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An authenticated encrypted routing protocol against attacks in mobile ad-hoc networks

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Abstract

Mobile Ad hoc Network is stated as a cluster that contains Digital data terminals and they are furnished with the wireless transceivers which are able to communicate with each other with no need of any fixed architecture or concentrated authority. Security is one of the major issues in MANETs because of vast applications such as Military Battlefields, emergency and rescue operations[10]. In order to provide anonymous communications and to identify the malicious nodes in MANETs, many authors have proposed different secure routing protocols but each protocol have their own advantages and disadvantages. In MANTE's each and every node in the communicating network functions like router and transmits the packets among the networking nodes for the purpose of communication[11]. Sometimes nodes may be attacked by the malicious nodes or the legitimate node will be caught by foemen there by controlling and preventing the nodes to perform the assigned task or nodes may be corrupted due to loss of energy. So, due to these drawbacks securing the network under the presence of adversaries is an important thing. The existing protocols were designed with keeping anonymity and the identification of vicious nodes in the network as the main goal. For providing better security, the anonymity factors such as Unidentifiability and Unlinkability must be fully satisfied[1]. Many anonymous routing schemes that concentrate on achieving anonymity are proposed in the past decade and they provides the security at different levels and also provides the privacy protection that is of different cost. In this paper we consider a protocol called Authenticated Secure Routing Protocol proposed which provides both security & anonymity. Anonymity is achieved in this protocol using Group signature. Over all by using this protocol performance in terms of throughput as well as the packet dropping rate is good compared to the other living protocols.

IndexTerms: ***Anonymity, Authenticated routing,Mobile-ad-hoc networks(MANETs),Group signature.***

I. Introduction

MANET can be defined as a network that contains self-configurable mobile nodes that are connected by wireless links with no access point. In MANETs, each mobile node functions as a router and forwards the routing packet from one node to another for the purpose of communication. Every mobile node is autonomous in nature and they have the ability to move from here to there within the communicating network. So, MANETs have frequently changing dynamic topology and the breaking of communication link is common in the network. MANETs have wide varieties of applications, namely Wireless Sensor Network, Military Battlefields [3], Device Networks, Tactical networks and many. Some challenges as well as the design issues are there to overcome regardless of attractive applications of MANETs. Here exist many security vulnerabilities that are related to security in MANETs.

The example for MANETs that consists of wireless mobile nodes can be seen through an example shown in the below Figure 1.1.Whenever a sender node wants to transmit the information to receiver node which is not reachable from its transmission range[2], then the sender node will initiate the routing process. The Route discovery process identifies the optimum route from sender to the receiver node. Here the intermediate nodes play an important role and they have the responsibility to forward the packets from one node to another node within communication range.

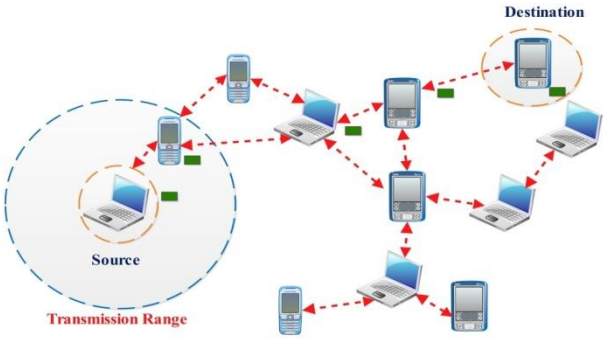

Figure 1.1: Infrastructure less network

II. Related work

Much work has been done in anonymous routing and provide short appraise on the living protocols.

The ad-hoc on-demand distance vector (AODV) routing protocol is based on DSDV and DSR algorithms [4].it uses the periodic beaconing and sequence numbering procedure of DSDV and similar route discovery procedure as I DSR. However there are two major differences between DSR and AODV. An important feature of AODV protocol [5] is the maintain ace of timer-based states in each node, regarding utilization of individual routing table entries. A routing table entry is expired not used recently.

The propose of a novel anonymous on-demand routing protocol, called MASK, which can concurrently accomplish anonymous MAC-layer and network-layer communications. The newness of this protocol deceit in the use of active pseudonyms rather than static MAC and network addresses. It offers sender and receiver anonymity as well as sender-receiver affiliation anonymity [6]. Specifically, adversaries might monitor a packet transmission, they cannot establish actual network IDs of its sender and receiver, nor can they choose if (or when) any 2 nodes in the network are communicating. In addition, It ensure node unlocatability and intractability, meaning that, although adversaries might know some real network IDs and/or group memberships, they be unable to decide whom and where the corresponding nodes are inside the network. Moreover, it ensures end-to-end flow intractability [8], Means those adversaries cannot trace a packet onward to its final destination or backward to its original source, nor can they recognize packets belonging to a same continuing communication flow.

The DSR protocol allows nodes to vigorously discover source path crossways numerous network hopes to any destination in the ad-hoc network. Every data packet sent then carries in its header the accomplished, ordered list of nodes all the way through which the packet must move, achieved packet routing to be trivially loop-free[7], and avoiding the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded .by including this source route in the header of each data packet other nodes forwarding or over caption any of these packets may also with no trouble cache this routing information for further use.

III. Methodology

3.1 Problem Statement

Many researchers and the many users for the mobile ad hoc network have been increasing drastically in the recent years. Providing security for the communicating network is an intense concept in MANETs. Many advance techniques and applications are built in the MANET field, so it is necessary to make available efficient and protected communication in the adversarial surroundings. The more is the network security and performance; more will be the advantages from it.

The protocol considered in this project aims to achieve the goals of Anonymity that are not satisfied in other existing protocols. Some of the existing protocols are not capable to authenticate packets so adversaries find one or the other way to track the information in the communicating network [9]. By considering all these issues the

protocol implemented in this project is aiming to give anonymous communications and improved performance in terms of throughput and packet loss ratio as compare to other existing protocols.

3.2 Objective

The aim of this paper is to achieving the anonymity goals and to protect against attacks under the presence of adversaries. It also aims to provide improved performance in terms of throughput and the packet loss rate as compare to existing protocols. Source node and the destination node identities cannot be revealed to any intermediate nodes or the adversary nodes in the network. Route anonymity: Route identities such as the path from source node to destination node cannot be recognized by any intermediate node or the adversary nodes.

3.3 Protocoldesign

3.3.1 Network topology

Consider the below network topology as shown in figure 3.3.1 which consisting of five-nodes for illustrating the proposed protocol. In the below topology S is the source node which needs to send data to the destination node D, so S initiates the route discovery process for discovering path to D **.**

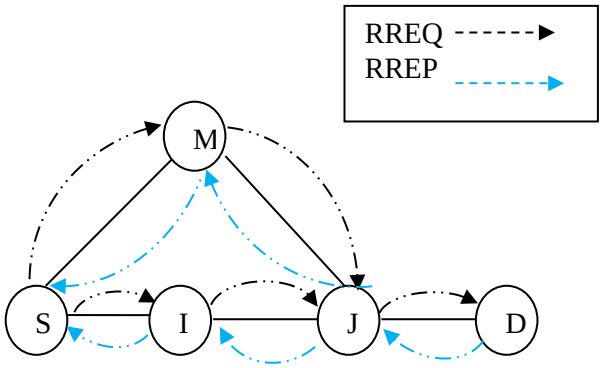

Figure 3.3.1 Network topology

3.3.2 Anonymous Route Request

1) Source node: Whenever the sender node S wants communicate and send some information to the destination node then it will look up into its routing table for checking whether it has the available path to the intended destination. If it doesn't have the active way to the destination then it'll initiate the way discovery method. Supply node at the start is aware of the knowledge regarding D, as well as this anonym, public key, and destine. The destine 'dest'is a binary string that indicates the node as "this is the destination" and may be familiar by D [5]. If there's no session key then it'll generate a new replacement period key K_{SD} for the safety organization among the source & destination node. Subsequently it'll update its destination table as shown within the below table 3.3.2.1

Table 3.3.2.1: Destination table of source node S

Des	Des.str	Des.Pub_key	Session key
N_D	Des	K_{D+}	K_{SD}

Then sending RREQ, source node S establishes an original entrance in its routing table as shown in the table 3.3.2.2.

Table 3.3.2.2: Routing table of source node S

Req	Des	Ver_Mes	Next node	state
N_{sq}	N_D	V_D	N/A	awaiting

2) Transitional node: RREQ packet beginning S is floated in **T**. The intermediate node I encounters the RREQ packet as shown within the Figure 3.3.2.3 Every intermediate node has the neighborhood relationship with each intermediate node within the network, that the node I has the neighborhood relationship with S and and

it aware of wherever the RREQ packet comes from. The table 3.3.2.3 shows the entries that are kept in I's neighborhood table of node S.

Table 3.3.2.3: Neighborhood table of source node S

Neighbour_Nym	Session_Key
N_S	K_{SI}
N_J	K_{IJ}

Table 3.3.2.4: Routing table of transitional nodes

Req_Nym	Dest_Nym	Ver_Msg	Next_hop	State
N_{sq}	N/A	V_D	N/A	Routing

3) Destination Node: When the destination node D receives RREQ packet then it'll validates the packet equally to the intermediate nodes I or J. Since D will decode the part of V_D, it realizes that it is the destination of the RREQ. D will acquire the session key K_{SD}, the validation nonce N_v, and therefore the validation key K_v. Then, shown in table 3.3.2.5 D is prepared to bring together an associate RREP packet to reply to the S's route request.

Table 3. 3.2.5 Routing table

Req.Nym	Dest.Nym	Ver.msg	Next_hop	status
N_{sq}	N/A	VSD	N/D	Active

3.3.3 Sending RREQ

It takes packets made by source node as input and logically processed it and verifies the RREQ packet and fat last destination node receives the RREQ packet. RREQ packet made by the source node

The RREQ packet is transmitted within the network per procedure shown in the figure 3.3.3.1

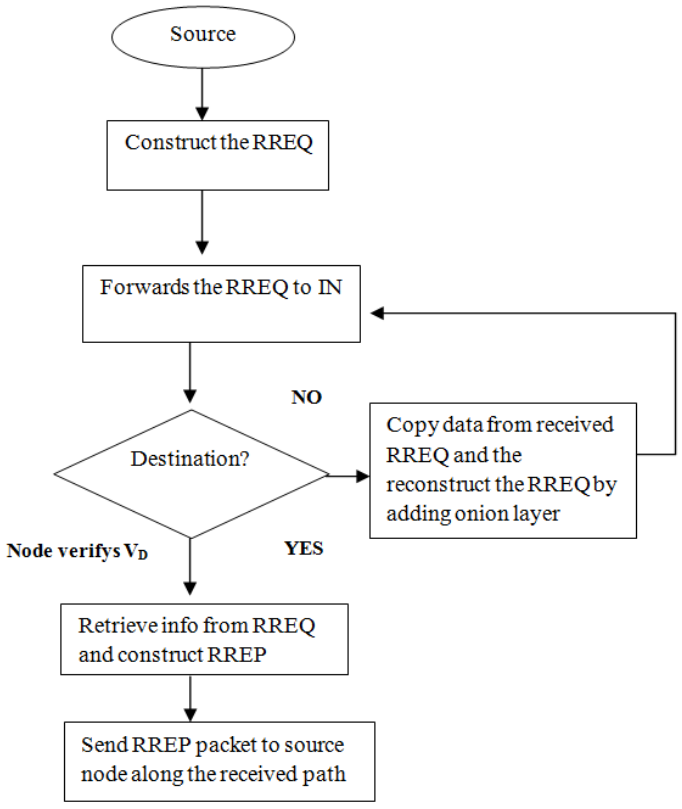

Figure: 3.3.3.1 Flow chart for sending RREQ

3.3.4 Sending RREP

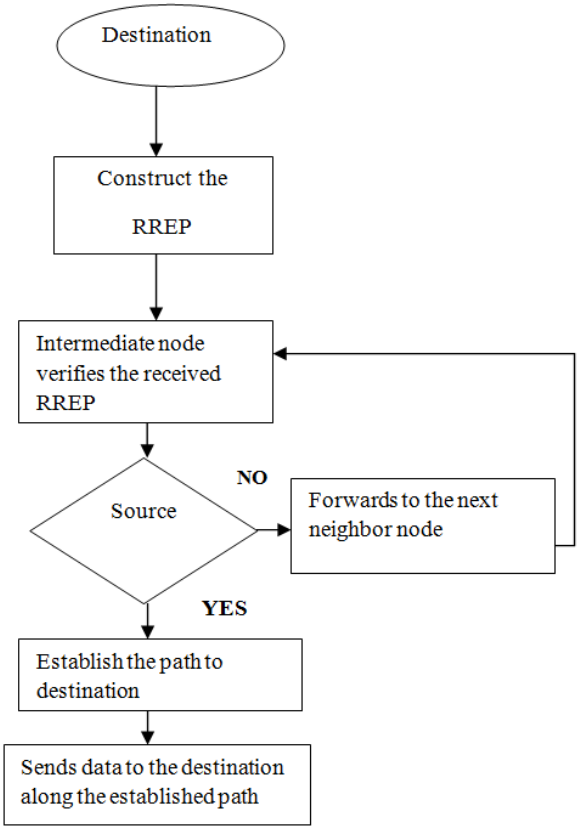

Figure 3.3.4.1: Flow chart for sending RREP

The RREP packet B transmitted in the network according to the procedure shown in fig 3.3.4.1. It takes packets constructed by destination node as input and logically processed it decrypting the outer onion part in the RREP packet nodes will forward the RREP to their neighbor nodes and RREP packet reaches the source node.

IV. Result analysis

The proposed AASR protocol has been implemented by the Network Simulator2 (NS2). It is mainly used to implement the routing protocols in the networking explore. The main focal point of our analysis is security and privacy under malicious nodes. Several performance parameters are used in the valuation of routing protocols. They represent different characteristics of overall network performance. Here 2 metrics are evaluated and used in comparisons to study their outcome on the overall network performance. These metrics are packet loss ratio and Average Throughput.

Packet loss ratio

It is stated as the rate between the numbers of packets lost to number of packets lost and the number of packets of received. The figure 4.1 shows the packet loss ratio comparison under malicious nodes. Compared with existing protocols AASR provides lower packet loss ratio in different mobile scenarios in the presence of adversarial attacks. It also provides better support for the secure communications that are sensitive to packet loss ratio.

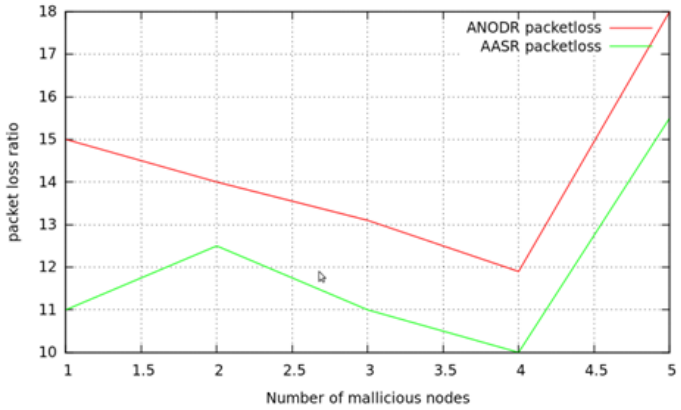

Fig 4.1 Packet loss ratio comparison under malicious nodes

Throughput

It is stated as the total number of delivered data packets divided by the total duration of simulation time. The figure 4.2 shows the comparison of Throughput between the existing and the proposed protocol. It can be observed that throughput of the proposed protocol is better compare to the existing protocol

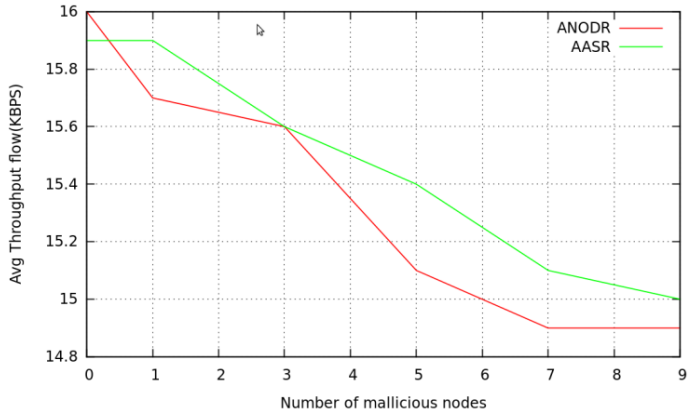

Fig 4.2 Avg Throughput comparisons under malicious nodes

V. Conclusion

The AASR protocol introduces the efficient way to anonymize the entire wireless communication in presence of adversaries. The protocol identifies the malicious node effectively and aims to provide security for finding path, routing and data transmission. From the simulation and analysis results, the packet loss ratio of the proposed system is efficient than the existing system and Throughput of the proposed system is better compare to existing anonymous protocols. So, from these evaluations the protocol is best for higher Packet Delivery Ratio consideration and it efficiently identifies the malicious nodes in presence of Adversaries, limited transmission power and partial dropping.

In future work, routing overhead can be reduced and the Throughput of the protocol can be increased using trust based routing. Another future aim is to consider the Average Routing overhead for the performance evaluation along with the previously considered parameters.

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Mobile Robot Localization and Navigation in Artificial Intelligence: Survey

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Abstract

The potential applications for mobile robots are enormous. The mobile robots must quickly and robustly perform useful tasks in a previously unknown, dynamic and challenging environment. Mobile robot navigation plays a key role in all mobile robot activities and tasks such as path planning. Mobile robots are machines which navigate around their environment getting sensory information about that environment and performing actions dependent on this sensory information. Localization is basic to navigation. Various techniques have been described for estimating the orientation and positioning of a mobile robot. Navigation may be defined as the process of guiding the movement of intelligent vehicle systems from one location to another location with the support of various types of sensors to the different environments such as indoor, outdoor and other complex environments by using various navigation methods. This paper reviews the following mobile robot systems which are used in navigation for localization (1) Odometry (2) Magnetic compass (3) Active beacons (4) Global positioning system (5) Landmark navigation (6) Pattern matching.

Keywords: ***Mobile Robot, Navigation, Localization.***

1. Introduction

In mobile robotics applications that require an autonomous steering system, localization and navigation are generally regarded as the fundamental problems. The previous existence of a map from the region to be explored by the robot can greatly improve the solutions for this problem, as it can reduce or even suppress, in certain cases – the accumulated localization errors created by dead-reckoning techniques [1].

There are two broad types of systems used in the field of mobile robotics such as indoor or outdoor environments. These two circumstances demand a very divergent set of challenges and needs, and often result in very diverse solutions for both software and hardware environment. However, in many ways this distinction between indoor and outdoor mobile robots is not optimal. For instance, mobile robots that operate indoors must still solve complex perception tasks that are more common in outdoor settings, and some outdoor systems operate in rudimentary or planned environments that are more similar to indoor environments. Therefore, it is more useful to use the following categorization when describing the operating environment of a mobile system. Mobile robot localization usually depends on position landmarks direction in a known environment [2] and dead reckoning. Due to slipping of the wheels and the error accumulation of the odometer measurements, the mobile robot may run off course in a short time if only dead reckoning is used. Landmark guidance depends on a priori knowledge of landmarks to estimate robot positions [3]. Localization is a crucial problem in autonomous mobile robots (AMR). Despite the efforts of many researchers, the problem is not yet solved for mobile robots navigating in complex environments or cluttered environments.

The various types of environments in which a robot can navigate are summarized below:

1.1. Structured Environments

Very strong assumptions can be made about properties of the environment. Environments that can be reliably partitioned purely into navigable free space and obstacles are a classic example. Most environments descend into this category, as would an engineered outdoor environment consisting only of flat ground and positive obstacles. A high level of environmental engineering is implied; that is the environment will be modified to enforce any assumptions made about it.

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1.2. Partially Structured Environments

Some assumptions can be made about pre-mapped terrain that although locally smooth, has potentially large changes in elevation. The classic example is urban environments: it is assumed that there are certain proper places to resolve that are easy to detect but may be occupied by dynamic obstacles. The system has three key capabilities namely – (i) tracking stated paths with high accuracy, (ii) detecting small obstacles reliably, and (iii) planning coverage patterns to completely cover a specified area. It is often the case that the environment was originally exaggeratedly created. However, continuous reformation to enforce strong environmental assumptions does not occur.

1.3. Unstructured Environments:

There are no regular assumptions that can be tracked for navigation about the environment. In these cases, two kinds of circumstances can be found:

i. The robot randomly explores the vicinity, like terrestrial vehicles [4]. The robot achieves a mission with a goal position. In this case, a map of the areas in which the robot moves has to be created and a localization algorithm is also needed. A remarkable example of a mapping and positioning system is "Robotic All-Terrain Lunar Explorer Rover" [5].

ii. Another, the "Mars Pathfinder" consists of two components, a lander and a drifter. The lander is a static component in which a stereo camera is fitted to shoot images of the Mars surface, while the drifter is the mobile component which explores the environment. The drifter mission path is determined by human operators in the earth control station by selecting the goal point in 3D representations of previously captured images of the terrain. The position is determined using dead reckoning techniques; in any case none can be assumed to have taken place.

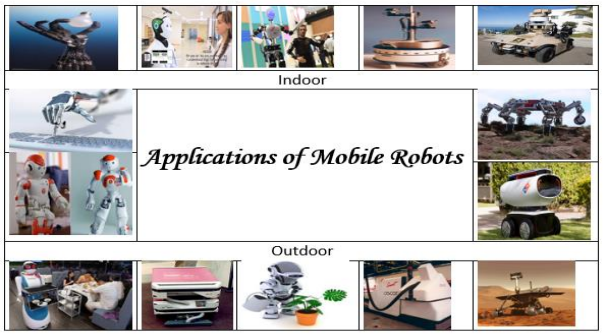

Figure 1: Various applications of Mobile Robots

2. Overview of mobile robot localization and navigation in Artificial Intelligence

Artificial intelligence (AI) is the broad category of mobile robot navigation (MRN) in various environment scenarios and proposes various methods based on navigation to accomplish its implementation. The robot navigation task is not an easy one. According to Leonard [6], the problem of navigation can be framed based on three questions: (i) "Where am I?" and (ii) "Where am I going?", and (iii) "How should I get there?". The first question has been termed the localization problem, the second and third questions are those of specifying a goal and finding an appropriate path to that goal. The navigation is a challenging approach given the high level of concept used to represent the environment, which supports the robot localization and navigation in a structure that also integrates the uncertainty. The various types of robot navigation under each category is summarized as follows:

Table 1. Taxonomy of robot navigation

Taxonomy	Types
Environment representation	Geometric
	Sensor based
	Topological

Localization	Continuous
	Stochastic
Navigation	Grid based
	Two Dimension (2D), Three Dimension (3D)

3. Framework for mobile robot navigation

There are three important components in mobile robot navigation, which are:

- Mapping: the process of memorizing the data acquired by the robot during exploration in a suitable representation
- Localization: the process of deriving the current position of the robot within the map.
- Navigation: the process of choosing a course of action to reach a goal, given the current position

Fig. 2 outlines the general framework of AI-MRN.

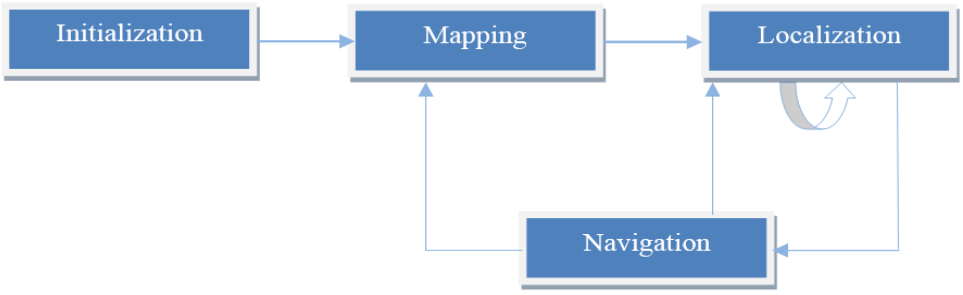

Figure 2: Framework for MRN in AI

4. Taxonomy of Mobile robot environment

Mobile robot navigation can be generally classified into two broad categories based on the environment in which the mobile will explore – (i) Indoor and (ii) Outdoor. Autonomous mobile robots which must be able to acquire and maintain models of the outside environment is said to be in the outdoor environment type. Autonomous mobile robots which must be able to acquire and maintain models of within the environment are said to exist as Indoor environment type. The taxonomy of various navigation strategy is given in Fig. 3.

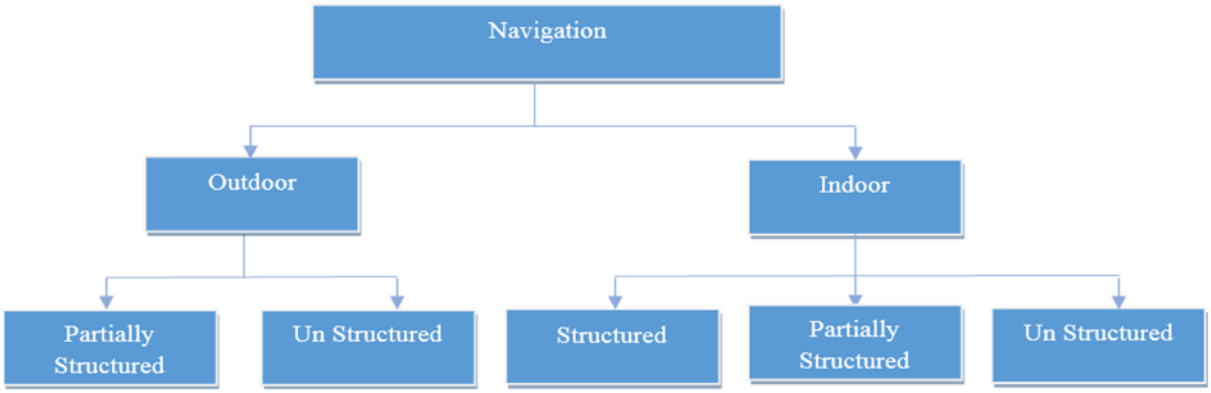

Figure 3: Taxonomy on Classification of MRN in AI

Based on outdoor environment they are classified as “partially structured environment (PSE)” or “un-structured environment (UE)”. Based on indoor environment they are classified as “structured environment (SE)”, “partially structured environment (PSE)” or “un-structured environment (UE)”.

Table 2: Comparison of various MRN in AI based on classification perspectives

S.No.	Technique	Author	Year	Navigation				
				Indoor Environment			Outdoor Environment	
				SE	PSE	UE	PSE	UE
1	Map based [21]	Jiann-Der Lee	1997			√		
2	Localization [11]	E. Stella et. al	2001			√		
3	Localization [10]	Gijeong et. et. al	2002	√				
4	Localization and mapping [12]	D. Lowe et. al	2002			√		
5	Localization [15]	S. Majura et. al	2008	√				
6	Map based[20]	Jean-Arcady Meyer et. al	2003			√		
7	Localization [34]	R. Biswas et. al	2002	√				
8	Localization & Mapping [36]	Happold et. al	2006					√
9	Localization [16]	Huidi Zhang et. al 2006	2006		√			
10	Mapping [25]	M.A. Porta Garcia et. al	2009		√			√
11	Localization [33]	PriscilaTiemi Maeda Saito et. al	2009	√				
12	Adaptive Based [23]	Matt Knudson et. al	2011					√
13	Localization [37]	Jian Kong et. al						√
14	Localization & Mapping[38]	Yoon chang Sung et. al	2016			√		

5. Mobile Robot Navigation in Indoor Environments

In the indoor environments the mobile robots can have disturbances caused by revealing conditions and stationary obstacles. Under these conditions, the lower level functions of robust and real-time landmark processing and trajectory generation must be established in order that the system can be easily applied to autonomous mobile robot. Mobile robots have no external guiding systems [7].

The indoor environment at the center mostly consists of few static obstacles as well as fast fluctuating dynamic areas with many movable obstacles. It provides a typical indoor environment. Therefore, the system developed there can be applied to similar environments without much alteration. The goal of the robot may be reaching a prescribed destination or following as closely as possible finding and mapping an area for a later use [7]. In some indoor environments, it is difficult to detect the movable area because of the complexity of environmental structures. However, when there is a plan to use mobile robots in artificially organized environments, the environmental conditions may be modified according to their complexity [8].

For the mobile robots working in indoor environments, a simple landmark model that is indicated by circle, square, rectangle, and a practical localization algorithm that uses a single landmark in a single image, which runs in real time scenario [9] are usually employed. Navigation in indoor environment can be achieved by goal-oriented technique. In fact, a map of the environment is generally a-priori known and a route to a goal position can be pre-planned. Then, the navigation task of the mobile robot, during the route consists of, continuously, determining its location in the environment in order to verify the vehicle is on the planned path [10]. Generally mobile robot navigation issues are separated from designing the artificial landmarks.

6. Mobile Robot Navigation in Outdoor Environments

Autonomous outdoor navigation ability is necessary for mobile robots employed in many military and civic application areas such as personal assistance, exploration, human robot interaction and transportation of materials [11] [12]. This navigation system that can perceive the environment with matching sensors would improve the mobility of robots and boost the use of them in many daily activities. Autonomous mobile robots can be defined simply as intelligent machines designed to achieve some given objectives by making decisions, managing their resources, and maintaining their integrity in an effective manner [13]. Mobile robots are typically employed in handling tasks that require navigational skills, and they are expected to move smoothly and precisely by utilizing their sensory resources.

The self-localization algorithm for navigation in the outdoor environment has been proposed for solving it. One approach is to construct the environment with identifiable objects with known positions. Another approach is to fix the robot by integrating over its trajectory information and dead-reckoning its position. The last approach is to match active sensor readings to a known model of the outside world or environment [13]. It consists of a very broad topic that has been studied for several years. In the mobile robotics context, navigation can be divided into two problems: static and dynamic obstacle avoidance and path planning. Path planning consists of deciding the most adequate way to achieve a fixed goal. Several path planning techniques have been proposed in the mobile robotics literature and different metrics can be used to evaluate such path planning algorithms. Most path planning approaches are designed to execute in static environment, where information about the environment is fully available.

Obstacle avoidance can be explained for mobile autonomous robots which have widespread applications in several fields like mining, manufacturing, underwater exploration, space missions and as service robots. Mobile robot agents need to move around and interact with different environments. Autonomous robot includes trajectory path planning and obstacle avoidance [14]. In this manner, the robot can avoid unpredicted and dynamic obstacles such as people walking around the robot. This is also a topic extensively addressed by the mobile robotics community.

7. Robot Navigation in Much Complex Environments

One of the key challenges in application of autonomous mobile robot is navigation in environments that are heavily confused with obstacles. The control task becomes more complicated when the configuration of obstacles is not known a priori [15]. The most famous control methods for such systems are based on reactive local navigation schemes that strongly combine the robot actions to the sensory information. Due to the environmental transformation, fuzzy behavior systems have been projected. Regarding intend of predilection based fuzzy behavior system for the obstacle avoidance path planning direct of mobile robot vehicles applications with the help of multivalve judgment network and hence robot travels efficiently even in a very disorderly environment. The hardest problem in applying fuzzy-reactive-behavior-based navigation control systems is that of arbitrating or fusing the reactions of the personal behaviors, which is addressed by the use of preference logic [16] [38].

Safe directional of Autonomous Ground Vehicles (AGVs) in unstructured complex environments, densely cluttered with obstacles is still a major challenge in goal-directed robotic vehicle applications. Navigation through a forest, which attracts special interest from the military community due to the lack of secrecy and destruction found in open environments, is typical for that type of challenges [37].

This navigation problem is a multi-objective control problem that seeks to ensure that the robot not only reaches its goal without hitting obstacles, but also does so at safe speeds that ensures stability. The problem is particularly difficult because some of the navigational objectives may be in opposition to one another.

The navigation problem in cluttered environment is divided into two parts actions: (1) Speed control (2) Heading control. The speed control uses two characteristics: (1) Overturning avoidance (2) Avoid the obstacles. The heading control executes four characteristics: (1) Avoid the obstacle on front side (2) Avoid the obstacle on right side (3) Avoid the obstacle on left side (4) Target seeking.

The obstacle avoidance behaviors use range finding sensors to determine distances to the nearest obstacle; the goal seeking behavior uses compass measurements to determine the direction of the goal and the overturning avoidance behavior uses a speedometer reading to determine the robot speed [17].

Local obstacle avoidance is a fundamental problem in autonomous navigation for mobile robot. Most of the navigation approaches in partially known environment combines a global navigation method to find a feasible free path leading to the goal and a local navigation method to follow the path avoiding obstacles [18][19]. Whenever a mobile robot has to deal with an environment that is totally or partially unknown, local navigation strategies are very important for the robot to successfully achieve its goals [30][31].

8. Mobile Robot Navigation Techniques

Mobile robotics is a motivating area for use of artificial intelligence (AI), as it is a domain in which huge bodies of knowledge are needed to enable tasks like intelligent navigation in a large or complex facility while there at the same time is a need for real-time response to external events[32]. Mobile robots can be used as an interesting test-bed for empirical verification of AI techniques and investigation of their applicability and feasibility in real world settings. In several experimental mobile robot systems and almost every commercial system the use of AI techniques has been enormous.

The following section explains some major works that fall under these categories.

- Orientation technique in MRN
- Path planning technique in MRN
- Map based technique in MRN

Landmarks are distinctive features that a robot can recognize from its sensory input. Landmarks can be geometric shapes (e.g., rectangles, lines, circles). In general, landmarks have artificial and known position, relative to which a robot can localize itself[33][34][35]. Landmarks are carefully chosen to be easy to identify. For example, there must be sufficient contrast relative to the background. Before a robot can use landmarks for navigation, the characteristics of the landmarks must be known and stored in the robot's memory.

8.1. Orientation technique in MRN

The main task in localization is then to identify the landmarks reliably and to calculate the robot's position. To simplify the problem of landmark acquisition, it is often assumed that the current robot position and orientation are known approximately, so that the robot only needs to look for landmarks in a limited area. Autonomous robotics 'intelligence' is defined as providing robots with some level of intelligence and ability to perform desired tasks without continuous human guidance. The following three properties are foundations of robust robot navigation: (i) the use of landmarks, (ii) the use of pre-determined paths, and (iii) the use of geometrical maps [18] [19].

Path planning of mobile robot performs an adaptive approach in order to always select the better method according to the environment difficulty. Environment characteristics are very variable: there are rather plane areas, cluttered-with or free-of obstacles and others which are uneven with respect to the movement capacities of the robot. Navigation on uneven areas involves fine terrain modelling, complex strategies to tackle robot self-localization and trajectory planning, whereas plane areas can be more easily crossed; motion planning is sometimes not necessary if the area is essentially obstacle free.

***8.1.1. Evaluation*:** Simulation based on the orientation of data gathered from geometric hashing and model-based scene matching.

***8.1.2. Advantage*:** (1) The image features and derivation of the geometric invariants from these features in robot-centered coordinates, (2) finding the best matched candidate and the corresponding transformation using geometric hashing and a weighted distance voting criterion, and (3) the verification of the match by back-projection of model features onto the intensity image of the scene

***8.1.3. Disadvantage*:** Limited to within the range of the uncertainty of the odometry data and the maintaining of the previous location error and to compute the geometric invariants for those scene features located within the range of the uncertainty about the predicted locations.

***8.1.4. Outcome*:** Achieves the comparison with robot centered coordinates with the distance voting criterion.

8.2. Path planning technique in MRN

Movement commands are determined on the basis of (i) a target value (heading or position) and (ii) the information provided by sensors [19] [20]. The capacity to navigate is obviously a major requirement for an animal striving to survive in a given environment, or for an autonomous guided robot trying to fulfill its mission, because it affords the possibility of finding dynamism sources while avoiding rude vulnerabilities [30] [31].

***8.2.1. Evaluation*:** Observation based on 85% strongly agree with that EDU Robot simulation.

***8.2.2. Advantage*:** Helped to understand the functional differences between the three different algorithms.

***8.2.3. Disadvantage*:** Software tool only supports only limited algorithms.

***8.2.4. Outcome*:** Over 90% agreed that the effects of parameter changes can easily be observed and majority of students (89%) agree that the simulator has helped them to understand the functional differences between three different algorithms.

The most primitive navigation strategy that helps the animal or the robot succeed in such tasks consists of relying on mere chance and of moving arbitrarily. Localization and map-learning are interdependent processes since using a map to localize a robot requires that map exists, while building a map requires the position to be estimated relative to the partial map learned so far [20].

An intelligent approach to robot navigation by landmark tracking using computer vision is proposed [21][22]. This approach is founded on the concept that a human can reach the destination by tracking the specific landmark in a previous atmosphere. Only a monocular image of the landmark taken by the mobile robot is required. One of the most important and challenging aspects of map-based navigation is map matching, i.e., establishing the correspondence between a current local map and a stored global map. Methods of pattern matching are integrated to resolve the problems of landmark tracking and understanding.

A great deal of work has recently been executed to address the problem of automated robot navigation in complex workspace using many different sensors. These sensors are composed of active sensors (e.g., optical, ultrasonic) and passive sensors (e.g., camera). A lot of the mobile robot systems using various sensing approaches to indoor mobile robot guidance can be found in [21].

In many robotic exploration missions, robots have to learn specific factors that allow them to: (i) select high level goals (e.g., identify specific destinations), (ii) navigate (reach those destinations), (iii) and adapt to their environment (e.g., modify their behavior based on changing environmental conditions) [22].

The exploration of an unknown environment is an important task for the new generation of mobile robots. These robots are supposed to operate in dynamic and changing environments together with human beings and other static or movable objects. Sensors that are capable of giving the quality of information that is required for the described scenario are optical sensors like digital cameras and laser scanners. Complementary sensory information is transformed into a common representation in order to achieve a cooperating sensor system. This sensor is performed by matching the local perception of a laser scanner and a camera system with a global model that is being built up incrementally environment system [24].

Robot navigation is one of the basic problems in robotics field. In general, the robot navigation algorithms are categorized as global or local path, depending upon surrounding environments. If the environment surrounding the robot is known and the path which avoids the obstacle is selected, then it is called global path planning. In local navigation path planning, the surrounding of robot is unknown environment, and sensors are used to detect the obstacles and avoid collisions.

Designing a robot entails the combination and direction of many sensors and actuators[28]. In general, the robot acquires information about its surrounding through various sensors mounted on the robot. Usually, many sensors, such as infrared sensor, ultrasonic sensor, laser range finder, touch sensor and camera can be used to detect the presence of obstacles [25].

Navigation in mobile robotic ambit is a methodology that allows guiding a mobile robot to accomplish a mission through an environment with obstacles in a good and safe path [27] [28]. The two methods involved in navigation are the environmental perception, and path planning. The concept of mission, mention to the realization of a set of navigation and operation goals; in this sense, the mobile robot should possess an architecture able to coordinate the on-board elements: sensor system, movement and its control, in order to achieve correctly the different objectives specified in the mission with efficiency that can be carried out either in indoor or outdoor environments. Generally global path planning methods complemented with local methods are used for indoor missions since the environments are known or partially known; for outdoor applications local path planning methods are more suitable than the global path planning methods because of the scant information of the environment [26].

***Evaluation*:** Simulation is based on both local and global navigation

***Advantage*:** The path planner application has two operating modes, one is for virtual environments, and the second one works with a real mobile robot using wireless communication. Both operating modes are global planners for plain terrain and support static and dynamic obstacle avoidance

***Outcome*:** This approach allows the detection of unknown obstacles simultaneously with the steering of the mobile robot to avoid collisions and ahead toward the target. The innovations of this approach, entitled the virtual force zone, lies in the combination of two known concepts: (i) certainty grids for obstacle representation, and (ii) potential zones for navigation. This combination is particularly suitable for the accommodation of inaccurate sensor data as well as for sensor fusion, and enables non-stop motion of the robot without stopping in front of obstacles.

8.3. Map based technique in MRN

Odometry is the most widely used method for determining the transient position of a mobile robot. The most practical applications, odometry (monitoring the wheel revolutions to compute the offset from a known primary starting position) provides easily accessible real-time positioning information in-between periodic absolute position measurements [27][28][29].

The authors of [34] aim at developing a method of recovery for the ego-motion and the 3D-structure of a scene, in the case of a virtual moving observer with visual, inertial and odometric sensors. The observer attempts to correct its trajectory and build a 3D depth map of its environment during the execution of a predefined trajectory (a prerecorded list of relative displacements). More precisely, they implemented a reactive visual module utilized on an autonomous mobile robot to automatically correct the predefined trajectory, using inertial and visual cues.

The mobile robot navigation system implementation that uses artificial beacons together with sensors that deliver accurate and consistent measurements of beacon location is a straight forward procedure used by many commercial mobile robots today[35][36].

***8.3.1. Evaluation*:** Simulation provides less energy consumption and supports with high speed of moving targets.

***8.3.2. Advantage*:** The anchor nodes are used to determine the position of a target and to calibrate the optimized value of estimation with help of automatic calibration device.

***8.3.3. Outcome*:** This approach allows the detection of unknown obstacles in indoor applications

The analysis and comparison of various AI based on MRN based on their characteristics are given in Table 3.

S.No	Technique	Author/Year	Odometry	Magnetic compass	Active beacons	GPS	Landmark navigation	Pattern matching
1	Map based [22]	Jiann-Der Lee 1997	NA	NA	NA	Map used	NA	NA
2	Localization [11]	E. Stella et. al 2001	re-calibration position of robot	NA	NA	NA	estimate the camera position	NA
3	Localization [10]	Gijeong et. et. al 2002	NA	NA	NA	NA	to update the artificial landmark points	NA
4	Localization and mapping [12]	D. Lowe et. al 2002	NA	NA	NA	NA	visual land-marks is used for navigation	NA
5	Localization [15]	S. Majura et. al 2008	Range sensor (High)	NA	NA	NA	NA	NA
6	Map based[20]	Jean-Arcady Meyer et. al 2003	NA	NA	NA	NA	land mark points are used	Map based environment & used camera
7	Localization [34]	R. Biswas et. al 2002	NA	NA	NA	NA	NA	Map used for navigation
8	Localization & Mapping [36]	Happold et. al 2006	NA	NA	NA	NA	NA	Stereo camera is used for adaptation to dynamic or unknown scenarios
9	Localization [16]	Huidi Zhang et. al 2006	NA	NA	NA	NA	NA	Stereo camera is used dynamic or unknown scenarios
11	Localization [33]	PriscilaTiemi Maeda Saito et.al 2009	NA	NA	NA	NA	NA	NA
12	Adaptive Based [23]	Matt Knudson et. al 2011	NA (simulation only used)	NA	NA	NA	NA	NA
13	Localization [37]	Jian Kong et. al 2015	NA	NA	beacon nodes used to track the unknown environment	NA	NA	NA
14	Localization & Mapping[38]	Yoon chang Sung et.al 2016	leg positions as well as human positions of mapping	NA	NA	NA	NA	NA

9. Challenges and Open Research Issues

The major problem of path planning in mobile robot lies in the three broad categories - mapping, localization and navigation in different environment. The source in this perception consists of sensors and various techniques like speed, accuracy and time performance. Therefore, any localization mechanism for mobile robot considers any one of the following absolute or relative measurements such as: (1) Odometry (2) Magnetic compass (3) Active beacons (4) Global positioning system (5) Landmark navigation (6) Pattern matching. MRN systems operate around orientation, mapping and path planning techniques. The drawbacks include (i) Uncertain changes

in the environment of mobile robot navigation (ii) Cost increases due to the use of high end sensors. Therefore, many researchers suggest that the distance based sensors is appropriate for mobile robot navigation for the indoor environment and pattern matching is appropriate for outdoor environment.

The following are the open research issues that can be addressed while developing a better mobile robot navigation system using artificial intelligence.

- Developing the real time robot navigation and investigating its applicability in localization with RF-based trilateration systems work reliably indoors.
- Developing hybrid maps, which supports almost all types of environments
- Developing computationally intelligent optimization technique for finding target in cluttered environment.

10. Conclusion

This survey paper introduces existing sensors and techniques for mobile robot positioning in all mobile robot's activities and tasks for Artificial intelligence along with their classifications based on various strategies. Further, different types of techniques in a MRN and respective navigation methods are also discussed. Also, silent features of MRN reformed for navigations with different type of sensor used by the robot are discussed and their significant features are emphasized in a comparable chart, followed by the critics about MRN that would be suitable to environment and localization technique are provided. Finally, as a measure to help out the researchers over the selection of appropriate environments and their path planning strategy, certain open research avenues in this field are also touched upon.

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Introduction to adoption of lean canvas in software test architecture design

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Abstract

The growth of the software dependent businesses, as well as the use of electronic devices in daily life, brings new challenges requiring the software to work error free all the time, to achieve this goal software needs to be sufficiently and effectively tested during various development phases. Most software development companies make great efforts in testing; it is even more difficult to reach the error-free software goal. Different software development methodologies (e.g. traditional waterfall, agile) brought in a new dimension for both - development and testing - introducing new technologies and tools. In software test automation the test architecture design plays a key role in managing written test cases and effectively executing them. Having the more effective software test automation architecture design in test process saves resources, efforts and reduces the technical depth.

This paper provides the new dimension and possibilities of using lean canvas in the design of the software test architecture.

Keywords: *software testing, test automation, lean canvas, test architecture design, software verification, software validation.*

1. Introduction

Nowadays the software development process accelerated with the adaptation of various new tools, and software testing gains significant value in early verification and validation of the built software. Few decades before software development and testing were more time consuming and expensive process. In recent years the focus changed to agile software development and testing that aims to deliver product fast. Various software applications also grew large and more complex, nevertheless, the software quality requirements and elimination of any bugs is still a topical issue. From software development to software testing the architecture design plays a key role to build high-quality software. Software development adopted different types of development methodologies and each mythology has their own property and contribution to software development process. Software development, testing, and delivery to production needs run in parallel, all these steps influence the entire development and testing process directly. In recent year`s software development also adopted many engineering design processes. The engineering design process is a methodical series for developing functional products and processes. As discussed further the engineering design process has a many stages in the same way as software development..

Engineering design process steps such as 1) ask, 2) imagine, 3) plan, 4) create, 5) improve can be applied in software development process, as well [3]. Comparing the engineering design process to software development process - both ideally share the same value, namely, building the usable product/software. In software development software architect [8] is a key responsible person for the framework design, project management, design, quality, and process and documentation. Software test architect is responsible for the developing the test architecture to test planning, test development, test interpretation and test harness creation.

Lean canvas principles are novel to both software development and engineering design practices, specifically, applying them at the architecture level. The main aim of this paper is to shed some light on the possible adoption ways of the lean canvas in software test architecture design.

A. Scientific Novelty of Paper

Lean canvas is used for evaluation of the business models on the white board with empty titled boxes. It is a one-page lightweight document that helps to plan product development from its start to end phase and evaluate marketing fit.

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Our core contribution is to identify possibilities for adapting lean canvas principles in software test architecture design..

Specifically:

- Design process for the software test architecture Scope for the lean software test architecture design
- Analysis of the complex system design for test architecture design
- Application of the lean principles in the software test architecture
- Identification of the software test architecture design optimization
- Design of the lean software test automation architecture
- Lean test metrics in software test automation architecture
- Lean canvas transformation models for test automation architecture

B. Structure of Paper

This paper is divided into three main sections and conclusions. Section 2 Paper begins with problem formation and in next. Section 3 design process and engineering analysis. Section 4 lean canvas principles for software development, and the related research. Section 5 Scope lean software test architecture design.

2. The Problem Statement

Software test architecture plays a key role in achieving effective software testing and related management activities. Not having properly designed test architecture framework could cause a delay in test automation, prevent or delay complex test cases testing and increase overall the software testing costs. The most common test automation architecture challenges are:

- Lack of proper test framework
- Lack of test environment
- Lack of test automation tools implementation
- Ineffective test automation techniques
- Failure to select test design, test data creation, release process techniques
- Lack of the right test architecture
- Ambiguity in test strategy
- Difficulties in handling custom built test automation tools
- Selecting the right tools and technologies for test automation

3. Related research

3.1 Principles and elements of the science of design

Design play key role in product success or failure in most of area and design bring the significant value to the product. Most of the companies and industry doing a lot of research and building the new tools for better design [1]. Effective design can bring effective product and that drive the business and bring more money into it.

Steps in design process

Defining the problem - It is very important to define what is problem user-facing or for whom we developing the product. Once we clearly define the problem then we can work around to solve the problems.

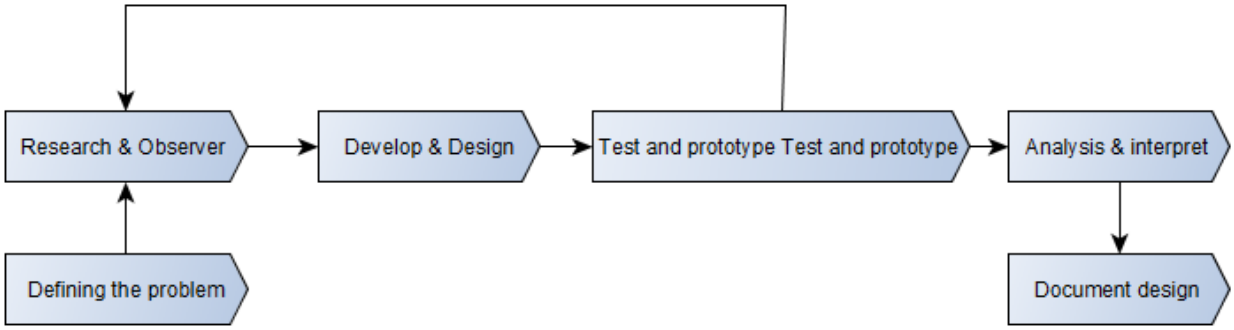

Figure 1: Steps in design process

- Research & Observer - In this step basic to an in-depth analysis done with research data or sample data. Data abstraction can help to set up a milestone for the next step.
- Develop & Design - In this step we use data to make the prototype and set a research framework so we work under that. First model development helps to know the early level success and failure of the product.
- Test and prototype - In this step product design is it tested with real or early stage users to check and give a feedback for the prototype.
- Analysis & interpret - In this step, continuous small feedback is given to developing a design stage for the to improve the design.
- Document design - Once a design is finalized and documentation is generated for the further references.

As we view in the above figure in test and prototype bring the validation and evaluation methods. The science of design brings new models and new opportunity solutions for the business to change their existing products with time and increase the customer stratification.

3.2 Iterative improvement of design

Make an observation, make a hypothesis, create and define an experiment to prove or disprove the hypothesis, Perform the experiment/test, Interpret the results of the experiment and find the result. Go back to the first step.

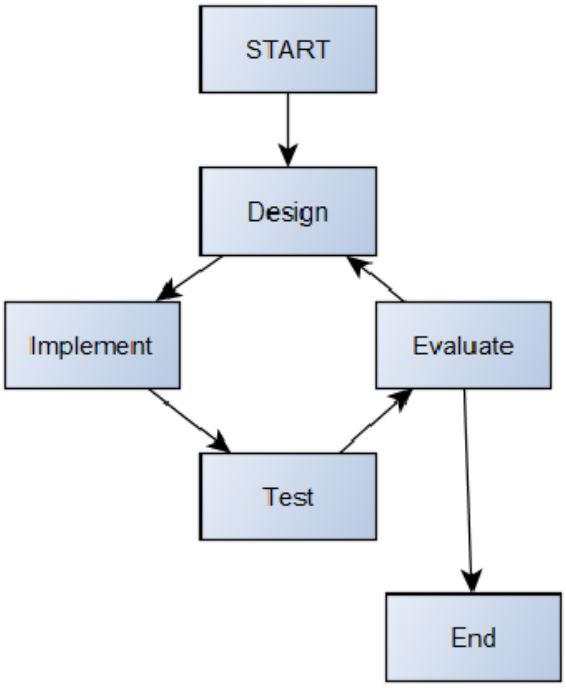

Figure 2: Iterative improvement of design steps

As we view in the above figure iterative improvement of design [1,2] we take initial design or a first model and start in design process, implement and basic design and test it in front of real or early user of the product, this process bring some intermediate results or observation collecting those data can further feedback to design to improve or use those data and finalize the design process. The end product is developed in such way that user can use it in an easy way and get maximum benefit from the product. Iterative improvement of design gives the constant feedback so the user can find the optimized design to the end users. One side iterative improvement of design adds a value to existing product and one side also brings new ideas od future implementation.

The design of science can be archived to multiple disciplines and for multiple purposes, my research is in this article is about how we can use the design in the software testing architecture. As we know the architecture play a key role in the building any computer based system, with software development to software testing architect bring the great value for the system to work it in an appropriate way. My research also towards the finding the lean architecture design advantages in test architecture. As we know software testing play key role in validating and verifying the software in early stage and reduce the overall cost. It's important to well-tested software need to deliver the end customer to improve the software quality..

3.3 The engineering analysis

The engineering analyses is a very basic and important tool for the performing and practicing engineering tasks in daily routine life. The analysis is used for the creations, decision-making, and problem-solving. As from history the scientist discovers the new things for humankind and engineers develop that idea and make it real to its users.

Engineers also make decisions some of the critical once those can affect the root or the system architecture and bring the very high impact. Engineers made a decision about the design [2,4], manufacturing, maintenance & expected conditions where critical decision need to be taken to go one step further more. Engineers solve the problem related to the design ambiguity, manufacturing fault, cost control, quality issues. An engineer can also make task creation, decision-making, and problem-solving.

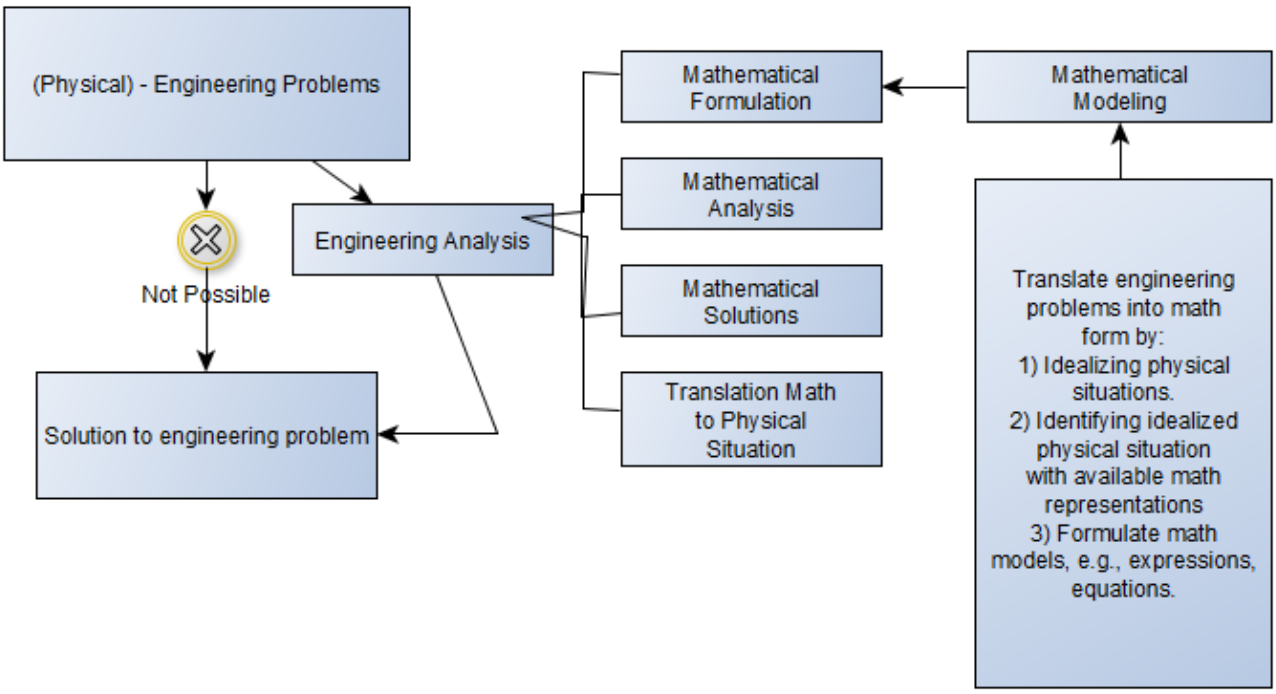

Figure 3: Model for the engineering analysis by mathematical modeling

As we seen in above figure the engineering analysis is core is mathematics [2.3], math plays a key principal role as a servant to engineering design and engineering practices. Mathematical modeling is a practice involving the translation of engineering items to mathematical forms.

3.4 Stages of engineering analysis for design

There are four stages in it, the first stage is indenting the real core physical problem and gathering the more specification about the problem. In second stage idealization of actual physical problem mathematic demission analysis. In later stage, mathematic modeling and analysis are done. At the end and in the last stage the results will be applied. Engineering analysis gathers the information that can be further used for detailed design.

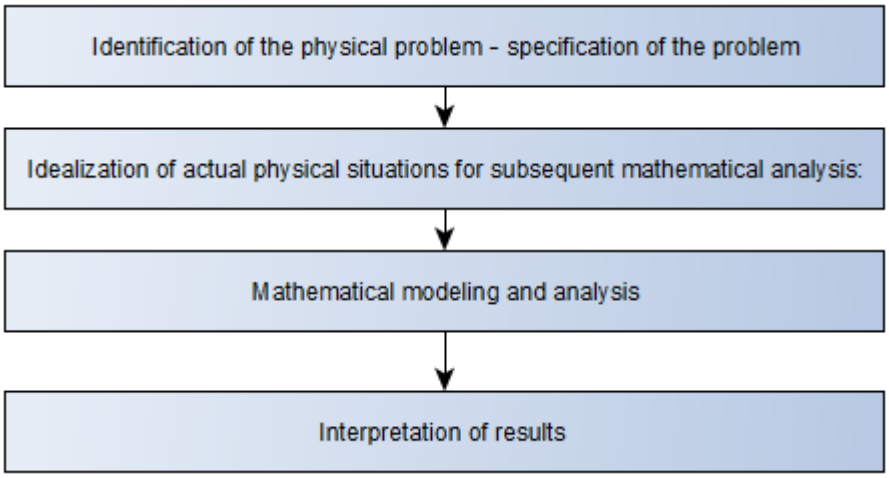

Figure 4: Stages of engineering analysis

4. Lean development and software architecture and test architecture design approach

Lean term grows from decades an ago from manufacturing to lean software development. Lean mean elimination of the waste in the Japanese language it called as a "Muda". Lear core principle says whatever we do it need to bring the value and customer willing to pay for that action.

Lean philosophy derived from the Toyota production system in 1990 in Japan from manufacturing industry. Lean work on 7 core principles 1) Transport 2) Inventory 3) Motion 4) Waiting 5) Overproduction 6) Over processing 7) Defects. The lean philosophy also focuses on the lean leadership who drive the lean team. Lean leadership address continues improvement principles 1) Challenge 2) Kaizen 3) Genchi Genbustsu..

Nowadays software development also adopted the lean development principles also called as lean software development [6]. The lean software development focuses on thinking all team members on its seven principles.

1. Eliminate waste
2. Increase Feedback
3. Delay commitment
4. Deliver fast
5. Build integrity in
6. Empower the team

Let`s identify the lean software waste to understand more

Table 1. Identify the lean software waste to understand more

ManufacturingWaste	Software Waste
Inventory	Partially developed software / code
Overproduction	Extra features
Extra processing	Software releasing
Motion	Task switching
Transportation	Handoffs
Waiting	Delays
Defects	Defects / Software bugs

4.1 Software test architecture

The Institute of Electrical and Electronics Engineers proposed IEEE-Std-1471-2000, put forward Practice for Architectural Description of Software- Intensive System, [IEE00] – to start a basic conceptual framework and vocabulary can be used later during the design of software architecture. It will help to provide detailed guidelines for representing a software architectural description, and also to encourage sound architectural design practices. Software architecture plays a key role in making software better for the end users and it drives the business value.

Software architecture begins from the requirement architecture

1. Understanding the software requirement, technical environment details, and constraints
2. Undemanding the problem domain / business domain
3. Identifying the possible objectives (e. g. Algorithms, technologies, best practices)
4. Identifying the and subsystem the solutions (e. g. reusable components)
5. Selection of appropriate solution (for reuse or future implantation)
6. Assign solution for main and subsystems
7. Identify and perform a risk analysis
8. Document the architecture design and subsystem interconnection with user interfaces
9. Review stakeholder needs and fulfilling the business objective

Software architecture significantly contributes the making system design more systematic this will help to build the subsystem with it in an easy way..

Core advantages of having better software architecture

1. Software architecture enhances the software reliability
2. Increase the performance
3. Enable software evolution
4. Software maintenance cost will reduce
5. Bring value to the agile software development
6. Risk minimization
7. Efficient software development
8. Accessible knowledge and decision

4.2 Test automation architecture design approach

As we understood how much software design an architecture is essential in same way software test architecture is very important to test the developed software. A software can be tested in fast manual or automated way if we have the efficient test architecture. Software testing broadly classified as a Manual testing and Automated testing.

Manual software testing architecture: In practical clear software test environment / clone environment test architecture itself can be used for testing purpose.

Test automation architecture: Its method of automating the human testing effort to test the software and reduce the regression cycles time and cost. This also in involves design the test framework, coordinating the implementation of test tools, creating the test environment for the test automation process. In the big picture, test automation process needs to be run in parallel to it. Test automation needs to support the development in all of its development life stages. One side this test automation architecture supports the test coverage and one side enhances the maintain flexibility.

There are much different to test automation, widely used GUI and API driven. In GUI software UI is tested and behaviors are recorded in negative and positive testing. In API testing software is validated with the help of tools.

Unit testing: when software complexity grows it’s become more important to test different components. Unit test confirms that all sub-component of software working normally in different circumstances.

Test automation architecture support to test software as an OS independent, data drive, customizable reporting, easy to debugging, support the version control, run in distributed environment. Now a day’s number of tools available those come with own architecture environment.

4.3 Identifying the scope for the lean software test architecture design

The growth of importance of developing and delivering error-free software given the new dimension for the test automation, it's very important nowadays to have a proper test automation environment and architecture to make test process more efficient. The rapid growth of agile software development also pushed software testing new dimension with new cutting edge tools [4]. Continues integration and continues deployment tools helping the team to send their code to test environment in parallel. One side deploying code continues and another side testing the code with automation continues same time.

In complex software development and a number of a team working on the different environment where the number of developer team developing and testing team working in parallel to test the code in such time it is very important to keep things simple and lean. As we know already lean principles and lean software development, not it's important to think lean software test architecture. As we know the software architecture it's a system design t shows the major components and their relationship. Software architecture also directly linked different IT and business components.

4.3.1 Goals of software architecture

The basic goal of the software architecture is to recognize the right requirement's those are linked with the structure of the application. The software architecture also helps to identify and reduce the risk and bridge the gap between business and technical requirements.

Other goals

- Show us the clear structure of the system, but hide all implementation details.
- Give an overview of al use-cases and scenarios.
- Address the different requirements for the different stakeholders.
- Show the clear subcomponents and their relationship in the system.
- Bring all team members on the same goal and reduce the goal of ownership.
- Clearly showcase system internal and external components, its help to scale the architecture.

Limitation with software architecture

- Lack of tools sometimes tools not fit with each other
- No standardize of the design or represent architecture
- Lack of the standard analysis method to predicts that current architecture full fill all requirements
- Lack of awareness how to implement the architecture itself
- Lack of understanding the requirements from stack holder by the architecture
- Lack of understanding design, analysis process for all architecture itself

Importance of design expertise for the software architecture.

It is very important software architecture have a clear view of design as the full system. A person needs to be expert in software design with different approaches, architecture design must full the integrity of the system design. Architecture design needs to be flexible for the scaling of the system.

4.3.2 Scope lean software architecture design

With software architecture, it is important to have a software test architecture for the testing purpose [7]. Effective test architecture will bring the fast results and easy to maintain in future. With the growth of cloud technologies, it's important to re think now how we can adopt the lean principles in the lean software test architecture. Lean architecture helps to build and deliver clear, consistent, complete set of goal-oriented test architecture.

Lean architecture could help us to bring the

- Simplified concept of system design
- System designs with least number of layered decomposition
- Build the architecture design customer value focused
- Identify the architecture level waste and add value stream
- Improving architecture consistency and flow with other subsystems
- Change or Improve the architecture based on demand

- Improve the architecture with continuous improvements
- Support the different test tools and programming languages

Lean architecture business agility

- Moving software application architecture from one data center to another in term of the upgrade, maintenance and cost effective.
- Improving dynamic allocation of the servers and storage so it provides the platform to add and run other related and sub comments in the smooth way.
- Managing the complex computing scenarios through different dynamic allocation such as locally stored vs stored in cloud web.
- Easy to manage the remote servers and applications who adopted the lean test architecture

Lean test architecture design considerations

- Virtualization
- Storage Virtualization
- Network Virtualization
- Service Orchestration
- Tools and Technology Support

Lean architecture is able to bring the number of opportunities and advantages than another way of architecture design process. Lean also eliminate the waist in the architecture level design and process. The growth of technology also increases the complexity of the development environment in such situation it is very important we think about lean principle adoption in development and test architecture design process.

5. Scope lean software test architecture design

As we noticed above we have already data from lean architecture design optimization, now can use that data to build own system architecture design.

Fig 5: Steps for lean test automation architecture design

Table 1: Indemnification of the lean test automation architecture design components

Learning	Lean architecture design	Removing the waste
System components	Use lean canvas	Identifying un used system component
Automation Frameworks		Identifying us used framework and libraries
Testing tools		Identifying un used testing tools
Domain knowledge		Identifying best fit knowledge
Types of tests		Identifying non automated test cases

6. Conclusion and future research

The above study explains the all new possible approach for the investigating more adoption of lean canvas in software testing architecture design to design test architecture in more efficient way.

In order to do more research, it is needed to accomplish the following activities.

- Need to do an experiment to identify the lean test automation architecture design metrics;
- Need to define the test design architecture criteria, that evaluate design architecture;

- To carry out more appropriate investigation lean test automation architecture design;
- Need to study if there is any need of the design tool for the test automation architecture design;
- Need to develop the canvas design tool that collect the all test automation architecture design components;

The new possible approaches proposed in this article are focused on the possibilities of finding that how we can use lean canvas for the test automation architecture design. The authors aspiration is that new approach will generate more new ideas, and some of the new ideas will be extracted from current article. In test automation design architecture, it's an endless search how lean canvas can be adopted in the design process.

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The analysis of perception of human resources on social responsibility of the companies in Dâmbovița

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Abstract

The vast approaches of literature regarding the concept of social responsibility is the result of the fact that it represents an area that attracts many specialists, and the states have to follow the directives of EU on the respect and protection of the individual and environment. Social responsibility represents a prominent feature of the literature that addresses ethical issues in businesses and social performance.

The article has a part of the level of knowledge and an applicative part. In the second part a direct research is made, a survey to observe the attitude of human resources toward the responsible behaviour. The hypotheses were verified through the SPSS tests (correlation and comparison).

Keywords: ***human resources, social responsability.***

1. Social responsibility-theoretical approach

Social responsibility is a core component of the strategy and organizational culture. The reason more and more people and corporations choose to adhere to a responsible behaviour is that this concept is based on moral, rational and economic arguments. (Kleef V& Roome N, 2007).

The level of social responsibility is conditioned by factors such as financial conditions of the enterprise and the economic situation of the country. The literature of specialty presents the reasons why an organization respects the principles of social responsibility. Their way of describing varies: economic or moral (TangpongC & Pesek J, 2007).

To determine the way social responsibility exists at the level of organizations, some authors made attempts to show the change of the degree of awareness, strategy and actions.

Jackson and Nelson (2004) in their works offer a frame based on the principles of responsibility to master what they call "the new rules of the game". Principles: innovation in the interest of the beneficiaries, putting people on the first level, and the diversification of economic opportunity. (Utting P , 2005).

Education remains an important source of ideas regarding the transition to an integrated system, rather than the one of the economy of knowledge, and this fact represents warning, meaning that the role and significance of socially responsible management should be constantly updated. (Roome N& Wijen F, 2006).

The pyramid of the companies in this field starts with the economic responsibilities and continues with the legal, ethical ones and those of other nature. The ethical principles are increasingly important in this period due to the changing environment in which the enterprises operate and the ethical responsibilities which are much more likely. (Alessia et all, 2009).

The theories regarding social responsibility according to several authors:

1. Utilitarian theory,
2. Managerial theory,
3. Relational theory.

Garriga and Mele (2004) present the four types of theories. These are (Ismail M, 2009):

1. Instrumental theories,
2. Political theories,

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3. Integrating theories,
4. Ethical theories.

The role of social responsibility in developing the community represents any direct and indirect benefit received by the community as a result of the social commitment. The roles in development:

1. To share the negative consequences as a result of industrialization.
2. Tighter connections between corporations and community.

2. The perception of human resources regarding the social responsibility of the companies

2.1. Methodology

This paper is a field research, an inquiry that uses as a tool the questionnaire. The observed unity-human resources from 10 organizations in Dâmbovița County (with varied activity object and number of employees). The size of the sample-100 people. The sampling method is random. The questionnaire was filled by respondents, but with advice from the operator.

Objectives:

- Knowing the responsible behaviour of the companies in Dâmbovița County,
- Highlighting the attitude of the respondents towards the involvement in social actions,
- Identifying the effects felt by the companies after the promotion of responsible behaviour.

Hypotheses:

1. Human resources in percentage of over 50% have concerns regarding social responsibility.
2. The main positive effect felt by the companies after involving in social actions is to increase notoriety.
3. There are no differences of opinion depending on the sex regarding the importance of social responsibility.
4. The environment of the respondents doesn't correlate with the frequency of involvement in social action.

The questionnaire has a number of 11 questions, and 2 are those from the category of demographic information. The data got from the respondents were introduced in the SPSS program and interpreted. Among the scales used in this research lie: the nominal and the ordinal one.

2.2. Interpretation of results

1. Have you heard of the concept of social responsibility?

Table 1. The answers of the respondents

Answer	Frequency	Percentage
Yes	70	70
No	20	20
I don't know	10	10
Total	100	100

At the first question analysed 70% of the human resources answered that they had heard of social responsibility, 20 % that haven't heard and 10 % t don't know.

1. In your own opinion social responsibility is:

Table 2. Answers of respondents

Answer	Frequency	Percentage
A concern for the environment and society	50	50
Way of increasing	10	10

profit		
Way to promote	30	30
I don't know	10	10
I don't answer	-	-
Total	100	100

50% of the participants thought that this concept is a concern for the environment and society, 30 % saw it as a form of promotion of the company, 10 % as a way of increasing the profit and 10 % didn't know what to answer.

2. The company where you work demonstrates social responsibility?

Table 3. Answers of respondents

Answer	Frequency	Percentage
Yes	70	70
No	20	20
I don't know	10	10
Total	100	100

The majority of human resources said that the company is demonstrating social responsibility (70%), 20% answered that this does not work, and 10% did not know what to answer.

3. Are you involved in social actions?

Table 4. The answers of respondents

Answer	Frequency	Percentage
Yes	60	60
No	30	30
I don't know	10	10
Total	100	100

From the human resources: 60% answered that they are engaged in social actions, 30% said that are not involved and 10% didn't know.

4. Promoting a responsible behaviour by a company leads to?

Table 5. The answers of respondents

Answer	Frequency	Percentage
Increasing notoriety	50	50
Keeping actual clients and attracting others	20	20
Attracting the support of media	30	30
I don't answer	-	-
Total	100	100

The practicing of responsible behaviour by a company is seen by the respondents as having a positive effect on: increasing notoriety (50%), keeping the actual clients and attracting others (20%) and attracting the support of the media (30%).

5. How would you characterize the level of importance given by the company:

Table 6. The answers of the respondents

Answer	Very important	Important	So and so	Unimportant	Very unimportant
Economic	30	50	20		

responsibility					
Legal responsibility	70	20	10		
Social responsibility	60	30	10		

In the case of this question we used as method of scaling -the semantic differentiation. Are calculated the average and overall scores.

a. Average score for the criterion "Economic responsibility", P=(30*5+50*4+20*3)/100, P=4.1-the criterion is important in the opinion of the respondents.
b. Average score for the "Legal responsibility" criterion, P=(70*5+20*4+10*3)/100, P=4.6. The criterion is very important.
c. Average score for the criterion "Social responsibility", P=(60*5+30*4+10*3)/100, P=4.5. In the opinion of the respondents the company considers very important the social responsibility.

The score at the level of the entire criterion, P=(4.1+4.6+4.5)/3, P=4.4. From this result it appears that it is given importance to the economic, social and legal responsibility.

6. How often does the company involve itself in such social actions?

Table 7. The answers of respondents

Answer	Frequency	Percentage
Very often	60	60
Often	30	30
Rarely	10	10
I don't answer	-	-
Total	100	100

According to the respondents the company involves:

a. Very often-60%,
b. Often-30%,
c. Rarely-10%.

7. I get involved in social activities because?

Table 8. The answers of the respondents

Answer	Frequency	Percentage
Of free will	60	60
Under the impulse of management	30	30
To be a role model	10	10
I don't know		

The aim of involving in social actions:

- Own choice for 60%,
- Under the impulse of the manager 30%,
- To be a role model 10%.

8. Does your company give money to support social actions?

Table 9. The answers of respondents

Answer	Frequency	Percentage
Yes	70	70
No	20	20

I don’t know	10	10
Total	100	100

In a percentage of 70% the participants think that money is allocated by the company in order to support social actions.

9. What is your gender?

Table 10. The answers of respondents

Answer	Frequency	Percentage
Women	60	60
Men	40	40

The structure of respondents by gender shows the fact that 60% are women and 40% are men.

10. What is your environment?

Table11. The answers of respondents

Answer	Frequency	Percentage
Urban	55	55
Rural	45	45

From the respondents 55% are from urban areas and 45% from rural areas.

3. Checking the hypotheses

All the hypotheses were confirmed. Too observe the negation or the confirmation of the first two was used the frequency, and for the next two hypotheses -the tests from SPSS (correlation and comparison).

The first two hypotheses:

1. Human resources in a percentage of over 50% have concerns regarding social responsibility.
2. The main positive effect felt by the companies after involving in social actions is the increasing of notoriety of the company.

Their confirmation was presented in detail in the part of the interpretation of results.

3. There are no differences of opinion depending on gender regarding the importance of social responsibility.

Table 12. The importance of social responsibility depending on gender

		The gender of respondents		
		female	male	Total
Social responsibility	Very important	30	10	40
	Important	20	20	40
	Indifference	10	10	20
Total		60	40	100

In the case of females social responsibility is: very important for 30 people, important for 20 people, it doesn’t matter for 10 people. In the case of males: for 10 is very important, in the case of 20 it is important and for 19 it doesn’t matter.

Table 13. The Hi square test

	Values	df	The value of the degree of significance
Pearson	3,225[a]	3	,358
Rate of probability	3,131	3	,372
Linear association	2,426	1	,119
Valid cases	283		

The test shows that there is no connection between gender and the importance given to social responsibility. The hypotheses number three was checked.

4. The environment of the respondents doesn't correlate with the frequency of involvement in social action.

Table 14. Correlation between variables

		The environment of origin
Frequency of involvement in social actions	Pearson	,055
	Sig. (2-tailed)	,355
	N	283
*. Correlation is significant at the 0.05 level (2-tailed).		
**. Correlation is significant at the 0.01 level (2-tailed).		

The coefficient of Pearson proves that there is no connection between the variables. The last hypothesis was checked.

Conclusions

The theoretical and practical research shows that the social responsibility represents not just the interest of the managers of the companies, but of all the human resources.

The theoretical approach showed that a responsible behaviour has to prove protection of environment and society.

The research made on the basis of the opinion survey showed that the individuals involved in social actions from their own initiative. The majority of the companies have joined to this concept to increase the notoriety, obviously and the financial results.

For the majority of respondents it is important for the company not to take into account exclusively the social responsibility, but they have to give importance to the economic and legal ones.

In conclusion, the companies are aware of the positive effects of responsible behaviour and seeks to comply.

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Importance of security and socialization in europeans life

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Abstract

The purpose of this research is to examine the importance of safety and socialization in the lives of individuals. The influence of agents of socialization (school, family, friends) are manifested as differences in preferences, feelings and thoughts of people. The article is structured in two parts. The first part presents the knowledge in the field, but in the context of Maslow's hierarchy of needs. In the second part is carried out an research among Europeans about some aspect of their lives: how they spend their free time, the feeling of attachment to the community, a sense of security and availability to communicate personal matters to their group of friends. The research method was investigating the secondary sources (database obtained from the survey from a site specializing in the analysis of living conditions of Europeans - European Social Survey). After the reception and processing of results in Excel and SPSS we obtained a general conclusion that people need to socialize, to be part of a group and feel safe.

Keywords: *needs, socializing, security*

1. Theoretical Approach

Safety and socialization are two basic needs of individuals. They are part of Maslow's pyramid of needs. Besides the two there's: physiological needs (food, clothing), esteem needs (to be appreciated by others, merits to be recognized) and self-improvement needs (desire to move forward). Once the physiological needs are met, they are no longer controlling thoughts and behaviors, and in doing so the security needs become active. Adults have a low awareness of their security needs except in emergency situations or periods of disorganization in the social structure and children in most of the cases shows signs of insecurity[1].

Culture affects individuals physically, cognitively and socio-emotionally, it causes behavioral development. People regardless of culture spend time with their peers and influence each other [2]. Research area of socialization emerged in recent decades. Specialists have made many studies about the relationship between personal behavior and antisocial behavior[3]

There are two types of socialization: primary and secondary socialization. Primary socialization arises during childhood and an important role is that of the family or other persons who have responsibility of caring for the child. Secondary socialization is a childhood period in which the child begins to interact with other social media than the family.

There is a link between attachment and socializing. Attachment mechanisms are relevant, and of these manifestations, mainly the self is one of the socialization process and ultimately leads to the formation of the ego and leads to the foundation of consciousness[4]. Agents of socialization can be seen in Figure 1.

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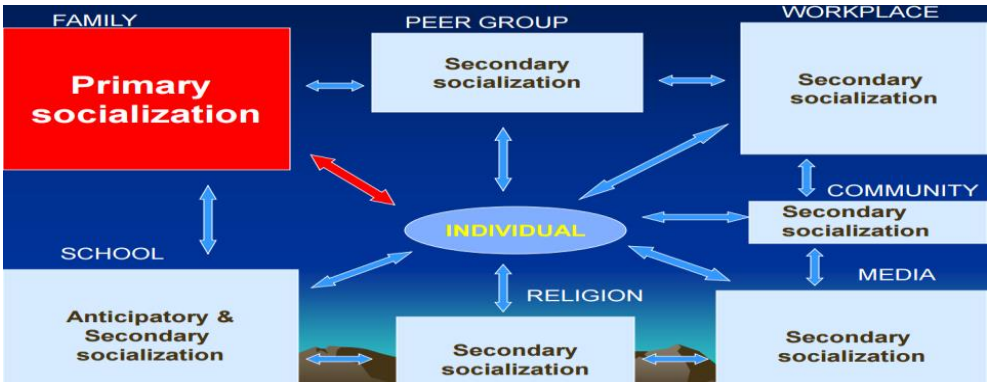

Figure 1. AGENTS OF SOCIALIZATION
Source: [5]

From the figure above we see that some of the socialization actors are: family, media, religion, school, close group of friends. Primary socialization is done at household level and secondary socialization outside the family.

Many specialists were interested in the study of socialization, and in this sense of social learning a theory appeared. This is based on observational aspects. Children imitate adults and so they learn something new. Gender roles guide the way we process the information, including information about gender. A theory that is considered important in this respect is based upon gender identity theory formulated by Bandura [6]

2. Study on Europeans perception on safety and socializing

This is an indirect research, it is based on investigation of the secondary sources. They were taken and compiled from the survey conducted by the European Social Survey in 2014. Romania was not part of the research. From the questionnaire we have selected the most important questions about socializing and safety. Research objectives:

O1: Knowing the extent to which respondents participate in social activities,

O2: Identifying the trust level they have in their group of friends,

O3: Observing the sense of security among Europeans,

O4: Presenting the percentage of the respondents who were victims of robbery or attacks,

Research hypotheses:

H1: Discrimination by gender and nationality is closely tied to the sense of security in terms of their strolling the streets after dark.

H2: Educational level affects the number of people that respondents confide in their group of friends.

H3: Most Europeans have not been victims of robberies or attacks.

Research sample consists of 16 European countries. They can be seen in Table 1.

Table 1. Countries

Country	Frequency
Austria	1,795
Belgium	1,769
Switzerland	1,532
Czech Republic	2,148
Germany	3,045
Denmark	1,502
Estonia	2,051

Finland	2,087
France	1,917
Ireland	2,390
Netherlands	1,919
Norway	1,436
Poland	1,615
Sweden	1,791
Slovenia	1,224
Total	28,221

Research results
We analyze every question

Question 1:How often socially meet with friends, relatives or colleague?

Table 2. Absolute and relative frequency

	Frequency	% of all	% of valid
Never	386	1.4	1.4
Less than once a month	1,898	6.7	6.7
Once a month	2,777	9.8	9.9
Several times a month	6,117	21.7	21.7
Once a week	5,169	18.3	18.4
Several times a week	8,192	29.0	29.1
Every day	3,627	12.9	12.9
Refusal	6	0.0	-
Don't know	43	0.2	-
No answer	6	0.0	-
Total	28,221	100.0	100.

Source:http://www.europeansocialsurvey.org/

On the question about the frequency with which respondents meet with friends in order to socialize we see the following: 29% indicated that they meet several times a weekend, 18.3% once a weekend, 21.7% several times a month, and the lowest percentage of respondents stated that never-1.4%.

Question 2: How many people with whom you can discuss intimate and personal matters

Table 3. Absolute and relative frequency

	Frequency	% of all
None	1,110	3.9
1	3,797	13.5
2	5,495	19.5
3	6,813	24.1
4-6	7,928	28.1
7-9	1,645	5.8
10 or more	1,295	4.6
Refusal	16	0.1
Don't know	117	0.4
No answer	5	0.0
Total	28,221	100.0

Source: http://www.europeansocialsurvey.org/

Respondents answered this question as follows: 28% confesses to a maximum of 6 people, 24% confides to 3 persons, 19% confess to a number of 2 persons, 13.5% confides only one person.

Question 3: Take part in social activities compared to others of same age

Table 4. Absolute and relative frequency

	Frequency	% of all
Much less than most	2,841	10.1
Less than most	7,507	26.6
About the same	12,727	45.1
More than most	4,076	14.4
Much more than most	763	2.7
Refusal	9	0.0
Don't know	289	1.0
No answer	9	0.0
Total	28,221	100.0

Source:http://www.europeansocialsurvey.org/

45% of respondents said that they are participating in social activities as much as people of the same age, 26% claim that they participate less than people of the same age, and only 14.4% participate more in social activities than other people of the same age.

Question 4. Feeling of safety of walking alone in local area after dark

Table 5. Relative and absolute frequency

	Frequency	% of all
Very safe	8,646	30.6
Safe	14,374	50.9
Unsafe	4,167	14.8
Very unsafe	844	3.0
Refusal	5	0.0
Don't know	175	0.6
No answer	10	0.0
Total	28,221	100.0

Source: http://www.europeansocialsurvey.org/

When asked about the safety felt strolling at night the respondents answered as follows: 50% feel safe, very safe 30%, 14% unsure and 3% very insecure.

Question 5: Respondent or household member victim of burglary/assault last 5 years

Table 6. Relative and absolute frequency

	Frequency	% of all
Yes	5,077	18.0
No	23,097	81.8
Refusal	7	0.0
Don't know	37	0.1
No answer	3	0.0
Total	28,221	100.0

Source: http://www.europeansocialsurvey.org/

81.8% of Europeans said that they were not victims of attacks and robberies.

Question 6: Discrimination of respondent's group: nationality

Table 7. Relative and absolute frequency

	Frequency	% of all
Not marked	27,829	98.6
Marked	392	1.4
Total	28,221	100.0

Source: http://www.europeansocialsurvey.org/

A percentage of 98.6% of participants did not specify if they feel discriminated depending on their nationality.

Question 7: Discrimination of respondent's group: gender

Table 8. Relative and absolute frequency

	Frequency	% of all
Not marked	28,012	99.3
Marked	209	0.7
Total	28,221	100.0

As with the previous question a percentage of 99% of respondents were unwilling to state whether they were discriminated against after sex.

Hypothesis testing

First hypothesis: discrimination by nationality and gender influence the feeling of walking safely in the streets after dark. The following two tables we're testing the hypothesis due to application of the test of Pearson's association.

Table 9. The association of discrimination by nationality and the safety to walk the streets at night

Feeling of safety of walking alone in local area after dark		
Discrimination of respondent's group: nationality	Correlation	0.042 **
	Significance	0.0000
	Count	28031

The test is significant because Sig's value is below the maximum limit imposed by statistical threshold, that Sig is less than 0.01.În After testing we see that the two variables correlate directly.

Table 10. The association between discrimination by sex and the safety to walk the streets at night

Feeling of safety of walking alone in local area after dark		
Discrimination of respondent's group: nationality	Correlation	0.016 **
	Significance	0.0080
	Count	2803

The result of Pearson's association coefficient shows that between the two variables is a direct link. Thus, the growth of one draws the other one's growth, being in a directly proportional relationship.

Table 11. The association between the level of education and the number of people to whom they can confide.

How many people with whom you can discuss intimate and personal matters		
Highest level of education	Correlation	0.114 **
	Significance	0.0000
	Count	27996

The signification level shows that the test is relevant. According to the association coefficient result the two variables directly correlate and are of directly proportional sizes. When a variable is changed in a certain sense, there is also changing other variables.

Conclusion

Abraham Maslow's theory of needs remains valid to this day (both in society and in the economic environment, specifically in the workplace). Any attempt to hinder its implementation will affect organizational culture and human resources (employee performance). Socialization can be operationalized in three distinct ways, as forms of transmission from parents to children being dependent upon personality and resources (self-esteem, age, status) and dependent on family life (cleaning, splitting).All stated objectives were achieved in the research methodology. All assumptions are verified: the first two in SPSS and last through research participant responses. The first two hypotheses were tested using Pearson's coefficient. The first hypothesis was verified that discrimination based on gender and nationality is related to feeling safe when respondent walk alone on the street after dark. Hypothesis number two checks because there is a link between the level of education of respondents and the number of persons to whom they confess. Over 80% of Europeans said that they were not victims of robberies and attacks (last hypothesis is verified by frequency).

In conclusion, the research carried emphasizes the fact that socialization and the sense of security occupies an important place in the lives of Europeans.

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The use of Markov chains in forecasting wind speed: Matlab source code and applied case study

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Abstract

The ability to predict the wind speed has an important role for renewable energy industry which relies on wind speed forecasts in order to calculate the power a wind farm can produce in an area. There are several well-known methods to predict wind speed, but in this paper we focus on short-term wind forecasting using Markov chains.

Often gaps can be found in the time series of the wind speed measurements and repeating the measurements is usually not a valid option. In this study it is shown that using Markov chains these gaps from the time series can be filled (they can be generated in an efficient way), but only when the missing data is for a short period of time. Also, the developed Matlab programms that are used in the case study, are included in the paper beeing presented and commented by the authors.

In the case study data from a wind farm in Italy is used. The available data are as average wind speed at an interval of 10 minutes in the time period 11/23/2005 - 4/27/2006.

Keywords: *Markov chain, wind speed, Matlab, Chapman-Kolmogorov, forecast*

1. Introduction and literature review

The market of wind energy is under development in the last years and many wind turbines installations are to be constructed in the following period, beeing considered a driver of the economy. This rapid development of the wind energy area is also due to scientifical reseach studies. Among the challenges in the domain are the understanding of the wind speed and applying the gained knowledge in the industry. Knowing the wind behavior in certain wind farms is extremely important for today's power systems, especially in the programming and operating means, wind power becoming an important part of future energy sources.

Futher there will be presented some of the existing models that were studied in modeling of wind speed and a case study on one of these models will be done.

Wind, solar, and biomass are three emerging renewable sources of energy, renewable energy replaceing conventional fuels. One of the benefits of this type of energy is the reduction of the production of CO_2 in the atmosphere. It can be said that global warming is also among the reasons for searching of alternative sources of energy production due to the fact that conventional sources are rich in CO_2 production.

This type of renewable energy can be achieved by installing wind turbines in the areas where the wind is suitable. For this reason, forecasting and analysis of wind speed can lead to the decision whether a wind turbine for a home (micro generation) is suitable or not, or whether to invest or not into so called wind farms which can fill the need of energy.

The problem of forecasting wind speed is quite known and has been dealt a lot in the literature. Among the models used in forecasting of wind speed are: Weibull and Rayleigh distribution (Aksoy 2005; Odo 2012; Ahmad 2009; van Donk 2005; Philippopoulos 2009; Ahmeda 2012), the AR (1) and AR (2) models (Aksoy 2005), the ARMA models (Philippopoulos 2009), Markov chains (Brokish 2009, Song 2011, Chen 2009, Aksoy 2005), wavelet transformation (Aksoy 2005), the Mycielski algorithm (Hocaoğlu 2009; Fidan 2012) and Weibull distribution (Akiner 2008; Ruigang 2011; Zuwei 2008; Isaic-Maniu 1983).

In this paper we propose a short-term simulation of wind speed using Markov chains, namely transition matrices. In the case study it will be noticed that this technique is useful to generate data which is very close to the actual values, which makes us think that Markov chains can be used to fill gaps in the data series, when these

gaps are on a short-term. Often, wind speed data sets from wind farms have gaps in measurements due to various reasons.

2. Wind speed forecasts using Markov chains (transition matrices)

Next, we present some theoretical concepts that are used in the case study, namely the Markov chains and the Chapman-Kolmogorov equations. The method of use of Markov chains in order to estimate wind speed will be presented and also, a possible procedure of simulation of the wind speed will be described.

2.1. Markov chains

Definition 2.1. Let $\{X_n, n = 0,1,2,\cdots,\}$ be a stochastic process that takes a finite number of possible values.

If the set of possible values is not otherwise stated, it will be indicated by a number of non-negative integer values $\{0,1,2,\cdots\}$. If $X_n = i$, this process is in state i at the time n. We assume that every time the process is in state i , then it is a fixed probability P_{ij} that its next value to be in state j.

Note 2.1.i. Thus we assume that:

$$P\{X_{n+1} = j | X_n = i, X_{n-1} = i_{n-1}, \cdots, X_1 = i_1, X_0 = i_0\} = P_{ij} \quad (1)$$

for all states i_0, i_1, ⋯, i_{n-1}, i, j and all $n \geq 0$. Such a stochastic process is known as a Markov chain.

Note 2.1.ii. Equation 1 can be interpreted to say that a Markov chain distribution in the future conditional status X_{n+1}, being given all the states in the past X_0, X_1,⋯, X_{n-1} and the present state X_n is independent of past states and depends only on the today's condition.

The value of P_{ij} is the probability that a process will be in state i at the next transition will be in state j. Since probabilities are non-negative and because the process must make a transition into a state we have

$$P_{ij} \geq 0, \;\; i,j \;\geq 0; \quad \sum_{j=0}^{\infty} P_{ij} = 1\,, \quad i = 0,1,\cdots$$

P indicates the one-step transition matrix, or otherwise the matrix of order 1 of the Markov chain, of P_{ij} probabilities, thus

$$\mathbf{P} = \begin{Vmatrix} P_{00} & P_{01} & P_{02} & \cdots \\ P_{10} & P_{11} & P_{12} & \cdots \\ \vdots & \vdots & \vdots & \vdots \\ P_{i0} & P_{i1} & P_{i2} & \cdots \\ \vdots & \vdots & \vdots & \vdots \end{Vmatrix}$$

2.2. Chapman-Kolmogorov equations

We have already defined the probabilities P_{ij} of one-step transition. We now define the probabilities P_{ij}^n of n-step transition.

Definition 2.2. P_{ij}^n is the probability that a process in the state i, will be in state j after n additional transitions. Meaning

$$P_{ij}^n = P\{X_{n+k} = j | X_k = i\}, \;\; n \geq 0, i, j \geq 0$$

Naturally $P_{ij}^1 = P_{ij}$.

Note 2.2.i. The Chapman-Kolmogorov equations, are giving a method to calculate these n-steps transition probabilities. These equations are:

$$P_{ij}^{n+m} = \sum_{k=0}^{\infty} P_{ik}^n P_{kj}^m \;\; for\; all\; n, m \geq 0, all\; i, j \qquad (2)$$

and are more easily understood by observing that $P_{ik}^{n}P_{kj}^{m}$ is the probability that a process that is in its original state i will arrive in state j in $n+m$ transitions through a path that will lead him to state k to transition n. Therefore, gathering all the k intermediate states, the likelihood that the process is in state j after $n+m$ transitions will be obtained. Formally we have

$$P_{ij}^{n+m} = P\{X_{n+m} = j | X_0 = i\}$$

$$= \sum_{k=0}^{\infty} P\{X_{n+m} = j, X_n = k | X_0 = i\}$$

$$= \sum_{k=0}^{\infty} P\{X_{n+m} = j | X_n = k, X_0 = i\} P\{X_n = k | X_0 = i\}$$

$$= \sum_{k=0}^{\infty} P_{kj}^{m} P_{ik}^{n}$$

Note 2.2.ii. If we note $\mathbf{P}^{(n)}$ as being the n-steps transition matrix with the probabilities P_{ij}^{n}, then Equation 2 can be rewritten as:

$$\mathbf{P}^{(n+m)} = \mathbf{P}^{(n)} \cdot \mathbf{P}^{(m)}$$

Where the dot operator is multiplying matrices. Therefore, in particular, we will have:

$$\mathbf{P}^{(2)} = \mathbf{P}^{(1)} \cdot \mathbf{P}^{(1)} = \mathbf{P} \cdot \mathbf{P} = \mathbf{P^2}$$

and by induction

$$\mathbf{P}^{(n)} = \mathbf{P}^{(n-1+1)} = \mathbf{P^{n-1}} \cdot \mathbf{P} = \mathbf{P^n}$$

Thus, the n-steps transition matrix can be obtained by multiplying the **P** matrix with itself by n times. Several times in this paper we will refer to the n-step transition matrix as the n-order matrix (Ross 2010).

2.3. The use of Markov chains in modelling of the wind speed

The determination of important statistical models for wind speed time series at different time periods is a huge point of interest for the wind power industry, in particular for optimal control of the wind turbines. Also important topics are: establishing of a sending schedule or programming the wind energy, designing and evaluating wind energy and so on.

Time series data for wind speed can be obtained from different sources, such as weather forecasting stations or from wind turbines itself that are equipped with anemometers.

Time series data set of wind speed may be noted as $v_t, t = 0, 1, 2, \cdots, T$ where v_t is the wind speed (discreet) at the time t, t starting at 0 and ending in T. The total number of discrete values of the wind speed for a time series is $T+1$.

Wind speed measurements are continuous values, but to be able to fit into an application of Markov chains, v_t is discreet and can take a finite number of possible states.

Let us suppose that continuous wind speeds can be discretized in r states, $S_i, i = 0, 1, 2, \cdots, r$. For example, S_1 state can be assigned for values of wind speed between 0 and 1 m/s.

The method in which wind speeds are divided in discreet values of r states, is highly dependent on the target application and other factors such as changes in wind speed or specifications of the turbine. In the literature often is used to make this division the range of speeds v_{cut-in} and v_{rated}.

The reason for this range is as follows: a turbine generates zero power as long as wind speed is between 0 and the cut-in speed. When the wind speed is higher than the rated speed, then the turbine will generate a set power (relatively constant), unless the wind is too strong and the wind speed exceeds the cut-out speed, moment that is equivalent with the turbine shutdown in order to protect it from potential damage.

Based on the startup speed and the normal speed of the wind we could define the state S_1 as being wind speeds that range from 0 to v_{cut-in}, meaning $0 \leq v \leq v_{cut-in}$. S_r could be defined as a state comprising wind speed values greater or equal to v_{rated}. Thus S_2 and S_{r-1} could be defined based on different classification schemes of wind speed.

A simple way would be addressing speed range, Δv. Let $\Delta v = 1\, m/s$ be a range, then S_2 is the state containing the following values $v_{cut-in} \leq v \leq v_{cut-in} + 1$. The states from S_3 to S_{r-1} could be defined in the same manner. In this case, the number of possible states is given by the interval Δv, v_{cut-in} and v_{rated}.

For an application of Markov chains with wind speed time series data, the one step matrix P contains probabilities that wind speeds in the state S_i will be in state S_j at the next sampling time. The one step transition matrix (order 1) P can be represented as follows:

$$P = \begin{pmatrix} P_{11} & \cdots & P_{1r} \\ \vdots & \ddots & \vdots \\ P_{r1} & \cdots & P_{rr} \end{pmatrix}$$

each entry of the matrix is a probability and satisfies the condition listed earlier in the definition of Markov chains. It is interesting to see the two step matrix of probabilities, because knowledge of future wind speeds is very important for the wind industry. The two step matrix tells us that a process that is in state S_i will be in state S_j after two additional transitions. In practice, long-term wind forecast with high accuracy can be a very difficult task due to the stochastic nature of the wind.

According to the Chapman-Kolmogorov equations previously presented, the two step matrix P^2 can be easily calculated, multiplying the matrix P with itself. Similarly, the three step matrix P^3 can be easily calculated.

Being given a time series of the wind speed $v_t(t = 0, 1, 2, \cdots, T)$, estimating the transition matrix of a matrix of order 1 is a direct process. Generally, let n_{ij} be the number of speeds that are in state S_i during the time period t (meaning $v_t = S_i$) and in state S_j during the time period $t + 1$ (meaning $v_{t+1} = S_i$), for t between 0 and $T - 1$.

Note 2.3.i. Then the transition probabilities can be estimated as

$$p_{ij} = n_{ij} \,/ \sum_{j=1}^{r} n_{ij} \qquad (3)$$

it is known the fact that this equation (3) it is a maximum likelihood estimator that tends towards zero when the sample is very large.

Similarly, the transition matrix of 2nd order can be estimated using the same process described above, only this time n_{ij} is the number of speeds that are in state S_i in the time period t (meaning $v_t = S_i$) and are in state S_j in the time period $t + 2$ (meaning $v_{t+2} = S_i$), for t between 0 and $T - 2$. The process for estimating the transition matrix of the order n can be deduced.

2.4. Procedure to simulate wind forecast

A procedure to generate an average of a simulated hour of a wind speed time series is described below.

The first step is to calculate the one step transition matrix. This matrix is a Markov chain so the sum of the probabilities of a single line (of the matrix) is equal to 1. Thus, an initial state is set. The first state, of no wind, S_0 can be considered. Using a random uniform number, the following state of the wind speed can be determined. If S_0 is obtained, then first we check if the wind speed is 0. If the wind speed is not 0, then a random number from the interval of states S_0 is used in order to generate a value. If the highest state is found then a distribution of a gamma parameter is used to calculate the wind speed. For intermediate states, a value is generated of a uniform

random number, it is taken from the range that corresponds to the state and it is set as the value of wind speed in that hour (Aksoy 2005).

Note 2.4. A gamma distribution has been used to generate the value of the wind speed in the last state, because this distribution has fitted best for the data set in the study (Aksoy 2005). The explanation is that a distribution without a superior limit should be used in order to choose the values for the biggest state from the Markov chain, so wind speeds bigger than the observed ones can be generated. The main idea is to use the distribution that generates the biggest values for the last state (Aksoy 2005).

3. Matlab source code

In this section of the article the Matlab source code used in the case study is shown and commented. Each of the four programs is custom made by the authors.

3.1. matrix.m

```
%% Data gathering.
WindData =  xlsread('Wind data.xls','unfiltred', 'C2:C22185');
WindDataFuture =  xlsread('Wind data.xls','unfiltred', 'C22186:C22329');
% Removal of the NaN (Not a Number) data
WindData = WindData(isfinite(WindData(:, 1)), :);
WindDataFuture = WindDataFuture(isfinite(WindDataFuture(:, 1)), :);

% General properties
 disp(sprintf('The lowest recorded speed: %f',min(WindData)));
 disp(sprintf(' The highest recorded speed: %f',max(WindData)));
 disp(sprintf('Mean speed: %f',mean(WindData)));

%% The definition of the states.
% Observation! The last state is v > 13 m/s.
states = [0 1;1 2;2 3;3 4;4 5;5 6;6 7; 7 8;8 9;9 10;10 11; 11 12;12 13;13 27];

Markov1 = matrixMarkov(WindData, states, 1);
disp(Markov1);

Markov2calc = Markov1^2;
disp('The 2nd order transition matrix calculated with Chapman-Kolmogorov equations:');
disp(Markov2calc);

Markov2est = matrixMarkov(WindData, states, 2);
disp(Markov2est);

%% Generating data using the obtained Markov chain

% Setting of the last known value
last = WindData(length(WindData));
% The length of the string that we will compare to
l = length(WindDataFuture);

GeneratedWind = generateWind(Markov1, states, last, l);

% The graph
xAxis = 1:l;
plot(xAxis, GeneratedWind, 'b*-', xAxis, WindDataFuture, 'ro-');
legend('Generated wind,'Real values');
```

3.2. currentState.m

```
%% Calculates the state in which the given value is assigned
function [stateValue] = currentState(val, states)
%% We initiate with state 1
stateValue = 1;
n = length(states);

for k = 1:n
   if (val > states(k,1) && val <= states(k,2))
      stateValue = k;
   end
end
```

3.3. matrixMarkov.m

```
%% Calculation of the Markov transition matrix of desired order
% @param array data    The time series to analyze
% @param array states  The states for the Markov chain
% @param byte  ordinul The desired order
% @return array Prob  The Markov transition matrix
function [Prob] = matrixMarkov(data, states, ordin)
   stateslength = length(states);

   %% The initialization of the matrix
   Prob = zeros (stateslength, stateslength);

   n = length(data);

   for i=1:n-ordin
      cState = currentState(data(i), states);
      nState = currentState(data(i+ordin), states);
      Prob(cState, nState) = Prob(cState, nState) + 1;
   end

   for i=1:stateslength
      Prob(i,:) = Prob(i,:)/ sum(Prob(i,:));
   end

   disp(sprintf('The estimated matrix of transition of order %d is:',ordin));
end
```

genValueRange.m

```
%% Generates values in a given interval
% @param integer min The minimum value
% @param integer max The maximum value
% @retrun integer val The generated value
function [val] = genValueRange(min, max)
   nr=1;
   val=min+(max-min)*rand(1,1);
end
```

3.4. generateWind.m

```
%% Generating values depending on the matrix of probabilities
% @param array   prob The Markov transition matrix
% @param array   states The states of the Markov chain
% @param integer last   The values that calculates the state of the Markov chain
```

```
% @param integer num   The desired number of values
% @return Generated The generated values
function [Generated] = generateWind(prob, states, last, num)

   lState = currentState(last, states);
   disp(sprintf('State from which we leave: %d ',lState));
   for i=1:num
        %%  Generate a random number
        randomNum = rand(1);
        disp(sprintf('The random value is: %f ',randomNum));

        [c nState] = min(abs(prob(lState,:)-randomNum));

        disp(sprintf('The new state is: %d ',nState));

        Generated(i) = genValueRange(states(nState,1), states(nState,2));
        % Initialize the last state with the new one found
        lState = nState;
   end

   disp('The generated values are:');
end
```

4. Case study

In this study data from a wind farm in Italy is used. The available data are as average wind speed at an interval of 10 minutes in the time period 11/23/2005 - 4/27/2006.

The lowest recorded speed: 0 m/s.

The highest recorded speed 26.08 m/s.

The mean of speeds: 7.1505 m/s.

The states of the Markov chain are defined as:

- state 1: $v \in (0,1] m/s$;
- state 2: $v \in (1,2] m/s$;
- state 3: $v \in (2,3] m/s$;
- state 4: $v \in (3,4] m/s$;
- state 5: $v \in (4\ 5] m/s$;
- state 6: $v \in (5,6] m/s$;
- state 7: $v \in (6,7] m/s$;
- state 8: $v \in (7,8] m/s$;
- state 9: $v \in (8,9] m/s$;
- state 10: $v \in (9,10] m/s$;
- state 11: $v \in (10,11] m/s$;
- state 12: $v \in (11,12] m/s$;
- state 13: $v \in (12,13] m/s$;
- state 14: $v > 13\ m/s$;

In Table 1 the transition matrix of order 1 can be observed. The highest probabilities are on the diagonal of the matrix, meaning that the wind from a certain state is very likely to remain in the same state rather than to change its state. Also it can be observed that if the wind is in state 1, then the furthest it can reach is state 5, and also from state 14 the lowest it can get is state 9. It can be concluded that radical changes in the wind speed (from fast wind speed to low wind speed or from low wind speed to fast wind speed) do not occur in a time interval of 10 minutes.

The Chapman-Kolmogorov equations that calculate the transition matrix of superior order have proven to be of use. By comparing tabel 1 with tabel 2 it can be observed that the 2nd order transition matrix calculated with the Chapman-Kolmogorov equations has similar values with the 1st order transition matrix.. The largest difference between probabilities is 0.06 for the wind to remain in state 13.

Tabel 1. The 1st order estimated transition matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	*0.6815*	*0.2713*	*0.0405*	*0.0054*	*0.0013*	0	0	0	0	0	0	0	0	0
2	*0.1621*	*0.6032*	*0.2064*	*0.0199*	*0.0038*	*0.0038*	*0.0008*	0	0	0	0	0	0	0
3	*0.0113*	*0.1734*	*0.5776*	*0.1955*	*0.0284*	*0.0095*	*0.0032*	0.0013	0	0	0	0	0	0
4	*0.0026*	*0.0175*	*0.2038*	*0.5045*	*0.2283*	*0.0343*	*0.0058*	*0.0013*	*0.0019*	0	0	0	0	0
5	*0.0005*	*0.0066*	*0.0234*	*0.1813*	*0.5358*	*0.2158*	*0.0300*	*0.0030*	*0.0030*	0	*0.0005*	0	0	0
6	*0.0004*	*0.0013*	*0.0039*	*0.0246*	*0.1896*	*0.5450*	*0.1986*	*0.0289*	*0.0047*	*0.0017*	0.0013	0	0	0
7	0	*0.0004*	0	*0.0044*	*0.0265*	*0.2124*	*0.5074*	*0.1950*	*0.0453*	*0.0074*	*0.0009*	0	*0.0004*	0
8	0	0	0	*0.0010*	*0.0035*	*0.0297*	*0.2397*	*0.4726*	*0.2061*	*0.0366*	*0.0094*	*0.0015*	0	0
9	0	0	0	0	*0.0006*	*0.0044*	*0.0470*	*0.2456*	*0.4292*	*0.2091*	*0.0498*	*0.0116*	*0.0028*	0
10	0	0	0	0		*0.0006*	*0.0135*	*0.0488*	*0.2510*	*0.4307*	*0.2073*	*0.0347*	*0.0090*	*0.0045*
11	0	0	0	0	*0.0007*	*0.0007*	*0.0037*	*0.0111*	*0.0656*	*0.2520*	*0.4385*	*0.1850*	*0.0354*	*0.0074*
12	0	0	0	0	0	0	0	*0.0058*	*0.0087*	*0.0618*	*0.2599*	*0.4473*	*0.1749*	*0.0415*
13	0	0	0	0	0	0	*0.0014*	*0.0014*	*0.0014*	*0.0114*	*0.0653*	*0.2798*	*0.4403*	*0.1989*
14	0	0	0	0	0	0	0	0	*0.0005*	0	*0.0042*	*0.0244*	*0.0768*	*0.8940*

Tabel 2. The 2nd order transition matrix calculated with Chapman-Kolmogorov equations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0.5089	0.3556	0.1081	0.0200	0.0051	0.0019	*0.0004*	*0.0001*	0	0	0	0	0	0
2	0.2106	0.4440	0.2545	0.0640	0.0157	0.0080	*0.0025*	*0.0006*	*0.0001*	0	0	0	0	0
3	0.0429	0.2114	0.4103	0.2204	0.0788	0.0248	*0.0077*	*0.0026*	*0.0009*	*0.0001*	0	0	0	0
4	0.0083	0.0569	0.2297	0.3370	0.2501	0.0885	*0.0206*	*0.0048*	*0.0032*	*0.0006*	*0.0003*	0	0	0
5	0.0025	0.0152	0.0652	0.1988	0.3709	0.2462	*0.0761*	*0.0162*	*0.0063*	*0.0015*	*0.0010*	*0.0001*	0	0
6	0.0009	0.0040	0.0141	0.0618	0.2160	0.3819	*0.2220*	*0.0700*	*0.0207*	*0.0055*	*0.0024*	*0.0004*	*0.0002*	0
7	0.0002	0.0010	0.0024	0.0146	0.0696	0.2354	*0.3494*	*0.2087*	*0.0856*	*0.0241*	*0.0068*	*0.0014*	*0.0006*	*0.0001*
8	0	0.0002	0.0004	0.0034	0.0158	0.0828	*0.2512*	*0.3234*	*0.2067*	*0.0804*	*0.0270*	*0.0068*	*0.0016*	*0.0003*
9	0	0	0	0.0007	0.0035	0.0219	*0.1068*	*0.2416*	*0.2928*	*0.2024*	*0.0921*	*0.0278*	*0.0081*	*0.0023*
10	0	0	0	0.0001	0.0009	0.0062	*0.0370*	*0.1108*	*0.2404*	*0.2943*	*0.2028*	*0.0744*	*0.0223*	*0.0107*
11	0	0	0	0.0002	0.0010	0.0024	*0.0128*	*0.0403*	*0.1243*	*0.2450*	*0.2983*	*0.1834*	*0.0664*	*0.0257*
12	0	0	0	0	0.0002	0.0004	*0.0038*	*0.0136*	*0.0417*	*0.1238*	*0.2551*	*0.3004*	*0.1682*	*0.0927*
13	0	0	0	0	0.0001	0.0004	*0.0021*	*0.0048*	*0.0113*	*0.0440*	*0.1334*	*0.2657*	*0.2605*	*0.2775*
14	0	0	0	0	0	0	*0.0001*	*0.0004*	*0.0013*	*0.0036*	*0.0170*	*0.0550*	*0.1069*	*0.8156*

Tabel 3. The estimated 2nd order transition matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0.5628	0.3090	0.0958	0.0229	0.0081	0.0013	0	0	0	0	0	0	0	0
2	0.1904	0.4817	0.2508	0.0466	0.0145	0.0084	0.0046	0.0015	0.0015	0	0	0	0	0
3	0.0309	0.2208	0.4416	0.2145	0.0587	0.0215	0.0082	0.0013	0.0019	0.0006	0	0	0	0
4	0.0110	0.0375	0.2199	0.3849	0.2490	0.0712	0.0175	0.0039	0.0032		0.0013	0.0006	0	0
5	0.0025	0.0152	0.0569	0.1899	0.4058	0.2489	0.0543	0.0142	0.0071	0.0020	0.0020	0.0005	0.0005	0
6	0.0013	0.0022	0.0116	0.0478	0.2111	0.4326	0.2176	0.0526	0.0151	0.0052	0.0022	0	0.0004	0.0004
7	0.0004	0.0017	0.0026	0.0144	0.0540	0.2180	0.3808	0.2232	0.0757	0.0200	0.0061	0.0022	0.0009	0
8	0	0	0.0010	0.0064	0.0188	0.0583	0.2650	0.3465	0.2012	0.0712	0.0252	0.0049	0.0005	0.0010

9	0	0.0006	0	0	0.0066	0.0210	0.0846	0.2378	0.3258	0.2052	0.0885	0.0177	0.0088	0.0033
10	0	0	0	0.0006	0.0019	0.0051	0.0353	0.0950	0.2548	0.3267	0.1861	0.0668	0.0186	0.0090
11	0	0.0007	0	0.0007	0	0.0037	0.0111	0.0398	0.1032	0.2351	0.3287	0.1945	0.0590	0.0236
12	0	0	0	0	0	0.0010	0.0029	0.0126	0.0367	0.1053	0.2696	0.3237	0.1778	0.0705
13	0	0.0014	0	0	0	0	0	0.0014	0.0043	0.0469	0.1080	0.2813	0.3224	0.2344
14	0	0	0	0	0	0	0.0016	0.0016	0.0005	0.0053	0.0154	0.0445	0.0864	0.8447

By using the 1st order transition matrix, we made a wind speed forecast for 24h. We compared the forecast with the real data from that day, and a graphical comparison can be seen in figure 1.

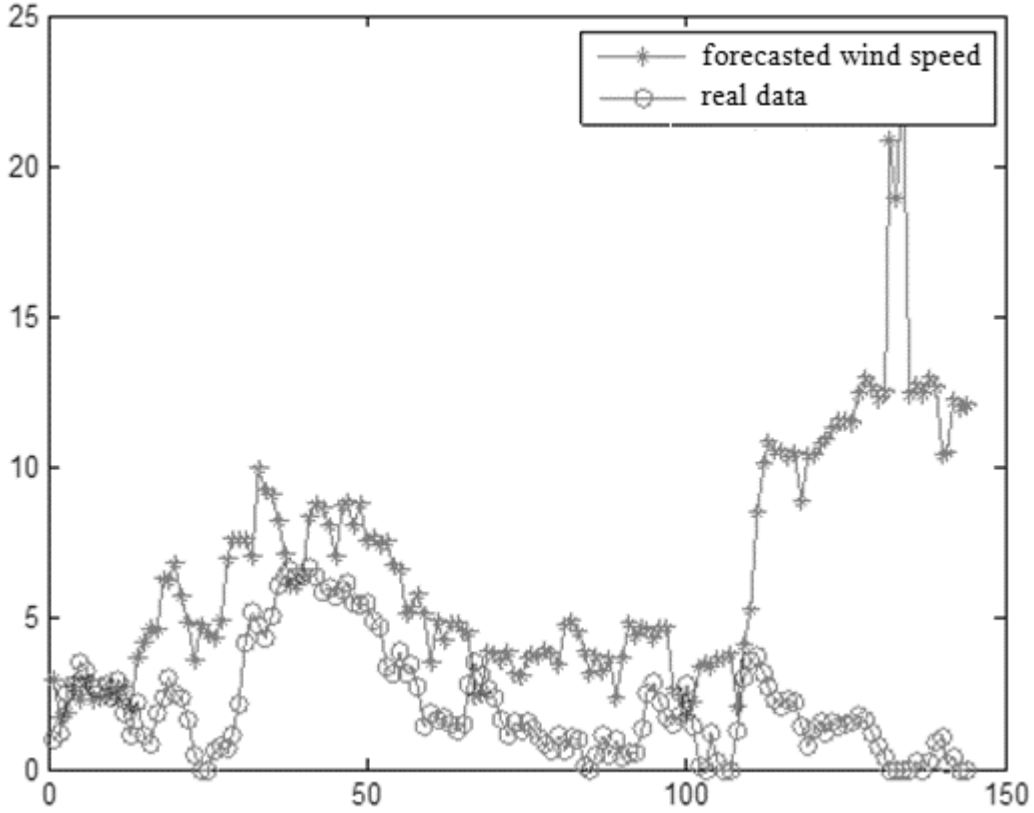

Figure 1. Graphical comparison between forecasted wind speed (represented with blue and stars) and real data (represented with red and circles)

Some metrics may be used to express more precisely the vicinity between the estimated and actual wind.

5. Conclusions

In this paper it is presented the importance of knowing the wind speed and the reasons why a good forecast is needed. The future investments in creating wind turbines in order to generate wind energy depend on proper wind analysis.

We have presented some of the models that have been used until the present days and we have conducted a case study using Markov chains. The result of the comparison between forecasted wind speed and real data for the selected wind farm indicates that this model is not the best, being very precisely on short term (the first hour) but after that it can take very different values.

It is important to underline the fact that this method, due to a good forecast on the short term, can be used to fill in gaps in the time series, when these gaps are not for a long period of time, because the Markov chains lose their precision. The filling of gaps is a subject of interest, because many times the re-measurement is not possible, or it is costly or unpractical.

Due to space limitation, the actual paper did not allow measurement with certain metrics of the vicinity of forecasted and actual values.

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Economic and social factors influence on unemployment in Romania at the local level

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Abstract

This study attempts to identify economic factors which influenced the number of unemployed people in each county of Romania, registered at National Employment Agency, in 2014. At the level of administrative units we considered a series of statistical indicators characterizing economic activity such as the number of active local units, number of employees, earnings obtained by employees as well as social indicators such as the resident population, the number of people who complete some form of education, social protection expenditure for unemployed people. The lack of jobs according to training and expectations of the population leads to migration of the population from one area to another which can lead to temporarily or permanent changes of residence. Thus, labor force migration can be a factor of influence of employment in the area of migration, but can generate unemployment in the area of origin.

Keywords: *unemployment, number of employees, regression models.*

JEL CODES: J64, J65, J69

1. Introduction

The labor market is subject to various economic and social factors, acting together, making it difficult to identify those that are important. Statistical indicators that can be used to characterize the labor market are those related to employment, earnings, labor force cost, productivity and unemployment. They are among the main topics of social and political debate in the European Union. One of the statistical indicators included in the Europe 2020 Strategy is the employment rate which should reach the value of 75% for the 20-64 years old people. This objective analysis leads to vacancy phenomenon and its causes belong. Thus, it is important to determine the factors that significantly influence unemployment and creating models that can be used later predictions of sizes for quantifying this phenomenon.

Many economists have tried to correlate over time indicators of unemployment with other economic indicators. Research conducted by Tony Lancaster and Stephen Nickell (1979) led to the idea that as unemployment benefits grow the chances that they engage fall. In 1997, Bertil Holmlund presented a study that demonstrated there is a positive relationship between the natural rate of unemployment and the "generosity" of the insurance system. Lucio Baccaro and Diego Rei (2005), using an econometric model, concluded that trade union density is strongly correlated with unemployment. Other economists took into account the age structure of the population and level of professional training. Thus, Paul Gregg (2001) conducted research on the causes what makes a person become unemployed and concluded that a person who has been unemployed around the age of 23 years, will have this experience by the age of 33 years. Structural changes in the economy of a country can generate imbalances in the labor market. Reduction of the activities in agriculture and industry together with an increased level of activities in trade and services result in a change of the workforce structure in order to fill the new jobs. Education institutions must change their educational offer to form people able to meet the new requirements of the labor market.

2. Considerations on unemployment in Romania, at the local level

In 2014, only 17 counties have registered an unemployment rate lower than the national unemployment rate. On the first 5 places were ranked Ilfov (1.5%), Timis (1.6%), Bucharest (2.0%), Cluj (2.8%) and Arad (2.8%). With an unemployment rate nearly double the national average, counties Mehedinti, Teleorman and Vaslui ranks last three places. Analyzing in terms of the number of registered unemployed, on the places with the lowest values are the following counties: Ilfov, Tulcea, Caras Severin, Timis and Covasna. Here, there are almost 5% of the total unemployed in Romania. Opposite, there are the counties Buzau, Teleorman, Galaţi, Bucharest and

Dolj, which comprises 20% of all unemployed people. Over 50% of the unemployed are registered in 14 counties (4 counties are in the South Muntenia Region and 4 of the North East Region).

Noting levels achieved by the proposed indicators (number of registered unemployed, number of active local units, number of employees, resident population, graduates, expenditures for unemployed social protection), we can highlight a few things about the situation within each region of Romania.

So, in the North - West Region, Cluj County stands with an unemployment rate of 2.8%. This rate ranks it on fourth place compared to the other counties. But, the large number of registered unemployed positions him to middle ranking. There is still on the 4th place, taking into account the size unemployed social protection expenditure. After the Bucharest Municipality, herein there are the most active local units. The 83 active local units with 250 employees and over, ranked this county on third place in terms of this indicator. These local units include 4.35% of total employees in Romania. With a sufficiently developed school system, in this county have graduated almost 5% of total national graduates.

In Central Region, Brasov County is positioned in the first half for all the analyzed indicators. Of the total resident population aged 15-74 years, over 40% is the employees which are working in the 18372 active local units in the county. In 2014 graduated 14811 persons, occupying only 12th place in the ranking.

In North East Region, Iasi County ranks third in terms of the resident population aged 15-74 years. The share of employees is only 26.3%. Here graduated 5.78% of total national graduates. Of these, 25% have finished high school or vocational schools. With an unemployment rate of 11.4%, Vaslui is last place in the country, in the active local units in the county working only 19% of the people aged 15-74 years.

With over 35% of the resident population aged 15-74 years employed in the more than 21000 active local units, Constanta County has one of the lowest rates of unemployment. Here, 20253 people have completed various levels of education, of which 43% have finished high school, vocational schools, post-secondary and foreman schools.

In counties in South Muntenia unemployment rate is over 5%. After the capital Bucharest, in Prahova County is the largest spending sums on social protection for the unemployed.

The large number of unemployed from South West Oltenia, makes all counties in the region have unemployment rates higher than the national level (value of 5.4%). Although it concentrates 2.58% of all employees in Romania, Dolj county experiencing a high rate of unemployment of 9.4%.

Western Region provides jobs for 10% of employees in Romania and almost half are employed in Timis county. Of the four counties, only Hunedoara County has an unemployment rate higher than the national value.

3. Identifying determinants of unemployment

In 2014 were 1.5575 billion lei spent on social protection for the unemployed. Approximately 50% of this amount were granted in the form of unemployment benefits persons registered with the National Agency for Employment (NAE). The other 50 percent includes amounts awarded to stimulate active measures to decrease the number of unemployed. To the previous year, there is an increase in the ratio of expenditure with vocational training and an increase the share of payments to stimulate employers hiring from disadvantaged unemployed category.

Correlating the number of unemployed with expenditures for unemployed social protection, Spearman coefficient (-0,66) showed a reverse link with medium intensity. Testing correlation coefficient resulted a value of 5.52, which is higher than $t_{40, 0.05}$=1,684, which validate the correlation coefficient. Thus, we can say that with increasing costs of social protection for the unemployed, the number of registered unemployed should decrease. This can be explained by the existence in legislation of the active measures to decrease unemployment, such as: the amounts granted to the employers who employed graduates of educational institutions, for indefinite duration; incentives for unemployed getting employed before expiring their unemployment period (the amounts paid to complete salary income); the amounts granted as credits to the small and middle enterprises to create new jobs; and s.o.

Analyzing the influence of social protection expenditure on the number of unemployed by linear regression method, the result leads to a different conclusion, as can be seen in Table 1.

Table 1. Regression of the unemployment on social protection expenditure

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXP	0.000117	2.92E-05	4.020032	0.0003
C	7031.712	1282.002	5.484948	0.0000
R-squared	0.287758	Mean dependent var		11389.00
Adjusted R-squared	0.269952	S.D. dependent var		5192.748
S.E. of regression	4436.833	Akaike info criterion		19.67972
Sum squared resid	7.87E+08	Schwarz criterion		19.76246
Log likelihood	-411.2741	Hannan-Quinn criter.		19.71005
F-statistic	16.16065	Durbin-Watson stat		2.136412
Prob(F-statistic)	0.000250			

Unlike the first step, regression coefficient of equation is positive. This, reveals that an increase in spending on social protection for the unemployed leads to an increase in the number of registered unemployed. The value of this coefficient is very low, it means that the influence is small, which is supported by the high value of the free term.

Therefore, they were looking for other influential factors, such as population aged 15-74 years residing in each county. On 1st July 2014, the resident population aged 15-74 years in Romania was 13876341 people, down 9.6% from the previous year. Nearly 10% are in Bucharest. The following counties are far from the capital. The second and third counties, Prahova and Iasi, have a population less than 250 000 persons compared with the resident population in the capital. On the last places are Covasna, Tulcea, Ialomita Salaj, those having a population under 200 000 people. Applying the method of linear regression between the number of unemployed and the resident population aged 15-74 years, it led to the idea of the existence of a direct link between the two variables, as shown in Table 2.

Table 2. Regression of the unemployment on resident population

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POP	0.014397	0.003715	3.875232	0.0004
C	6632.356	1408.925	4.707388	0.0000
R-squared	0.272958	Mean dependent var		11389.00
Adjusted R-squared	0.254782	S.D. dependent var		5192.748
S.E. of regression	4482.694	Akaike info criterion		19.70028
Sum squared resid	8.04E+08	Schwarz criterion		19.78303
Log likelihood	-411.7060	Hannan-Quinn criter.		19.73061
F-statistic	15.01742	Durbin-Watson stat		2.061011
Prob(F-statistic)	0.000386			

Another variable that can influence the number of unemployed it could be the number of active local units, which are in local territory. In 2014, there were 521 381 active local units nationwide, over 4.5% more than in 2013. Again, Bucharest Municipality is first place in the ranking of counties, concentrating over 20% of active local units. Number of active local units in the following 5 counties Cluj, Timis, Constanta, Brasov and Ilfov, is lower by 2000 units compared to the number of units operating in capital. Of the 1779 local units large having 250 or more employees, 403 were in Bucharest. Calculating Spearman coefficient for the 42 counties ($r = -0,6238$), we find that the number of active local units does not seem to influence significantly the unemployment.

But, shows that the two variables have contrary developments: increasing the number of local units, the number of unemployed decrease. Parametric correlation performed in all counties does not reflect an inverse relationship, although tests would indicate a valid model as a whole (Table 3).

Table 3. Regression of the unemployment on active local units

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ALU	0.104328	0.046711	2.233500	0.0312
C	10093.89	959.8592	10.51601	0.0000
R-squared	0.110884	Mean dependent var		11389.00
Adjusted R-squared	0.088656	S.D. dependent var		5192.748
S.E. of regression	4957.221	Akaike info criterion		19.90153
Sum squared resid	9.83E+08	Schwarz criterion		19.98427
Log likelihood	-415.9321	Hannan-Quinn criter.		19.93186
F-statistic	4.988524	Durbin-Watson stat		2.052915
Prob(F-statistic)	0.031175			

Often, unemployment occurs due to a lack on labor market of those persons qualified for the available jobs. Thus, the number of graduates may be an indicator that can influence the size of unemployment. In 2014, over 550 000 students have graduated from different levels of education. Of these, 76% have graduate pre-universitary education level. Ranking the counties by number of graduates, the first places are counties which are university centers: Bucharest, Iasi, Cluj and Timis. If ranked the counties according to the number of graduates from high school, vocational high school and foremen, Bucharest and Iasi County remain on the first two places. Applying the ranks method for the number of registered unemployed and the number of graduates, it was obtained the Spearman coefficient equal with -0.57 and t_{calc}=4,39 (t_{calc}>t_{tab}). Thus we can say that there is a reverse medium intensity link between the two variables. Applying linear regression method, the link is confirmed (Table 4), but these two variables have the same sense of evolution. This can happen when, after graduating, young people turn to the labor market and they can't find a job, for various reasons.

Table 4. Regression of the unemployment on number of graduates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GRAD	0.210459	0.060712	3.466515	0.0013
C	8595.823	1074.844	7.997276	0.0000
R-squared	0.231017	Mean dependent var		11389.00
Adjusted R-squared	0.211792	S.D. dependent var		5192.748
S.E. of regression	4610.178	Akaike info criterion		19.75637
Sum squared resid	8.50E+08	Schwarz criterion		19.83911
Log likelihood	-412.8837	Hannan-Quinn criter.		19.78670
F-statistic	12.01673	Durbin-Watson stat		2.040150
Prob(F-statistic)	0.001274			

4. Applying multiple regression method to estimate the number of unemployed

The phenomenon of unemployment is not under the influence of separate factors of economy and then, multiple regression method is a method commonly used. Considering that between the number of unemployed and the following external factors: resident population aged 15-74 years, expenditure for unemployed social protection, active local units and the number of graduates, there is a linear relationship, stated the following multifactor regression equation:

UNEMPL= 0,00018*EXP+0,04*POP - 0,49* ALU - 0,04* GRAD - 661,97 (1)

Table 5. Multiple regression model 1 estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ALU	-0.486816	0.106535	-4.569546	0.0001
POP	0.035886	0.014233	2.521356	0.0161
EXP	0.000182	6.27E-05	2.903008	0.0062
GRAD	-0.038495	0.228492	-0.168475	0.8671
C	-661.9740	2192.470	-0.301931	0.7644

R-squared	0.566397	Mean dependent var	11389.00
Adjusted R-squared	0.519521	S.D. dependent var	5192.748
S.E. of regression	3599.434	Akaike info criterion	19.32628
Sum squared resid	4.79E+08	Schwarz criterion	19.53315
Log likelihood	-400.8520	Hannan-Quinn criter.	19.40211
F-statistic	12.08290	Durbin-Watson stat	1.913065
Prob(F-statistic)	0.000002		

The coefficient of variable expenditure for unemployed social protection is very small, leading to the idea that this factor can be eliminated from the analysis. The growth of the resident population seems to lead to increase in unemployment, while increasing the number of active local units lead to a decrease the number of unemployed by labor absorption. The model explains only in proportion of 56,6% the variation of the number of unemployed in counties. The variable Durbin Watson (1,91) is within the range for which we accept the hypothesis of of residual variable uncorrelation (for n=42, k=4 d2=1,72). F test validate the model as a whole. The chosen model explains only 56% of the variation of endogenous variable, so we propose a new model to include a factor related to population migration.

Migration to a higher standard of living, which implies a better paid job, access to a higher level of education, a higher level of health services make the population of Romania to migrate or people from other countries to reside in various counties. Taking into account three factors analyzed above: active local units, resident population aged 15-74 years, expenditure for unemployed social protection and adding migration balance after residence it was obtained following equation:

UNEMPL=0,04*POP+0,000152*EXP - 0,43*ALU - 0,23*MIGR - 841,95 (2)

Table 6. Multiple regression model 2 estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ALU	-0.425311	0.121046	-3.513625	0.0012
POP	0.035893	0.009520	3.770094	0.0006
MIGR	-0.234121	0.235466	-0.994287	0.3265
EXP	0.000152	6.77E-05	2.252083	0.0303
C	-841.9506	1884.475	-0.446783	0.6576

R-squared	0.577357	Mean dependent var	11389.00
Adjusted R-squared	0.531666	S.D. dependent var	5192.748
S.E. of regression	3553.653	Akaike info criterion	19.30068
Sum squared resid	4.67E+08	Schwarz criterion	19.50755
Log likelihood	-400.3143	Hannan-Quinn criter.	19.37651
F-statistic	12.63610	Durbin-Watson stat	1.996350
Prob(F-statistic)	0.000001		

Though not all of the variables pass t-test ($t_{0,05,38}$=2,03), model bring a plus in explaining the variation of unemployment by the increasing coefficient of determination. Thus, the four exogenous variables explaine 57% of variation the number of unemployed persons. Also in this case, the Durbin Watson test statistics (1,99) is within the range for which we accept the hypothesis of residual variable uncorrelation.

The two models identifies some of the factors that influence the number of unemployed. Analysis can be directed to factors that are components of those identified, for example: active local units by industry, components of expenditure for unemployed social protection and so on.

5. Conclusions

Unemployment is a phenomenon that is important both at the macroeconomic level, but also at the individual level. The lack of jobs, lack of interest of creating specialists for areas with shortage of staff, of providing attractive salaries lead to imbalances in the labor market. In Romania, the legislation provides a series of active measures to encourage the reduction of unemployment phenomenon, such as: payments for training, payments to boost graduate employment, payments to unemployed people who find themselves job, payments to be granted in the form of loans of small and medium enterprises to create new jobs, etc. Analyzing the share of expenditures for training of unemployed, only Bucharest and Brasov County have a higher share (12%, respectively 8%, in 2014), the remaining counties paying less than 2%. The share of expenditures that lead to new jobs, the retraining of the unemployed are smaller than expenditure on unemployment benefits in all counties in Romania. Thus, in the future, it is necessary to create a favorable socio-economic climate in order that these active measures produce a more powerful effect.

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