlate the requirements of human resources management with technological management, taking into account current regulations in the construction sector, quality assurance, cost level and execution deadlines. In view *of the current concerns, established by technical reference documents such as technical, regulatory, technical and staff specifications, rules on the quotation by category of works have resulted in a complete need to base integrated technology management with a shift to digitized technology management.*

The content of the doctoral thesis includes the results of research into the definition, background and development of integrated technology management so that the transition to digitized technological platforms can be ensured.

The importance of the thesis lies in the fact that for the category of road construction works, especially for the processing of asphaltic mixtures, the important stages of ensuring integrated technological management have been established, on the basis of decidetic analyzes for the specialized human resource, stabilization, the qualification and motivation of the working and technical staff, the basis for the technological management based on the analysis and case study on the processing and production of the asphaltic mix, and finally the quality requirements in the regulated area were established. In this case, a chapter has been dedicated to the quality management system in construction based on technical approval, certification of conformity and technical inspections with the direct involvement of the specialized human resource at the level of higher training, and the elucidation of the stages of the documentary analysis for the issue of technical approval, certificates of conformity, and the inspection report. The importance of the thesis can also be appreciated by the results presented which can be used by users in the field of specialized human resources for construction, as well as by the relevant economic operator.

1.4. Objectives of the doctoral thesis

The doctoral thesis was designed and developed as a specific research in the field of technological development in construction for processing materials for the production of asphalt mixtures intended for road, bridge and viaducts.

The fundamental motivation of the doctoral thesis is that in Romania it is necessary to develop suitable construction technologies, starting with integrated technological management and finishing with digitized technological management following the new approach industry 4.0.

The essential elements justifying the need for research in the thesis are:

- establishing the concept of integrated technology management based on the functionality, efficiency and quality relationships of key factors such as work process, technology equipment, specialized staff, quality materials, automation-training and laboratory testing;
- the desirability of ensuring the level of quality and performance established by the project of execution both by means of research carried out on the process of preparation of the asphaltic mix and the decisive contribution of the specialist staff, in relation to the quality of the materials and the precision of the equipment, and by official technical regulations on quality assurance in construction.

Consequently, in addition to the specific quality requirements of materials, equipment, real-time quality performance monitoring systems, specific requirements have been introduced for attesting the conformity of quality in the area covered by technical approval for construction products, certification of construction products, technical inspection of construction equipment, all of this ensures the infrastructure of quality documentation.

The specific objectives of the doctoral thesis are as follows:

a) Establish the concept of integrated technology management regulated by quality regulatory requirements in construction, with development directions through digitalisation based on industry 4.0;
b) the development of individualized procedures for attesting the conformity of construction products for road works on the basis of documents in the regulatory field of technical approval, certification of conformity and technical inspection;
c) Integrated technology management for the asphaltic mix preparation station with sensors, instrumentation and informatics to move to the digitized stage with data transfer for technology platform and GPS communication;
d) analysis of the influence of human resource on the efficiency and quality of technological processes in construction;
e) development of individualized motivational criteria for the stabilization of specialist staff in order to ensure functional and efficient conditions for the processing of materials with the asphaltic mixing station;
f) management of the training and efficiency of the human resource for processing technology.

1.5. Structural content of the doctoral thesis

The sentence is structured around 6 chapters and includes general bibliography and documentary references within each chapter.

CHAPTER I - State of play on technological management and specialization human resources in the construction industry

Chapter I analyzes the current stages and trends in the field included in the technical literature at home and abroad. This highlights trends in technology development at various stages of development, finishing with the new Digital approach industry 4.0. Five key directions of influence are also analyzed for the development of technology management, the use of data, their transmission, and the achievement of the necessary interactive correlations between the main stakeholders, namely: Beneficiary, designer, contractor, contractor and technology equipment owner.

It is noted that the state of play of technological management has been analyzed in the light of influence factors, namely: Material processing management, non-conformities of existing equipment, specialist personnel required by specializations and qualifications categories, digitization in construction as a clear trend in industry 4.0 and management of automated and digitized work processes.

CHAPTER II – technological management and quality assurance through certification conformity of products

This chapter covers the conceptual and applied approach of technology management in construction, defined on the basis of equipment, execution processes and real-time monitoring system using automation components and software. Furthermore, the content of the quality requirements in the field covered is reproduced by the presentation of procedures for attesting the conformity of construction products. These are reflected in requirements, principles and codes of good practice for technical approvals, certificates of conformity and inspection reports.

In this context, it is noted that they are submitted to their own research carried out by product category, which is concluded by documents specific to the type of attestation of conformity.

CHAPTER III – impact of human resources on efficiency and quality technological processes in construction

The basic content and structure of Chapter III refer to the analysis of the impact of the human resource on the efficiency and quality of technological processes in construction. Thus, the role and tasks of the specialized technical staff (engineers, technicians, qualified workers) were analyzed, defining the training requirements, their position in the organization chart, as well as the expected efficiency in the workplace. Also, based on a localized case study for a asphalt mixer station, the structure of the staff is analyzed, from which the job requirements for each category are derived.

The analysis addressed the level of training and training of staff in two areas, namely: The requirement for training through a valid diploma in school education, continuous specialist training for quality assurance in construction according to the legislation in force.

The issue of stabilizing qualified professionals and their efficiency in production was carried out in the thesis by an impact assessment and its effect on training and the efficiency of the execution staff with examples and case studies.

As a personal contribution, it may be mentioned that motivational criteria for technical staff should be developed taking into account three essential strands: Motivation by advantageous pay, creation of continuous forms of improvement and economic efficiency on the basis of the financial balance between revenue and expenditure.

This chapter is completed by a case study carried out on the basis of a survey of data collected from 22 companies in the field of road works.

CHAPTER IV – Management of the preparation and effectiveness of the human resource for construction processing technologies

The structure of this chapter is based on two essential directions concerning the human resource involved in quality assurance, the building processing technologies, namely: Ensuring the training management of specialized personnel and the efficiency of the continuous training system for qualification categories.

The documentary data contained in this chapter are the information gathered from the official expert documentation of the national Statistics Institute, so that Romania can get an up-to-date situation of construction workers.

It also analyzed the situation of restricting their technological activity as a whole in the national economy, covering activities in industry, construction and services, and restricting construction activity to certain categories of works with unemployment in these industries. Statistical data were analyzed and processed by category of industry and, at the end of the chapter, the notion of management of vocational training was introduced as a dominant and motivational note for skilled workers and technical staff with higher education involved in construction technologies.

CHAPTER V – exploratory research on the analysis of recruitment, selection, motivation and staff evaluation requirements based on surveys conducted at specialized firms.

This chapter presents the criteria for determining the measurement of the motivational level for the working and specialized staff within small and medium-sized companies in the construction sector, having as main activity the processing of building materials for the road works. In this context, a questionnaire drawn up on a sample survey of options and motivation consisting of 161 firms is submitted.

The results obtained from the questionnaire to which the companies replied are processed statistically, using wage correlation as the main element of interest, and the evolution over time of the motivational meaning of the employees, the function of regression from grade I to grade III. Sectoral percentage representations have also been used to better represent the data obtained.

CHAPTER VI – conclusions. Personal contributions. Research Directions.

This chapter presents two aspects summarizing the results of the research that led to the conclusion of the sentence, namely:

a) drawing the final conclusions highlighting the results of the documentation, the evolution of the research carried out and the results that can be used by small and medium-sized companies to optimize production by applying integrated technology management and in the future the development of digitized technology management;

b) formulation of personal contributions aimed at modernizing and improving the technological processes of preparing the asphaltic mix through efficient, efficient management and quality assurance based on regulatory documents.

CHAPTER II - MANAGEMENT OF QUALITY IN CONSTRUCTION BY CERTIFICATION OF CONFORMITY PRODUCTS AND TECHNOLOGICAL PROCESSES

2.1. Conformity and conformity assessment

Compliance is intended to meet quality and/or safety requirements for the product/service based on a reference document.

The market economy has two main players with strong interests – **the producers** and **the market. State** and **civil society** are the key drivers of active participation in the development process.

Manufacturers want the free movement of goods without any tariff barriers. This requirement is necessary in order to have confirmation of the technical and safety compatibility of the product delivered to the market.

The market is composed of final consumers, the distribution chain (distributors, carriers, traders) and requires that the products are safe and comply with the technical specifications in the reference documents.

The State is acting, both by law and technical regulations and by market surveillance, to stop the placing on the market of products that do not comply with the safety requirements laid down by the regulations and which may affect health, life, the environment and property.

Civil society is made up of stakeholders: Employers and trade unions, consumer rights organizations, professional organizations, professional organizations, environmental organizations, etc.

Manufacturers may choose the technical solutions and technologies they consider to comply with the requirements (Figure 2.2.). Materials and product design can be adapted to technological progress.

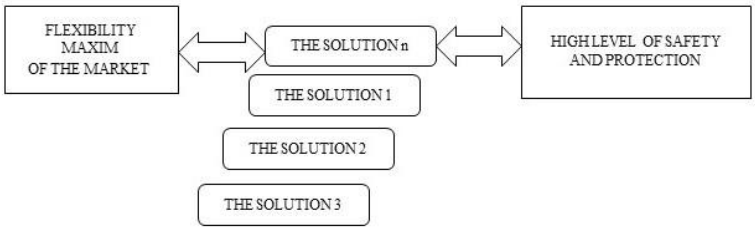


Figure 2.2. Technical and technological solutions

Conformity assessment

Conformity assessment is a complex process by which a systematic examination of the degree to which a product, process or service fulfills the specified conditions is carried out. Conformity assessment may be carried out in **the area covered** by harmonized European standards (the set of economic activities and products associated with them for which specific technical regulations on conditions of placing on the market and use are issued) or in **the non-regulated area, in accordance with national, non-harmonized European or sectoral technical documents.**

The conformity marking is a symbol affixed to the product, its packaging and/or accompanying documents and has the meaning of the conformity of the product with all the

essential requirements laid down in the applicable regulations (directives or national legislation transposing these directives) [9].

Figure 2.3 shows the relationship between the CE (security) marking applicable to the regulated area and the quality mark applicable to the voluntary area.

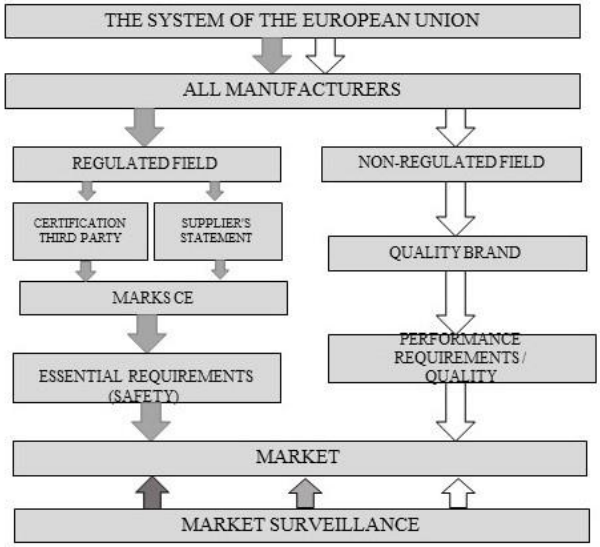


Figure 2.3. Relationship between the applicable CE (safety) marking in the regulated field and the quality mark

2.2. Technical approval in construction

2.2.1. Technical approval for construction — AT

- **General information concerning the obtaining of technical approval in construction**

Technical approval is a written document based on a documented procedure establishing, in accordance with the law, the suitability for use in the construction works, the conditions of manufacture, transport, putting into service (use) and maintenance of products, processes and equipment incorporated in the construction works, For which national standards or other official technical regulations do not exist and cannot yet be developed, or for which standards and regulations exist, but the products do not comply with their requirements, the difference influencing one of the requirements laid down in Article 5 of Law 10/1995 on quality in construction.

The procedure for obtaining technical approval is similar to a type (conformity) certification, except that the reference to which the product, process or equipment is assessed is laid down by provisions of the relevant national authority and cannot be negotiated between the manufacturer and the customer [128,131].

TA shall be granted for a limited period, up to a maximum of 5 years, for the holders or distributors of the manufacturer requested by the request.

[9] *** *Enciclopedia calităţii.* Editura OIDICM, Bucureşti 2005

At the expiry of the time limit may be extended upon request. The at can also be extended or modified.

- **The procedure for obtaining technical approval**

The applicant shall contact one of the bodies entitled to draw up the technical approval, the specialized group of which shall correspond to the type of product requested for approval, by providing it with a preliminary application dossier containing:

1. The application for technical approval for each product or family of part-products
2. The manufacturer's agreement
3. Description of the product
4. Technical reference documents
5. Previous technical approvals
6. Complete list of previous uses (at home and abroad, with indication of year in which they were applied).
7. The internal approval report

- **Extension of technical approval**

If the applicant wishes to extend the technical approval, the approval body shall be sent to a technical approval body (usually the original approval manufacturer) whose specialized group corresponds to the type of product requested for approval, with an application file and a type application for the extension of the technical approval.

An extension of the technical approval shall be requested by the holder 3 months before the expiry of the period of validity of the technical approval.

2.2.2. European Technical approval — ETA

- **General provisions**

European Technical approval — ETA is a technical specification indicating a favorable technical assessment of the reliability of a product for its intended use based on the satisfaction of the essential requirements applicable to the construction in which the product is to be used [133,134].

European technical approvals may be requested by manufacturers or their authorized representatives established in Romania or in a Member State of the European Union in accordance with the procedural rules laid down in the 11.10.2017 European Technical approval for construction products Regulation, drawn up by MTCT and published in the Official Gazette, Part I No 829 of 19 October 2017, the request being made to any of the EOTA (European Organization for Technical approvals) Member bodies.

In order to prevent an application with the same content from being lodged with several EOTA Member bodies, the body with which the application was lodged shall be obliged to inform the EC Commission, the other EOTA Member bodies and the General Secretariat of EOTA of the content of the application.

The application shall be submitted together with a description of the construction product, specifications, drawings and test reports explaining in detail the subject matter of the application and the intended use of the product, indicating all the production units. It must

ensure that these units can be checked by the approval body or its representative at any time during working hours with a view to issuing the ETA.

Within two months of the submission of the application, the approval body must acknowledge receipt of the application and that it will initiate the approval procedures by means of a standardized address.

2.2.3. Quality requirements for materials and technological equipment for the preparation of hot-melt asphaltic mixtures

The making of clothes, made from warm-cooked (cooking temperature above 1500C) or cold-formed asphalt mixes (cooking at ambient temperature) comprises activities and resources which are closely interrelated [22,23,24,25].

The resources used to prepare asphalt mixes are [26,27,28,29]:

material resources;

technical and documentation resources;

human resources.

The quality requirements of the materials used for road works, including the preparation of asphalt mixtures, are defined in the reference standards and technical specifications where the areas of use and requirements for factory production control (CPF) are presented [30,31,32,33].

The quality requirements are mainly limited to the following materials:

- Mineral aggregates;
- Limestone filer;
- Bituminous binders;
- Recovered asphaltic mix;
- Polymers, additives, fibers, other additions.

Deviations from the reference standards (non-conformities) may occur in the process of producing and processing materials, which cause the improper management of the maintenance of the technological equipment used in the process, but especially the human resource (technological indiscipline - statistics provided by conformity certification bodies and inspection bodies reveal a lot of non-conformity due to technological indiscipline)[34,35,37,38].

The certification of capability of the technological equipment participating in the production, bedding and compaction of the asphaltic mix shall be carried out according to the following technical inspection procedures:

• CPC 018-2015, inspection procedure mineral aggregate processing plants;

• CPC 019-2015, inspection procedure for installations producing asphalt mixtures;

• PCC 022-2015, procedure for technical inspection of equipment for the operation of paving mixes at road and airport works.

These procedures, along with publication in the Official Gazette and in accordance with Law 10 (the Law on quality in construction), art. 10 Al. 2, are required.

CHAPTER III - IMPACT OF HUMAN RESOURCES ON EFFICIENCY AND QUALITY TECHNOLOGICAL PROCESSES IN CONSTRUCTION

3.1. Role and powers of the technical staff concerned

3.1.1. Role of technology engineers

The qualification in the engineering engineering engineering engineering profession consists in acquiring specific knowledge and skills for organizing and coordinating the execution of construction works [5,6,7,8].

The Technologist must have the capability to coordinate, verify, and control the designs put into operation for the following job categories:

- earthworks and foundation ground;
- materials used in construction;
- cement, ceramic materials, wood, steel, bituminous and hydraulic binders;
- cement asphalt, bituminous asphalt,
- laboratory tests for construction materials;
- verification of the quality of construction work;
- field drawing of construction works, building design elements;
- construction defects, methods and remedial procedures;
- the organization and operation of on-site laboratories;
- construction and rehabilitation technologies;
- building reinforcements;
- construction legislation;

The work of the yard and the knowledge acquired as a self-didact are not sufficient for the management and coordination of the work of a road yard. General and specific knowledge on construction works must be acquired, which can be obtained through appropriate university-level training [1,2,3,4].

The Tech Engineer shall have higher education and specialized skills for the performance of projects, such as [44,45,46]:

- Be familiar with the flow and frequency of site work, be familiar with and guide the work of the site laboratory and the working team he is running. It must develop decent people-to-people relationships, with workers in the working team, with senior hierarchical leaders, with other assisting economic agents.
- To run a construction site as a good organizer, to take the necessary steps to comply with the safety standards and the PSI on site, on the road, and on the operation of work equipment and machinery. Be a sociable and easily adaptable person to the harmful, heavy and dangerous working conditions on the site.

3.1.2. The role of post-secondary technical personnel

The qualification of the construction technician is to acquire specific knowledge and skills for the organization and operational coordination of the execution of the construction works [56,57,58].

The construction technician must be able to coordinate the following categories of work [59,60,61,62]:

- earthworks and foundation ground;
- materials used in construction;
- cement, ceramic materials, wood, steel, bituminous and hydraulic binders;
- cement asphalt, bituminous asphalt,
- Laboratory testing for construction materials (grade III);
- verification of the quality of construction works (by stage of execution);
- field drawing of construction works, building design elements;
- construction defects, methods and remedial procedures (not requiring special technical expertise);
- ensuring the operation of the on-site laboratories;
- operational construction and rehabilitation technologies;
- building reinforcements;
- construction legislation;

It shall have the following skills:

- Be familiar with the flow and frequency of site work, be familiar with and use the results of the site laboratory and the working team he is running. It must develop decent people-to-people relationships, with workers in the working team, with senior hierarchical leaders, with other assisting economic agents.
- To run construction teams, to take measures to ensure the necessary working conditions, to comply with safety standards, and with the ISPs on site, in the course of the work, and to ensure the operation of work equipment and machinery. Be a sociable and easily adaptable person to the harmful, heavy and dangerous working conditions on the site.

3.1.3. Role of skilled workers

The qualified construction worker must have specific skills for the following categories of activity [63,64,65,66,67]:

- The use of equipment and machinery for processing materials specific to construction, plant and public works;
- The use of conventional representations, implementation plans and signaling systems for the purpose of building, installations and public works;
- Making measurements specific to construction, installations and public works;
- Execution of construction and plant works;
- Quality check of the works carried out by category of objectives (mixes, road foundations).

It must meet the following occupational and competent requirements for employers, namely [68,69,70,71]:

- The planning of its own work for execution;
- Integration into work equipment;
- Respect for the organization of the yard;
- Organization of the workplace;
- Cooperation with members of the working teams;
- Completion of material records and quality execution;

- The supply of materials to the workplace;
- The processing, checking and storage of materials necessary for putting into operation;
- Efficient team working capacity;
- Quality assurance of works executed on the basis of understanding and ability to perform the specific task in an operational manner.

3.2. Current approach to the preparation process

Current concepts argue that learning is an individual activity, carried out freely within a framework without external control.

The following are considered to be:

- preferences are targeted at the employee – learner, rather than the organization;
- learning through experience – "the person has the freedom of choice and action";
- participatory forms of training in which learners agree with the trainers on how their training needs are to be met;
- flexible training programs that allow learners to work at their own pace rather than on a rigid schedule.

In terms of employee improvement, the current practice is somewhat behind the complex human theory. Most organizations continue to focus on the collective rather than personal needs of employees.

Since the policy of professional training organizations is primarily directed toward the goals of the organization, there will inevitably be some tension between collective and personal priorities.

Thus, the learning theory applied in working environments must identify ways to resolve this conflict between the requirements of the organization that needs well-trained employees and those of employees who aspire to personal progress and career development.

For example, if the focus is on the skills required for the job, then the chosen methods will be systematic training and testing. If the first priority is general managerial skills, then programd, structured and restructured approaches can be used.

Robert Gagne (1970), in a work that has become classic on the subject of learning, considers that it can be divided into nine categories, as follows:

- Signal learning – that is, reacting to some form or other of a signal, for example Pavlov's chime;
- stimulus-type learning – response – requires a non-instinctive response to the perceived stimulus;
- chaining (chucking). This type of learning involves linking two or more "stimulus-response" behaviors previously assimilated;
- verbal associations – is a similar process to the one of concatenation, but with links between requirements, between shares;
- learning by differentiation – is the ability to distinguish between several different but related stimuli. This type of learning applies in particular to stimulating learning in people (skills);
- conceptual learning – refers to the ability to find a common response to a class of objectives or phenomena (concrete or abstract); this type of learning together with the following two involves higher forms of learning;

- Assimilation of rules – it is the acquisition of a chain of two or more concepts, as in statements such as "if.... then...';
- solving the problem – it is a learning process, which discovers kings and new solutions based on the previously assimilated ones.

Carl Rogers (1979), a psychologist, takes a humanitarian perspective on how to best facilitate learning. Roger's ideas have deep roots in Jean-Jacques Rousseau's conception of people as good and active beings of nature.

Another American psychologist, David Kolb (1979), says "teaching" learning is perceived as a special activity, cut off from the real world, and where "learning and doing" are two separate actions. B. Kolb has developed a highly relevant model of learning through experience, combining the characteristics of the learning process "teaching type" with "solving the problem", thus resulting in a learning cycle derived from experience.

3.3. Training programming

When we have established the training needs based on the analyzes carried out at the company level, those responsible for these activities can proceed to the selection and prioritization of training, the setting of goals and the preparation of training plans.

The objectives of the training shall specify the results to be achieved by this training process. The objectives of a training process can be grouped as follows:

a) training objectives – covering the types of principles, concepts and techniques to be learned in the training program, who must learn them and when to be assimilated;
b) company and department objectives – which include determining the impact of training on phenomena such as absenteeism, staff turnover, cost reduction, productivity gains;
c) employee-wide goals – set out what the impact will be on employee behavior, on employee performance growth.

Setting training objectives as clearly as possible is an essential condition for the subsequent assessment of the training program. Having clearly defined the objectives of the training program, it will be easy to establish the training methods, the content of the training and the resources allocated to that training program.

The use of various forms of incentives to promote vocational training must take account of the objectives of this activity and the specific features of each individual, so that the training program can deliver the maximum return.

On-the-job training methods have the advantage that theoretical knowledge can quickly and easily be transferred into practical work, and do not involve the student getting out of production, and are less costly, as follows:

- on-the-job training — consists of training the employee by an instructor in the performance of the duties of the job;
- the turnover per job — consists in passing the student over several posts within the same department;
- guidance or advice – consists of training with the help of a mentor that involves supporting the unexperienced colleague by the mentor to understand the firm's activities and demonstrate his or her qualities;
- employee training – in solving professional problems: participation in the development of projects, works, studies, delegation of tasks;

Out-of-work training methods require the use of a learning environment specially designed for this purpose outside the workplace, thus learning takes place far from the pressure of everyday work. These may be:

- lectures – involve a transfer of information of a specified content and duration;
- participation in conferences and seminars – experts and learners discuss issues and exchange ideas;
- case study method – develop the learner's analytical capacity and represents the learner's practice of theoretical knowledge, self-sustaining, teamwork;

3.4. Technical and aptitude training

Technical and skill training programs[10] (i.e. training in skills for different occupations) can be divided into four broad categories:

- ❖ graduate training programs — post-graduate training of general education institutions to obtain professional qualifications;
- ❖ student training programs — courses of instruction and practical training to obtain a title or qualification, such as engineer, technologist, or technician. In the United Kingdom, employees can make several breaks, for different periods, to go to college, or participate in a full study program, with the practice being done before or after the end of their studies or during holidays;
- ❖ training programs for technicians — education and practical training of up to three or four years, usually leading to a degree and a technician job;
- ❖ vocational programs – courses lasting several years, depending on the level of qualifications pursued, usually concluded with the award of professional certificates or other forms of attestation. In the past these training schemes were called apprentices, with a fixed period of training foreseen for the employment contract.

In the technical fields of engineering and construction, skill training shall comprise the following three phases:

Basic training

During basic training, employment leads the basic skills at workshops. The training program compositions severe modules. The standard modules shall be selected on the basis of an analysis of the required skills and, if necessary, additional modules shall be set up.

General training

During the overall training period, employees go through a number of different departments, processes, and operations designed to strengthen their training.

Final training

During the course of final training, employees settle with the department they have chosen or are deemed appropriate for. During this period they must perform the same tasks as the qualified operators, technicians or technologies working there.

Personal development

[10] Michel Amstrong – Managementul Resurselor Umane – Ed. Codecs, 2003

Personal development must be a constant goal in everyone's career. Continuous, lifelong education has long been no longer just a pedagogical concept, and is now reflected in better jobs and higher wages.

CHAPTER IV - MANAGEMENT OF THE TRAINING AND ENSURING THE EFFICIENCY OF THE HUMAN RESOURCE FOR CONSTRUCTION PURPOSES

4.1.3. Employment and labor market policies

Employment and labor market policy includes all agreements whose purpose is to influence labor supply and demand and to change the quantitative and qualitative relationship on the labor market.

The system of measures used is normally grouped into two categories: Passive and active measures.

In the second half of the 1990s, Europe became the experimental laboratory of active labor market policies.

Traditional means may be grouped into four categories:

- employment grants (part of salary costs, organization of public works),
- corporate sponsorship;
- initial vocational training and retraining;
- limiting labor supply (through early retirement and reduction of working time).

Although some countries have adopted these policies in various ways, some clear periods have emerged.

The first period, between 1973 and 1977, after the sharp rise in oil prices, when decision-makers were sure that economic development was only temporarily halted and the lack of balance between supply and demand for labor was not of structural origin, they expressed preference for using the partial take-up of labor costs by the state in order to maintain employment.

In the second period, between 1978 and 1981, when economic growth stagnated and structural changes occurred, the emphasis was on the social approach to unemployment instead of the economic one. In this respect, there has been a reduction in skills, employment in public services and the labor supply problem has become acute.

In the third, 1982-present period, where the limits of the social approach were revealed, there was a three-way movement, as will be seen below:

4.1.3.1 supporting employment

Support to stimulate the employment of the unemployed plays an important role in managing unemployment through active labor market measures.

These are usually known as ‘subsidized employment’ and include:

- wage support for regular employment of the unemployed in the private sector;
- tax reductions offered to unemployed people setting up their own business;

- the so-called *direct job creation in the public and non-profit sectors*, for which the term "public works", "works of public interest" or "employment from public needs" is also used.

The grant for additional employment may be general or limited to certain groups. Its beneficiary is the employer who increases the number of employees of his company for a certain level (e.g. 90% or 100% compared to the current number).

These subsidies were considered to be a form of extension of the aid schemes for the unemployed.

In line with the internationally accepted definition, public-needs employment as an alternative to unemployment is an optimal solution that temporarily ensures the reintegration of unemployed into the labor market. This creates additional jobs to fulfill the general duties vis-à-vis the public and the non-profit sector, without affecting the functioning of the competitive sector due to the lack of natural capacity of market forces to create jobs. Participants can only be unemployed persons for whom jobs have been found by the relevant governmental organization.

This means is used, in particular, when high unemployment is distributed unevenly among the various social groups and there is permanent mass unemployment. Its origins can be found in the major infrastructure investments (construction of roads and apartments), initiated in the 19920s and the , which were organized for the unemployed.

Such public works still exist today, but most are focused on the service sector or on developing and maintaining local infrastructure. The change in the nature of public works is due, on the one hand, to the fact that construction and investment activities are too capital intensive and, on the other, to the fact that the composition of the unemployed population has also changed according to qualifications.

4.1.3.2 qualifications and re-skilling on the labor market

Vocational training has a dual role to play. On the one hand, like any form of training, it means an investment in human capital, and on the other it is advisable to overcome temporary difficulties related to unemployment. In line with this aim, training in the labor market means intervention in specific relationships, which reduces real unemployment and the number of people in need of unemployment benefits. It is generally considered as priority active measures, as they help to increase people's chances of finding a job after they have completed a qualification course.

Vocational training means preparing employees present or waiting to appear on the labor market. Training helps them engage and can also be defined according to purpose. Vocational training thus comprises the forms of training intended to acquire the knowledge and skills needed to acquire and retain a job. In this respect, any type of vocational training (obtaining a first profession = *qualification*, obtaining a new profession = *retraining*, continuing training based on previous knowledge and skills = *continuing vocational training*) can be called *labor market preparation if it helps employment.* This includes, above all, job-search training courses, which often provide the most direct help in finding a job or in initiating a particular type of vocational training.

As the division of labor increases, people's ability to work is increasingly driven by the acquisition of knowledge and skills, and less and less by physical force. With the rapid renewal

of the technology, the knowledge acquired becomes obsolete and new knowledge is needed for it. In countries with developed market economies, it may be necessary to change the profession 4 or 5 times during a lifetime. Thus, it is the knowledge acquired in youth and in maturity that depends on the ability of a person to find and maintain a job, adapting continually to the new requirements of the person.

The training of the workforce can be done in a variety of ways: Traditionally (outside the workplace), in an official educational establishment or in special training centers set up for this purpose.

On-the-job training means that the company places the individual – for a certain period of time – in a special working situation where it can acquire the skills needed for the production process.

Finally, to combine work and training, *the classic example is apprenticeships.* Across Europe, apprenticeship schemes aim to provide work experience for young school leavers in a dual way, i.e. by combining general school education and training in companies. In particular*, the German dual apprenticeship system* is considered to be a model for other countries, although in its original form it forms part of an intermediate training system rather than a labor market medium, bearing in mind that it includes about half of 16-18 year olds The German system itself has radically changed over the last ten years School training, which represents 1-2 days a week, has become more robust. The practical training, which businesses are responsible for, partly with state support, has also improved. A large number of special training workshops and other institutions have emerged which are often jointly run by several companies in the same branch.

The refresher course is part of the re-training process, which is subsequent to the initial training. The training is done in groups of 10-15 people. The essential element of these courses is not to obtain the certificate, but to acquire the basic knowledge and skills for the occupation in question.

4.2. Trends in employment and unemployment

Employment developments

One of the essential objectives of the alignment with the European strategy is the field of employment and, in particular, of the young one, as a workforce adaptable and able to react quickly to the evolution of the European standards of the Romanian economy.

Successful achievement of this objective depends on the joint efforts of government, civil society, business and individual citizens.

As is well known, the development of the labor market depends on Romania's growing economic power, but the evolution of macroeconomic indicators illustrates that Romania's economic activity is currently characterized by a sinuous evolution, and the reform measures implemented are not always the most appropriate, these are shown by economic growth and decline cycles.

But as we know, as restructuring and job insecurity are accelerating, a large number of social problems have built up on the labor market, with employment becoming one of the strained areas of the Romanian economy. Economic uptakes have also restricted employment opportunities, reducing the number of working people employed, employment and employment

rates, increasing unemployment and increasing emigration for young people to achieve better paid jobs.

In order to put an end to these phenomena as a matter of urgency, a coordinated employment strategy should be adopted and, in particular, a trained, qualified and adaptable workforce and labor markets responsive to economic developments should be promoted, in order to achieve the objectives set for integration into the european structures.

This will allow a number of factors to influence employment developments. On the one hand, stable European legislation will foster the flow of foreign investment, which will generate new jobs. On the other hand, the development of the MMI would make a positive contribution to increasing the level of development and employment, especially in terms of labor. For these reasons, particular attention should be paid to the re-training and re-conversion of the workforce.

We also need to examine the conditions under which the education certificates and diplomas of higher education institutions in our country can be recognized at European and international level.

In the light of the above, a pragmatic vision open to the real economy, toward the harmonization of our employment and labor market legislation at European and international level must be adopted.

Consideration should also be given to promoting a higher level of the minimum wage per economy as a benchmark throughout the wage system in order to stimulate the process of motivating work.

Employment in Romania remains one of the most tense areas of transition. The main trend in employment over the last 10 years is continuing to decline. The process is generated both by demographic trends, with a smaller influence, for the time being, the drastic reduction in birth rates and natural growth starting to occur in this decade, and by the low absorption capacity of the economy. In 2016, the civil population increased to 1.360,3 thousand people, compared to 1.274,7 thousand people in 2015, with a higher value than in 2002 (906,4 thousand people). The unemployed registered with employment agencies are down from 25.261 registered in 2013 to 20.581 registered in 2016. This indicator shows a decrease of 10.083 unemployed people compared[11] to 2002.

The vocational training population and other working-age groups are declining considerably from 248,2 thousand people registered in 2013 to 164,5 thousand people registered in 2016, almost one third of 473,8 thousand people registered in 2002.

4.3. Management of human resources at a paving mix preparation station. Case study.

SC DIMEX 2000 COMPANY SRL has as its object of activity the construction of county, national and motorway roads, and is equipped with construction equipment for earthworks, installations and equipment for processing mineral aggregates, concrete and asphaltic mixes. The department for the preparation of the necessary asphaltic concrete, the connection layer and the wear layer, underpins its production activity, coordinating a number of 8 asphalt mixer stations, one of which is the upgraded LPX 200 station, manufactured by Nicodina Iasi.

[11] Anuarul Statistic al României 2002-2016

The technological flows, preparation networks, the quality of input materials and the quality of the finished product on the output are monitored in dual control by specialized staff of three engineers, four technicians and one hundred and twenty workers. Dual production control is that the functions of each professional employee, starting from workers to engineers, are as follows:

- automatic control with computer data retention for each stage of the technological flow that is achieved both at the working positions of the equipment and at the control desk in the station head's cabin;
- visual and physical inspection of equipment operation, correct supply of materials, compliance with dosage and checking of unexpected situations which could result in flow interruption.

This integrated organizational and technological management framework includes the setting up and real-time operation of the LPX 200 asphalt mixer, which has been modernized, where 50% of the staff are used as compared to the initial non-upgraded version of the same plant.

The trend of organizing the materials processing companies in the construction sector since 2010-2013, has been increasingly materializing through reorganization so that an integrated technological management can be established and developed.

In this context, a first reorganization was to base and develop the management of human resources in such a way that specialized staff had knowledge, understanding and application of the technical, quality and economic requirements specific to the site or production process at firm level.

The second line of action to implement technology management is to ensure material resources at the level of performance and quality requirements in the regulatory field, i.e. materials, equipment and systems of process management are approved, certified or approved.

I. MATERIAL RESOURCES

The material resources that are essential for the technological process to be carried out at a qualitative, predictable and guaranteed level are the following product categories:

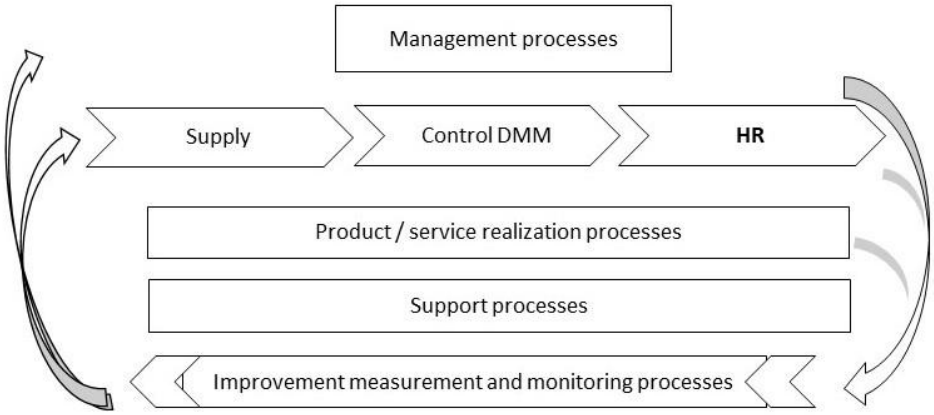
- processing materials consisting of: mineral aggregates, filer, fiber, bitumen, additives; they must be technically approved or certified in accordance with the reference documents in the regressive area;
- Equipment for the process MA document or design performance level, as follows: Aggregate dryer, blender, asphaltic mix, gravimetric detector silos, gravimetric and flow rate feeders, vibratory screeds, horizontal and vertical elevators with environmental protection system; they must be technically checked, certified and regularly inspected;
- automation and it systems at the performance level of production quality tracking and phase control requirements so that final production can be achieved on the basis of a certified recipe.

Management undertakes to allocate material resources and equipment (acquisition of appropriate working facilities, quality training and specific training, etc.) to the following objectives:

- implementing and maintaining the quality management system;

- continuous improvement of technological and production efficiency;
- provides quality requirements for customer satisfaction.

II. HUMAN RESOURCES



Compartments on the basis of which an organizational structure is conceptually and in detail identified are contained in the organization chart of the undertaking as shown in Annex 1.

The station shall be adequately staffed. Persons assigned to the laboratory establishment plan are set out in Annex 2.

Records of any training activities shall be maintained according to the production of "competency, awareness and training". The annual training plan for the station staff shall be drawn up by the head of the station in collaboration with the quality, Environment and SSO (Operational Safety and Health) officer.

The training shall be carried out by the chief of station for staff in the suborder.

The station uses personnel who are a permanent employee of the firm on a contract basis. The responsibilities and technical authority of each person in the station and their boundaries shall be defined and documented in the job Log.

It also specifies the responsibilities, authority and independence of the personnel who direct, perform and verify activities that influence quality.

The head of the station is authorized by the State construction inspection and the operators are licensed in-house.

CHAPTER V – EXPLORATORY RESEARCH ON THE ANALYSIS OF RECRUITMENT, SELECTION, MOTIVATION AND STAFF EVALUATION REQUIREMENTS BASED ON SURVEYS CONDUCTED AT SPECIALIZED FIRMS

5.1 introduction to research

Good human resource management is essential for businesses of all sizes, we can say that it is the practice of managing people to achieve better performance.

Successful performance Management is a shared responsibility between HR and Management, where the manager usually leads and supports HR. Good performance management is essential because employees who are consistently performing may not fit well with the company and/or culture and should be released.

Human resources management is a particularly important aspect of modern management of the enterprise, through the performance of human resources management, can optimize the company's staff structure, improve the overall quality of staff, coordinate the relationship between the enterprise and staff, which provides the guarantee of stable operation and long-term business development.

Modern enterprise can use the method of statistical analysis for human resources management. It is based on three fundamental aspects: Supply, demand and investment in human resources.

The purpose of this study is to collect information relevant to identify the level of organization involvement in the implementation of the human resources strategy, the recruitment and selection methods used by organizations, the methods of personnel assessment and motivation, and the evolution of the staff training role.

Research methodology

In order to diagnose motivational aspects, to determine motivational techniques and the rewards system applied in Romanian companies, a full quantitative and qualitative study was carried out, aimed at the scientific-practical basis of the results, for which I chose to use a sociological survey based on the questionnaire.

The scientific approach of the study focused on the basic stages of organizing and conducting statistical research.

The investigation methodology used allowed the interrogation of a sufficient number of construction organizations within the selected target population. The research tool (questionnaire), which was applied on-line, allowed a high number of answers to be recorded compared to the situation with the fatal questionnaire. This is a self-administered questionnaire which, on the basis of which it was completed, was validated in parallel with the summary of answers, thus obtaining the necessary database for statistical processing. Validation shall be ensured by verifying the correctness of the application of the questionnaire and by analyzing the results obtained with regard to their reliability.

The minimum target for registration, in order to validate the data, was a weighting of 98 % of the number of answers for each organization in order to consider the results obtained as statistically relevant.

In this research, I have also proposed, at the level of the entire population being questioned, a 95 % confidence rate of the entire population being studied.

Each organization received an application, via e-mail, for access to the questionnaire, which allowed each person to reply according to the time available. This has led to the avoidance of mangement errors which are specific to probabilistic samples.

Through the questionnaire I was able to obtain information on the motivation and methods of recruitment and the instruments of evaluating those who are part of the target population. The questionnaire was pre-tested on a sample of 22 companies in the construction sector. The questions raised were closed, with variations of confidence, and opened as appropriate, and the above permitted data to be processed on a percentage and average basis to make comparisons and correlations relevant to research.

The topics addressed in the questionnaire are: General data on the scope of the activity, type of firm, level of involvement in the implementation of the HR strategy, methods for selecting and assessing staff efficiency, difficulties in assessing employee performance.

Recognition of the problem and the objective of the research. The correct expression of the problem allows avoiding ambiguities in the research. Regarding the content of the research within the thesis, we considered the analysis of the motivational process and the implementation of a strategy regarding the professional training of the employees within the Romanian construction companies.

Establishing the objectives and hypotheses of the research. Achieving the research objective provides an answer to the research question. The objectives of the research are divided into several parts so that each part can be approached separately.

The objectives of the research refer to the following aspects:

- identifying the factors that have an impact on employees' performance;
- establishing the level of work performance;
- establishing the main shortcomings of employees;
- identifying and analyzing the main motivational strategies of companies from the perspective of managers and executives;
- establishing the hierarchy of employee rewards.

The hypotheses that we formulated based on the defined objectives, take into account the answers expected from the research conducted.

Thus, these hypotheses are:

- the feeling of satisfaction at work can be an important reason for keeping employees in companies;
- appreciation of the work done and safety at work brings great satisfaction to employees;
- different conceptions of managers and employees regarding job satisfaction/dissatisfaction cause insufficient motivation of employees;
- the possibility of professional advancement at work is a variant in keeping qualified employees;
- the existence of a close link between the due salary and the effort made;
- the clear transmission of tasks and the establishment of responsibilities of employees will have the effect of increasing performance;

Selection of information sources. Based on the answers obtained from the respondents from the organizations under analysis, the information necessary for the research was selected.

Gathering and organizing information. The information was collected using the survey method based on the questionnaire. The 16 proposed questions were addressed to the managers and execution staff within each analyzed organization. The questionnaire was focused on closed questions, based on which we were able to establish the attitude of the interviewees regarding job satisfaction.

Sampling method. For the sizing of the sample, 161 organizations in the field of constructions in Romania were taken into account, which were divided according to the number of employees and the field of activity (Annex 5.3.).

The respondents surveyed from the 161 organizations were managers (23) and executive staff (97).

For each employee within the organizations to be included in the sample with the same probability, the random method was chosen.

The information was collected between October 2019 and April 2020.

Chapter VI – CONCLUSIONS. PERSONAL CONTRIBUTIONS. FUTURE DIRECTORATES OF RESEARCH

6.1 conclusions

The principles of analysis and development of the concept of technological management in construction have been addressed in the research carried out for the development of doctoral thesis, as follows:

(a) establishing essential requirements for materials, equipment, specialist personnel and technological processes, which contribute to the completion of work of predictable quality, in accordance with specific reference documents;

b) design of the functional interactive system to underpin integrated technology management with switchover to the industrial platform 4.0 for digitization in the specialized field of construction materials processing on site in real time;

(c) base the quality requirements in the regulated area on the basis of procedures for technical approval, product certification and technical inspections of technological equipment, in accordance with the regulations in force;

d) explore the possibilities for developing a future digital, efficient, integrated technology management through a comprehensive program of coherent, efficient and effective links between all key actors involved in the process. In this context, the quality of materials, processing equipment, coordinating and serving personnel, instrument and it equipment supporting the technological process, as well as the assessment of the final quality of the product produced, shall be mentioned;

The research was based on technological, economic, social documentation and the impact of the concept of integrated technological management on the development of the society, with its particularity in the construction technological processes. For this we have benefited from the compenent guidance of specialists from the University of “Dunarea de Jos”

Galati, as well as from the Institute of Research for construction technologies and equipment ICECCON Bucharest. In this context, the main directions of applied research of technological management have been established, as well as development research in the fields of equipment for the production of building materials with real-time processing, such as: plants for the production of mineral aggregates with the improvement of the vibration regime for high precision sorting by particle size classes, fresh concrete preparation stations and asphalt mixer pump stations for road works. The case study was developed for asphalt pump stations where the concept of integrated technology management with development in digitalization was introduced.

Specifically, the technological management issues integrated in Chapter 2, the fundamental aspects of the non-conformities of processing equipment in Chapter 3 and the influence of the training of inspection staff in Chapter 4 have been addressed. Chapter 5 also addresses the challenges of modernization, automation and digitization, including the speculative workforce.

In addition to the above, the following conclusions can be summarized in the light of the objectives of the thesis and the results of the research carried out:

(a) analysis and development of methods for assessing the level of appreciation of existing technological management in construction, based on facilities with different generations of equipment and on specialist staff constantly seeking and changing jobs;

(b) establishing the concept of integrated technology management based on quality requirements in the regulated area based on technical approvals, certificates of conformity and third party technical inspections;

c) analysis of procedures and methods for assessing the quality of construction works with the processing of instrument and computer aided materials, with the development of a case study for a type of asphalt mixer station;

d) determining the efficiency of construction works as a result of the fluctuation of the workforce, its preparation and the motivational requirements for stabilizing functions of execution and management;

(e) the development of a case study for the construction workforce, with the drawing up of charts and the establishment of quality indicators;

F) developing a monitoring system for a asphalt mixer station by providing sensors, transducers and signal acquisition, processing and treatment systems so that GPS data can be used in a digital platform common to a consortium of users;

g) assembling the quality requirements, the functionality of the equipment and the professional training of the professional staff in the concept of integrated management in the construction.

6.2. Personal contributions

The results of the research carried out, both within the Institute of Research for building equipment and technologies ICECCON Bucharest and at the University of “Dunarea de Jos” Galati, Faculty of Economics and Business Administration, have been translated into the objectives and conceptual and operational approaches contained in this doctorate thesis. In addition to the general conclusions presented above, following the use of knowledge and

specialized approaches in the field of technology management in construction, the following personal contributions can be mentioned:

1) Establishing the technological requirements and management of the specialized staff (management and execution) to define and develop the concept of integrated technology management with prerequisites for the switchover to the digitized system for technology platforms generated by the industry 4.0 program;
2) production of operational processes to certify conformity of construction materials processed 'in situ' and in real time with asphalt mixer stations, concrete stations and mineral aggregates production stations. Thus, procedures have been developed for technical approval, certificate of conformity and technical inspection report, all individually tailored for concrete products, asphaltic mix and mineral aggregates;
3) Building on the concept of "real-time" specialized staff for "smart" work processes with provision of skills, labor stability and operational responsibility when processing materials with automated, computerized and digitized GPS communication equipment;
4) Digitize a asphalt mixer station by upgrading an existing LPX 200 copy run by Nicolina-isi so that the processing technology can be optimized in real time by adapting integrated management;
5) design of the technology requirements matrix as part of integrated technology management for an asfali mixer station with sensors, transducers, memory chips, specialized software;
6) developing exploratory research on the analysis of recruitment, selection, motivation and staff evaluation requirements based on surveys conducted at specialized firms.

6.3. Future Research Directions

Given that construction technologies are disvoted on the basis of high-performance materials and advanced equipment with advanced electronic, it and intelligent systems, the subject of this doctorate thesis has allowed the concept of integrated technology management to be built into the concept and directions for further development of these technologies. In this context, it is noted that the sentence contains concepts, ideas and opportunities that can in future prime the following areas of research:

a) total computerization of the processing activities of construction materials, both at the manufacturer and at the site, so that technical and economic efficiency can be optimized in real time;
b) the improvement of specialized staff at all levels of execution, administrative decision, technical decision and management decision, so that the necessary knowledge can be linked to the possibilities and performance of the working technology system,

ensuring on a technical, economic, information basis all data and multiple user requirements for the transition to full digitization in technology platforms defined by consortia of material producers, users, designers and executors on the entry into service.

SELECTIVE BIBLIOGRAPHY

[1] Armstrong Michael, Cummins Ann, Hastings Sue (2005) - Job Evaluation: A Guide to Achieving Equal Pay. London: Kogan Page Limited.

[2] Armstrong, Michael, Helen Murlis (1991) - Reward Management, Ed. Kogan Page.

[3] Aurel Manolescu (2003) - *Managementul resurselor umane* – Editura Economica, Bucuresti

[4] Bach Stephen, Sisson Keith (2000) - Personnel management: a comprehensive guideto theory and practice. London: Blackwell Publishers.

[5] Bahamid, I. (1995) - Participative Change: The Creation of a Social Dynamic Conducive to Improvement. Asia Pacific Journal of Human Resources, 32, pp. 105 - 130.

[6] Barrett, G., Kernan, M. – Performance, Appraisal and Termination: A Review of Court

[7] Barton, P.G. (1984) - Job Evaluation: Maintenance Procedures: How to avoid catching a tiger by the tail. Asia Pacific Journal of Human Resources, 22, pp. 17 –20

[1] Blaga, P. (1997c). *Managementul în construcţii şi mediul - cauze şi efecte*. Analele Universităţii din Oradea, VI: 276-278

[2] Book Reviews (2000) - The American Review of Public Administration, 30, pp. 334 - 360.

[3] Bordea (Debeleac), C., Năstac, S., Structural requirements of bituminos paving mixtures, The Annals of ”Dunărea de Jos” University of Galati, Fascicle XIV Mechanical Engineering, ISSN 1224–5615, 2002-2003

[4] Bratu, P., Bordea (Debeleac), C., Request of performance for asphalt mixtures finishers, The Annals of ”Dunărea de Jos” University of Galati, Fascicle XIV Mechanical Engineering, ISSN 1224–5615, 2001

[5] Bratu, P., Bordea (Debeleac), C., Request of performance for equipments for the preparation of asphalt mixtures, The Annals of ”Dunărea de Jos” University of Galati, Fascicle XIV Mechanical Engineering, ISSN 1224–5615, 2001

[6] Bratu, P (2008) – *Starea tehnica a echipamentelor pentru procesarea materialelor(aggregate minerale, beton, mixture asfaltice)* Conferinţa Tehnico-Ştiinţifică Internaţională “Probleme actuale ale urbanismului şi amenajării Teritoriului”, vol I concept de securitate la echipamente pentru lucrări de drumuri în conformitate cu directive europeană Maşini 98/37/CE, ISBN 978-9975-70-774-9. Chişinău, 13-14 noiembrie

[7] Bratu, P. *(2008), Legislația Europeană pentru Construcții,* Universitatea Tehnică a Moldovei

[8] Bratu, P. (2002) – *Nivelul de performanţă tehnologică al staţiilor de producere a agregatelor minerale pentru construcţii*, Seminarul Internaţional “ Impactul Tehnologiilor Moderne asupra Dezvoltării Durabile“, Universitatea Tehnică a Moldovei, Meridian Ingineresc, 4 pag.

[9] Bratu, P. (1990) – *Sisteme elastice de rezemare pentru maşini şi utilaje*, 260 pag., Editura Tehnică

[10] Bratu, P. (2018) – "*Analysis of the dynamic regime of forced vibrations in the dynamic compacting process with vibrating rollers* „ - ACTA NAPOCENSIS – Applied Mathematics, mechanics and engineering, vol. 61, nr. 1
[11] Bratu, P. (2019) - "*Hysteretic Loops in Correlation with the maximum dissipated energy, for linear systems*" by Symmetry, 11(3), 315; https://doi.org/10.3390/sym11030315-02.03.2019;
[12] Bratu, P. (2019) – "*Parametric assessment of anti-seismic devices according to the nature of kinematic excitation*", - Acta Technica Napocensis – Applied mathematics, Mechanics and Engineering, vol. 60, no 2.
[13] Bratu, P. (2019) – "*The innovative impact on acoustics, vibrations and system dynamics*" – RJAV vol. 16 no. 1 Romanian Journal of Acoustics and Vibration 39-46;
[14] Bratu, P. (2002) – *Analiza comportarii dinamice a masinilor vibratoare folosite la tehnologiile de construcţii*, Partea I – Seminarul Internaţional "Impactul Tehnologiilor Moderne asupra Dezvoltării Durabile" – Universitatea Tehnică a Moldovei, Meridian Ingineresc;
[15] Bratu, P. (2002) – *Structura şi ponderea tehnologiilor folosite la realizarea construcţiilor durabile*, Seminarul Internaţional "Impactul Tehnologiilor Moderne asupra Dezvoltării Durabile", Universitatea Tehnică a Moldovei, Meridian Ingineresc;
[16] Bratu, P. (2000) – *Vibraţiile sistemelor elastice*, 600 pag., Editura Tehnică, Bucureşti;
[17] Bratu, P. (2011) –"*The variation of Natural Frequencies of Road Vibrator-rollers, as a Function of Parameters of Neoprene Vibration Isolation Elements Materiale plastice 2/2011*" pag144, ISSN 0025/5289;
[18] Bratu, P. (2018) – Adriana Stuparu, Sorin Popa, Ovidiu Voicu, Nicolae Iacob, Gianina Spânu – "*The Dynamic Isolation Performances analysis of the vibrating equipment with elastic links to a fixed fixed base*" – ACTA NAPOCENSIS – Applied Mathematics, mechanics and engineering, vol. 61, nr. 1
[8] Chişu, A. V. (2005)– Posturi, salarii şi beneficii, IRECSON, Bucureşti
[9] Costache,R., Voicu, M. (2001) – *Managementul resurselor umane în asigurarea calității*, Editura Economică, București
[10] Daley, D. (1992) – Pay for Performance, Performance Appraisal, and TQM. "Public Productivity and Management Review"
[11] Davis, E. Louis (1967)– The Design of Jobs, "Journal of Industrial Relations", Vol. 9, No. 2
[12] Debeleac, C. (2013) – *Corellations between operating modes and environmental emissions of non-road machines at construction sites*, The Annals of „Dunarea de Jos" University of Galati, pag. 289-292, Fascicle IX, Metallurgy and Materials Science, Year XXXI (XXXVI), November 2013, ISSN 1453-083X
[13] Debeleac, C.N. (2019 – *Mașini și echipamente tehnologice pentru construcții*, Editura Galati University Press - GUP, cod CNCSIS 281, ISBN 978-606-696-173-8, 231 pag.,)
[14] Duhamel, C. (2020) – Le choix des tests de recrutement. Guide du professionnel, Les Éditions d'E A Okunkova, , *Development of personnel as a factor in increasing*

production efficiency in construction, IOP Conf. Series: Materials Science and Engineering 775

[15] Eargle, F.L. – Introduction in Job Evaluation and Compensation Management, North Ed. “The Job Analysis Handbook for Business”, Industry and Government, Vol. 2., New Editia: 10. London: Kogan Page Limited.

[16] Erita Mazwin Mazlan (2019) – *The Level of Competency Knowledge in Safety Training among Construction Personnel*, Journal of Construction in Developing Countries, 24(2), 157–172,

[17] Gasparotti Carmen (2007) – *Management în construcții navale*, Didactică and Pedagogică Publishing House, Bucharest, ISBN 978-973-30-1744-5, 404 pp.

[18] Gasparotti Carmen (2008) – *Eficiența construcțiilor de nave în Romania*, Didactică and Pedagogică Publishing House, Bucharest, ISBN 978-973-30-22324-1, 234 pp.

[19] *Industry 4.0 for the Construction Industry: Review of Management Perspective*, DOI: 10.3390/economies7030068Job Satisfaction Survey. American Journal of Community Psychology, 13London: Sage Publications

[20] Major Virender Singh Phogat et al. (2013), Selection of Equipment for Construction of a Hilly Road using MultiCriteria Approach, 2nd Conference of Transportation Research Group of India (2nd CTRG)

[21] McCormick, E.J., & Jeanneret, P.R.(1990) Position Analysis Questionnaire (PAQ), in Gale, S., March

[22] Mihăilescu, Şt., Bratu, P., Zafiu, P., Vlădeanu, Al., Gaidoş, A., Mihăilescu, S. (2005) *Tehnologii şi utilaje pentru executarea, întreţinerea şi reabilitarea suprastructurilor de drumuri – Executarea suprastructurilor de drumuri*, Vol. I, 287 pag., Editura Impuls, ISBN 973-8132-47-9, Bucureşti

[23] Mihăilescu, Şt., Bratu, P., Zafiu, P., Vlădeanu, Al., Gaidoş, A., Mihăilescu, S. (2005) *Tehnologii şi utilaje pentru executarea, întreţinerea şi reabilitarea suprastructurilor de drumuri – Repararea şi reabilitarea drumurilor*, Vol. II, 141 pag., Editura Impuls, ISBN 973-8132-50-9, Bucureşti

[24] Mihăilescu, Şt., Bratu, P., Zafiu, P., Vlădeanu, Al., Gaidoş, A., Mihăilescu, S. (2006) *Tehnologii şi utilaje pentru executarea, întreţinerea şi reabilitarea suprastructurilor de drumuri – Întreţinerea sezonieră a drumurilor*, Editura Impuls

[25] Natalia Safronova (2018) *Application of digital technologies to increase business activity in construction*, MATEC Web of Conferences 170, 01113

[26] Nica, P., Iftimescu, A. (2008) Management. Concepte şi aplicaţii, Sedcom Libris, Iaşi

[27] NICOLESCU, O., (coordonator) (2004) *Managerii și managementul resurselor umane*, Editura Economică, București

[28] Nițu Marilena Cristina, Carmen Gasparotti (2019) The efficiency of the Human Resource Management in the Construction Field, Review of Management and Economic Engineering, vol.18/no.2 (72), ISSN 1583-624X, pg. 284-293 Todesco Publishing House, (ULRICH'S Periodicals Directory, EBSCO, IndexCopernicus, Cabell's Directories), http://www.rmee.org/72engleza.htm

[29] Nițu Marilena Cristina, Carmen Gasparotti (2019) The relevance of the TALIS tests in the teaching and learning process in Romania, Review of Management and

Economic Engineering, Vol. 18, No. 1 (71), ISSN 1583-624X, pg. 131-141 Todesco Publishing House (ULRICH'S Periodicals Directory, EBSCO, IndexCopernicus, Cabell's Directories), http://www.rmee.org/71engleza.htm

[30] Orio Giarini, Patrick M. Liedtke (2001). *Dilema ocupării forței de muncă și viitorul muncii*, ed. All Beck

[31] Owen John M., Rogers Patricia J. (1999) Program evaluation: forms and approaches.

[32] Patric Dallasega (2018) *Industry 4.0 as an enabler of proximity for construction supply chain: A systematic literature review*, Computer in Industry 99

[33] Peretti I. M. (1990) – Ressources Humaines, Vuibert, Paris

[34] Peter Boxall, *Human Resource Management: Scope, Analysis, and Significance,* The Oxford Handbook of Human Resource Management

[35] Phillips Jack J., Phillips Patricia Pulliam, Hodges Toni Krucky (2004) Make Training Evaluation Work. Alexandria: ASTD Press.

[36] Pitaru, D. H. (2000) Managementul resurselor umane: evaluarea performanţelor profesionale, All Beck, Bucureşti

[37] Pitaru, D. H. (2003) – Proiectarea fişelor de post, evaluarea posturilor de muncă şi a personalului, IRECSON, Bucureşti