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STRUCTURE

INTRODUCTION

The problem of risk, uncertainty and unpredictability of the future is significantly increasing nowadays due to the multifaceted processes associated with globalization. As a result, a rhythm of life accelerated formidably requiring social actors to enhance decision-making process. In all domains of lphaseife (e.g., consumption, education, labor, leisure, etc.) the spectrum of potential choices is vast. The more available options people face, the "less predictable are the decisions they will eventually take" [65].

In this context, the role of such social phenomenon as trust is especially relevant as trust "becomes the crucial strategy for dealing with an uncertain and uncontrollable future" [43]. When uncertainty exists, society provides many mechanisms for managing it, such as, contracts, insurance and hedging. But much of daily life is conducted relying on others without the use of such mechanisms.

Moreover, world resources are concentrated mainly in highly developed countries. It makes the problem of lack of resources much more acute for certain social groups. Due to the specific nature of resources distribution in the context of globalization, certain social groups are emerging to be cut off these resources and opportunities associated with them. Institutions tend to evaluate the reliability of social actors to determine the feasibility of providing them with their resources and minimize risks. Thus, they determine the level of trust that should be given to the actor in a particular situation (lending, employment, partnership, service, etc.). Certain social groups are excluded from the assessment process at the initial stages due to the lack of necessary data or characteristics on which assessment tools are based.

Therefore, there is a need to develop alternative instruments for trust measurement in the context of globalization to enable more people to be included in the resource allocation process and increase the effectiveness of risk management.

The concept of trust is regarded as one of the essential building blocks of social science theory. It has been studied across a variety of disciplines. Interest in trust has grown significantly since the early eighties, stimulated by on-going changes in society, characterized as late modernity and post-modernity. When it comes to trust, sociology is mainly concerned with the position and role of trust in social systems. Trust was developed by sociologists such as Simmel, Luman, Barber, Giddens, Fukuyama, Gambetta and others. Stomka and Mölling devoted their scientific interest to the analysis and structuring of different theories of trust.

Modern approaches to the interpretation of trust were proposed by Barbalett, Khodyakov, Meyerson, Wake and Kramer, Brynov, Harwood and others, considering trust as a process. Today, the most popular instruments for trust measurement are still those proposed by Rosenberg and Rotter. The contributions of Almnod and Verba, Berg, Glayser, Fehr and Soroka were no less significant. Much current trust research largely revolves around the functional properties of the concept. Of particular note is the concept of computational trust, proposed by Marsh and developed by Sabater and Sierra, Schillo, Abdul-Rahman and Hailes, Muller and others, allowing to elaborate trust modeling and trust systems.

A close analysis of the ways the term 'trust' is used in the literature revealed a disagreement among scholars about the definition, characteristics, and even the nature of trust. The multiplicity of meanings of trust creates a measure of conceptual confusion, because confidence, reliability, faith, and trust are often

used as synonyms. Moreover, there is no consensus among social scientists about the object of trust. Furthermore, empirical research has relied on rather general and unspecified ideas, confusing problems of trust with positive or negative attitudes, with alienation, with hopes and worries, or with confidence [43]. Thus, the **object** of the research is trust in the context of globalization

Despite the fact that many scientists spoke about the role of trust in postmodern society, relatively little attention was paid to the phenomenon of institutional trust, as well as the problem of its measurement. Since it has not been studied in detail, the **subject** of the research is alternative scoring as a modern tool for measuring institutional trust.

The **goal** is to prove the possibility of measuring institutional trust by applying alternative scoring technology. The **tasks** are:

1.   To identify the fundamental differences between the classical and modern approaches to the interpretation of trust; identify an approach that is relevant in the context of globalization.

2.   To define the structure of trust as a social process.

3.   To describe and substantiate institutional trust as a specific type of trust in the context of globalization.

4.   To structure existing trust measurement methods.

5.   To analyze the capabilities of such a method as scoring to measure trust.

6.   To unleash the potential of alternative scoring to measure trust through personality traits of the individual.

7.   To consider cultural characteristics that affect the reliability of a trust measurement tool using alternative scoring.

In-depth analysis of trust theories recognized in sociological community provided a substantial basis for the development of the institutional trust concept

and its' measurement specifics. In the research, general scientific and special methods were used, such as retrospective analysis (to study the evolution of understanding the features and structure of trust in sociological discourse); system analysis (to study the phenomenon of trust through the mechanisms of its influence on society throughout its functions and the process of its development, the features of measurement and estimation in various social contexts, as well as the study of the trustworthiness assessment through the study of the modern approaches to interpreting the concept of trust, as well as its main components); analysis and synthesis (to determine the characteristics of institutional trust as a specific type of trust within the framework of a modern society).

The theoretical basis of the study is the classic and modern sociological theories that describe trust as a variable or as a process, considering the mechanisms of its development and influence on the decision-making process in the situation of uncertainty of the future outcome.

The innovation of the research lies in the development of the concept of institutional trust as a specific type of trust, as well as proposition of its measurement tool, suitable in the context of globalization.

Historical overview of the trust interpretation and measurement, definition of institutional trust in line with its main characteristics and analysis of the modern trust measurement method such as scoring makes a theoretical significance of the research.

The results of the research are employed by the commercial organization, operating in the area of risk assessment and decision-management software development. Approach to institutional trust measurement, proposed in the research, allows to improve the process of trust measurement for institutions and organizations worldwide, providing more opportunities for the growth and prosperity in the context of globalization.

SECTION 1
TRUST ANALYSIS METHODOLOGY

While many scholars agree on the essential role trust plays as a concept in social theory, they do not necessarily agree on its meaning. All the approaches to identifying trust as a social construct proposed by different scientists can be grouped into classical and modern.

In this section the most influential sociological theories of trust are reviewed.

1.1. Classic context of trust connotation

Society has been on-going rapid changes in the XIX century within the late modernity. Those transformations became the reason sociological interest in trust has increasingly grown in the early eighties. However, there were earlier studies of trust as well. One of the first scholars who studied trust was Georg Simmel.

Many influential typologies of trust clearly stated that trust can be produced in various analytically distinct but practically complementary ways, for instance: process-based, characteristic-based and institutional-based trust (Zucker 1986), cognition-based and affect-based trust (McAllister 1995), or calculus-based, knowledge-based and identification-based trust (Lewicki and Bunker 1996). However, Simmel's work, published in 1950, already contained crucial thoughts regarding such bases of trust, including the recognition of affect besides reason, and system trust besides personal trust [51].

Simmel argued, that "the link between trust bases and a trustful state of expectation is much weaker than is commonly assumed" [51]. Simmel's idea of trust wasn't restricted to a simple, calculated prediction. In particular, Simmel

noted a kind of faith, so called 'further element' that was indispensable to explain the unique nature of trust.

According to Simmel, trust is "a mental process of two elements that further research should embrace: expectation and interpretation", thus functional consequences of trust such as risk-taking, co-operation, relationships or social capital should not be confounded with trust [52]. He also mentioned that any form of interpretation is supposed to be limited, and it does not inevitably enable expectation.

Nevertheless, the most intense attention to trust was paid following the early works of Niklas Luhmann, Bernard Barber and Anthony Giddens.

In 1979 Niklas Luhmann published an influential analysis of trust, relating the concept to the growing complexity, uncertainty, and risk characterizing contemporary society. For the first time, there was an assumption that trust is not a typical phenomenon of traditional society, but on the contrary, "it gains in importance with the development of modern social forms, becoming truly indispensable in the present phase of modernity" [65].

According to Luhmann, the function of trust is "the reduction of complexity" [43]. This complexity is observable in the temporal aspects of social life, especially in modern industrial society. It results in a real challenge of fitting unique sets of social timetables together and simultaneously coping with the unforeseen circumstances and timetables of others. It is obviously impossible to develop plans of action that consider all possible contingent futures.

Rational prediction is one of the strategies of the reduction of this growing complexity. Predictions made after collecting and processing information about known causal relationships help to identify certain futures that are highly probable and need serious consideration in present planning.

But Luhman claimed, that rational planning alone is not enough, because of the lack of time and resources to rationally control all the effects of oncoming futures. Thus, trust is a functional alternative to rational prediction for the reduction of complexity, since to trust means to live as if certain rationally possible futures will not occur [41].

After Luhman, Bernard Barber in 1983 reviewed the display of trust in various institutional and professional domains of modern society, and proposed a useful typology based on the kind of expectations that trust involves. He thought the category of "fiduciary trust" was particularly insightful [4].

In the nineties Anthony Giddens, first himself alone, and then together with Ulrich Beck and Scott Lash, approached trust as the characteristic feature of late modernity, elaborating on Luhmannian themes of complexity, uncertainty, and risk [65].

A number of other significant theories were developed between the Barber's and Giddens' studies. In 1984 Shmuel Eisenstadt and Louis Roniger discovered trust as a core ingredient in the "patron + client" relations, as they appear in various guises from antiquity to modernity. In 1988 Diego Gambetta brought together a number of authors looking at trust and distrust in various settings, and presented the analysis of trust in closed, exclusive communities, like the Mafia [65].

In 1990 James Coleman devoted two chapters of his comprehensive treatment of social theory to the issue of trust, providing the model for analyzing trust as a purely rational transaction, within the framework of rational-choice theory. This avenue was followed in a number of contributions in the nineties by Russell Hardin who extended the rational-choice framework to the analysis of distrust [65].

The next substantial step in the trust analysis was made in 1995 when Francis Fukuyama provided an in-depth exposition of trust as an essential part of viable economic systems. Fukuyama argued that economic prosperity and business success cannot be adequately explained by abundance of natural resources, brilliance of intellect, or development of the law system. It is not determined exclusively by the operations of rational self-interest in free market environments. Rather, business success and economic prosperity require a culture of trust and a capacity for what Fukuyama called "spontaneous sociability" [24].

Fukuyama claimed that societies tend to differ depending on the so called 'radius of trust' they have. According to Fukuyama, the radius of trust is "the circle of people among whom cooperation and mutual understanding exist" [24]. Thus, if society has a narrow radius of trust, it is a 'low-trust' society, where people prefer to trust only those to whom they are similar, and mainly in the private sector. On the contrary, in societies with a large radius of trust, citizens actively participate in civic activities and develop trust in the public sphere. Such societies are labeled 'high-trust' societies.

Also, similarly to Almond and Verba (1965), Fukuyama emphasizes that trust in people is necessary for the development of trust in institutions: if there is no interpersonal trust, institutional trust is impossible. However, the relationship between trust in people and trust in institutions can go in both directions, because institutional trust can also promote, or hinder, the development of interpersonal trust [37].

On the subject of the institutional trust we can further refer to the approach offered by Geraint Parry in 1976. Parry claimed that institutional trust is more likely to be rooted in the effective performance of institutions than in the overall level of societal trust and citizens' participation in civil society [26].

Following Fukuyama, Adam Seligman in 1997 presented an interpretation of trust as a specifically modern phenomenon linked with the division of labor, differentiation and pluralization of roles, and the consequent indeterminacy and negotiability of role expectations. He noted that the role of trust in social relations is already becoming more essential, because "performance based on ascribed status-roles reinforced by severe sanctions is less assured" [62].

As postmodern society has generated both new opportunities and new challenges to trust at the interpersonal, organizational and cultural levels, cross-disciplinary research has intensified in all these areas. Theoretical insights introduced by Georg Simmel and Niklas Luhmann that stimulated interest in trust in the first place, were accurately remastered by Guido Möllering in 2001.

For example, an additional element to Simmel's theory suggested by Guido Möllering was suspension, that actually enables the leap of trust. Suspension was defined as "a mechanism of bracketing the unknowable" or making an interpretative knowledge momentarily certain [51]. Möllering also provided a critical assessment of other contemporary concepts of trust that offer multiple definitions [52].

To summarize, the common features of classic trust theories were highlighted. Trust is considered to be a variable, that allows social interactions to proceed on a simple and confident basis where, in the absence of trust, the complexity posed by contingent futures would obstruct the process of making rational decision which action to take. Along with the expectation, interpretation and suspension, trust is defined by so called 'faith', resulting in the belief that the certain event will take place rather than the other rationally possible options.

On the macro level trust is considered to be a basis for co-operation, social relations and social capital. Although trust is essential in social relationships, it always involves an unavoidable element of risk and potential doubt. According

to David Lewis, "we would not have to accept this risk if there were some functional alternative to trust" [41].

However, there are changes in trust dynamics in the transition from traditional to postmodern society, and the search for new modalities of trust continues apace with the increase of freedom and role ambiguity.

1.2. Modern interpretations of trust

Although the latter group of scholars mainly studied factors that influence development and maintenance of trust, it is still considered to be a variable. On the contrary, some sociologists argued that trust was mistakenly characterized as a 'medium' or 'glue' for the social relations. They emphasized the dynamic foundation of trust and developed the idea of trust building.

In this context, Jack Barbalet in 2009 clarified the interrelation between the emotional and rational dimensions of trust: it involves a feeling of 'self-trust' and 'other-trust' [3]. The emotional content of trust "is emergent and nontransitive like any other social emotions (e.g., shame, guilt, loyalty)", thus when trust is betrayed, "the emotional pain of self-reproach is experienced side-by-side with strong emotions toward the betrayer" [3]. This affects individual's confidence in the ability to judge the trustworthiness of others and may inhibit the future capacity to trust even in case there are strong rational reasons to do so.

Account for both rational and affective dimensions of human behavior as well as the idea of temporality was reflected in the definition of trust, offered by Dmitry Khodyakov. He considered trust as a process, that allowed him to include temporal dimensions into the concept of trust. Khodyakov defined trust as "a process of constant imaginative anticipation of the reliability of the other party's actions based on (1) the reputation of the partner and the actor, (2) the evaluation

of current circumstances of action, (3) assumptions about the partner's actions, and (4) the belief in the honesty and morality of the other side" [37].

Because the composition of these dimensions of trust in society are constantly changing, it seemed more logical to Khodyakov to treat trust not as a variable with different levels of strength, but rather as a process of its creation, development, and maintenance [37]. However, using trust as a process is difficult without a comprehensive definition of trust that would emphasize its temporal characteristic.

One of the widely cited definitions of trust formulated by Gambetta states that trust is "a particular level of the subjective probability with which an agent assesses that another agent or a group of agents will perform a particular action, both before he can monitor such action (or independently of his capacity ever to be able to monitor it) and in a context in which it affects his own action" [25]. Although this definition can be used to classify people into high-trustors and low-trustors, it does not explain how trustworthy relationships are established and maintained.

At this point a concept of **Swift Trust,** introduced by Meyerson, Weick and Kramer, can be used. Meyerson, Weick and Kramer aimed to provide an explanation for the situations that differ from the classical conditions for trust. According to their theory, "trust is founded jointly upon the roles inhabited by participants in an interaction" and the participants perception of the social categories they share with one another as a result [30]. These categories may include specific social roles and statuses (e.g. doctor, lawyer, parent) as well as social characteristics in common (e.g. nationality, having kids, being a fan of the same sports club).

However, in both classical and Swift trust theories the possibility to learn from the experience of others or simply by being told by someone already trusted

was not taken into account. This entirely new source of trust was defined as "the embeddedness of individuals in social information networks that provide them with information about other individuals and circumstances with which they have no direct contact" [30]. The term 'embeddedness' was chosen in order to exhibit the idea of established and lasting relationships, that allow to judge about the trustworthiness of the directly connected individuals.

On the contrary, developing the Luhman's theory, Sviatoslav Braynov contended that society needs trust because "it increasingly finds itself operating at the edge between confidence in what is known from everyday experience, and contingency of new possibilities" [12]. However, he proposed a new concept of trust describing it as a bet on one of the contingent futures that may deliver benefits. According to Braynov, "once the bet is decided (i.e. trust is granted), the trustor suspends his or her disbelief" completely ignoring the possibility of a negative outcome [12].

Continuing to challenge the classical connotation of trust, William T. Harwood defined trust as "the rational belief by an individual, the truster, that another individual, the trustee, will keep a promise where the truster cares about what results from the promise and the truster has chosen to rely on the trustee keeping the promise" [30].

According to Harwood, rational belief arises from incomplete and inconsistent information. It can be best described as a vague knowledge supported by unverified facts somehow combined to provide with the most persistent description of reality that can be gathered from the available information.

For example, trustworthiness may be assessed based on a number of factors: the individual's past behavior in similar situations, correlation of the promised behavior with the general character of the individual (character), the

degree to which the individual may gain or lose by keeping their promise (circumstance) and the relationship that exists between the trustor and trustee [30]. Nevertheless, those factors will not provide complete or consistent information to make a decision.

Thus, Harwood claimed that "people often break promises when circumstances change in such a manner that they may pay a high penalty if they keep their promise" [30]. Another example of those factors influencing trust is that an individual of decent character may be expected to keep his or her promise even if the circumstances have changed. In some cases, close relationship between trustor and the trustee may be the reason to expect the trustee who even has a history of breaking promises with other people, to keep promises to that particular trustor.

A promise in this context is "a freely given commitment" [30]. Harwood emphasized that it can be kept, broken or retracted, but it can only be retracted with the consent of the promise: if it is kept only when convenient to the promiser, and broken when it is inconvenient for the promiser to keep it, then it is not a promise.

A promise is often a commitment to a future 'truth'. More precisely, it is a commitment to ensure that something will be true in the future. As to the components of promise, it implicitly means that the promiser both intends to keep the promise and that he or she has the required capabilities for it. It is assumed that a promiser is fully aware of his intentions, however, he or she may be unaware of the limits of his or her capabilities. Thus, a broken promise may be forgiven when it is broken for reason of failure of capability, but not when it is broken because of failure of intention.

Since promise is a commitment, it implies a cost. Harwood explained it using the example of thinking democracy is a good thing and being committed to

democracy: the first statement would be an observation one might make, but the second would mean that one is willing to pay some sort of costs to ensure living in a democracy [30]. At the same time, being committed to something means that one is willing to pay a forfeit if he or she do not meet that commitment.

Harwood's main idea is that if there is no promise, there is no trust but simply a belief that in certain circumstances someone will or will not act in a particular way. Although this belief may be reliable, supported by statistics or other sources, "this only means that there is predictability rather than trust" [30].

Modern approach positions trust as a social practice and process because it involves the responsibility of both parties and commitment to the relationship. According to scholars supporting this approach, to trust means "to anticipate that the other party will exhibit benevolence supported by moral competence in the form of loyalty, generosity, and honesty" [37].

At this point scientists moved their attention from the general construct of trust to its specific features especially focusing on the micro level characteristics in order to identify the way trust is developed and maintained. The concept of trust was widened by adding the idea of promise, required to distinguish trust from the prediction or belief.

Although classical approach is thoroughly considered, an alternative way of trust measurement, described in this research, is mainly based on the Harwood's theory of trust as a rational belief.

1.3. Integral properties of phenomenon of trust

According to the theoretical review presented in paragraphs 1.1. and 1.2. of this section, trust has several connotations in a social context. To summarize, sociologists tend to focus on two distinct views: the macro view of systemic role

of trust in society, and a micro view of individual social actors' interactions. For the purposes of the study the further development of the topic will be narrowed to the terms of trust on the micro level.

When it comes to defining the structure of trust on the micro level, it typically includes the following **elements**: one party (trustor) is willing to rely on the actions of another party (trustee), and the situation is directed to the future. Scholars acknowledge that the trustor can be considered dependent on the trustee because of the contingency of the future, thus trust appears to be one of the possible methods to resolve such a dependency, alternative to control [52]. Trust is specifically valuable if the trustee is much more powerful than the trustor, yet the trustor is under social obligation to support the trustee [2].

The trustor appears in an equally difficult situation if he or she tries to control trustee's conduct instead of predicting. It is very rarely that individuals have full control over others, thus an essential part of the interaction of this kind is that by deciding to trust the trustor abandons control over the actions of trustee. [49]. As a consequence, the trustor is uncertain about the outcome. This uncertainty involves the **risk** of failure or harm to the trustor. Thus, trust is considered to be "intimately related to risk" [65].

Generally, risk is referred to as the chances of harmful events or unpredictable consequences. Ulrich Beck in his work "Risk Society" defined risk as "a systematic way of dealing with hazards and insecurities induced and introduced by modernization itself" [7, p.21].

The probabilities of outcomes may be objectively specified and quantified or may reflect an individual's subjective beliefs. The process of estimating risk is usually basic to those in the industries where profit is determined by how often uncertain events occur (e.g. insurance or actuarial analysis). Commercial organizations also seek to assess risk as part of their business strategies.

However, the most common use of the term implies that the underlying probabilities of outcomes are unknown [14].

Individuals are assumed to be seeking ways of reducing their personal risk by choosing to trust when the potential benefit is higher than the cost or potential harm. This strategy of behavior is defined by the term 'risk averse'. As a result, individuals prefer to "invest" (or to be willing to lose in other words) into the risky matter a value equal or lower than the potential benefit. For example, this term refers to investors who, when faced with two investments with a similar expected return, prefer the lower-risk option. Risk averse can be contrasted with risk seeking. In case individual focuses solely on potential gains regardless of the risk, he or she is considered to be risk neutral [17].

The practical significance of trust lies in the social action it precedes. In terms of behavior, to trust means to act as if "the uncertain future actions of others were indeed certain in circumstances wherein the violation of these expectations results in negative consequences for those involved" [41]. Undertaking a risky action base on the expectation that all individuals involved in the action will act reliably is considered to be a **behavioral content** of trust.

The behavioral content of trust is associated both with its cognitive and emotional aspects. Actions involving trust allow to establish and strengthen the emotional sentiment of trust as long as the positive affect influences those who express trust behaviorally, just as negative affect arises among those who betray or act distrustfully toward each other [41].

Although according to **psychological approaches**, trust is treated as a personal attitude, it is now mainly considered to be the trait of interpersonal relations. David Lewis claimed that the primary function of trust is assumed to be sociological rather than psychological since individuals have no need to trust without social interaction. According to Lewis, trust is conceived belonging not

to separate individuals, but to groups and collectivities since it is "applicable to the relations among people rather than to their psychological states taken individually" [41]. Thus, from a sociological perspective trust is an objective social reality not reducible to individualistic psychological factors.

As trust is associated with social action, the relevant features of that action were further identified. One of the most important features is orientation toward the future: interacting with others, individuals formulate specific **expectations** about their actions. Expectations can be defined as "an individual's theory as to how another person will perform on some future occasion" [65].

Another essential feature of trust is **commitment** through action. In terms of Braynov this is "placing a bet", Harwood called the same feature "a promise". Sztompka distinguished three types of commitments [65]:

1. *Anticipatory trust* is based on the belief that the actions of others will be favorable to the trustor anyway.

2. *Responsive trust* is specifically addressed and motivated by the expected response of the others. It often involves the act of entrusting some valuable object to somebody else and expecting responsible care.

3. *"Trust to evoke trust"* is based on the belief that the other person will reciprocate with trust toward the trustor. This type is typical for the close, intimate relationships.

Since trust is an essential part of establishing relationship with others, granting trust is based on the estimate of their **trustworthiness.** This estimate is primary an assumption based on the information the trustor obtained about the trustee: the bigger is the amount of true facts about the trustee, the higher is the probability of trust resulting in being justified [65].

There are three bases on which the primary trustworthiness of individuals or social objects (institutions, organizations, regimes) is usually determined:

1. Reputation: the record of past deeds

2. Performance: actual deeds, present conduct, currently obtained results

3. Appearance and demeanor

Performance is considered to be a less reliable than reputation, because it "does not allow for a judgment as to whether trustworthy performance is typical" [65]. Appearance and demeanor is a specific base, it depends on a large number of external characteristics and can be misleading.

There is a distinction between **targets of trust** categorized by Sztompka. The targets of trust are objects, the trust was directed to. More specifically, the trust is directed to the "contingent actions" of others, that appear in different forms [65].

According to his classification, the most fundamental targets are individuals or individual actors. Following the Babrer's statement that among various kinds of trust there are those "existing not only between individual actors but also between individuals and systems", Sztompka distinguished trust in more abstract social objects as another target of trust [4]. Among those social objects there are social categories (e.g. gender, ethnicity, wealth), as well as roles and groups. Institutions and organizations are also identified as targets of trust. Barber claimed that trust exists even between and among systems.

Considering the variety of targets of trust, different **types of trust** were distinguished:

1. *Thick interpersonal trust* is trust between the family members and close friends.

This type of trust is the first developed in life and is basic for the further social interactions with others. The basis for thick interpersonal trust is familiarity and similarity with a trustee. It often becomes automatic, and thus not even perceived as trust. Thick interpersonal trust can also develop in the opposite

direction towards distrust. For instance, family members tend not to loan money to a relative who has previously borrowed cash and didn't pay it back.

2. *Thin interpersonal trust* is trust between people whose real intentions may not be clear.

This type is riskier than thick interpersonal trust: an uncertainty of intentions of others increases vulnerability and dependency on their actions. However, it is still possible to establish trustworthy relationships during the consistent interactions with the same actor, if there is a reliable information about the other party, and both parties act rationally.

3. *Impersonal trust* is trust in institutions.

This type is very different from trust between individuals, because of the impersonal nature of institutions. It is considered to be more problematic to trust some abstract concept with no human manifestations.

Some sociologists prefer to use the term 'system trust', and some researchers, however, question the very possibility of trust in institutions. For instance, trust for Levi exists only between people, while trustworthiness can be attached to both people and institutions. Regardless of the theoretical approach, trust in institutions is often more significant than interpersonal trust in a modern society, because "institutional trust has the potential to encourage voluntary deference to the decisions made by institutions and increase public compliance with existing rules and regulations" [37].

4. *Institutional trust towards social actors* is a newly defined type of trust.

This type refers to the trust granted by social structures or organizations towards individuals who interact with them in order to reciprocally meet their needs. In this case trust is usually confirmed by some kind of legal obligation that clearly states the commitment of both the institution and social actor and

clarifies the expectations of both parties, although it doesn't completely reduce the risk of the outcome being different from the agreed and expected one for the institution.

Institutional trust towards social actors can be described as the opposite to the impersonal trust. However, apart for the individuals, more abstract social actors, such as organizations and social groups, can be targets of the institutional trust. Another distinctive feature of this type of trust is that both trustor (institution) and trustee (social actor) gain benefit from the decision to trust, but for trustee this benefit is usually instant or received in a short period and for trustor it is postponed or extended in time.

At the same time, commitments of the parties are supposed to be mutual, but the equivalence of those of trustor and trustee may seem controversial. However, this isn't the case as long as agreement between trustor and trustee was reached with the consent of both concerned parties, since that would mean they are satisfied with the potential benefit they are getting for the defined cost.

The main challenge of the institutional trust towards social actor is for trustor to accurately assess the trustworthiness of the trustee, because in case of the poor estimation trustor gets to pay the cost and trustee may not even have to lose the gained benefit if he or she violates the obligation and betrays trust. However, the potential cost of the mistake can be calculated as well and added to the commitment of trustee.

Such calculation is still an approximate estimate of probability of the future outcome and not a confident knowledge. However, institutions have more resources to increase the effectiveness of this estimation, because they have access to a bigger amount of available information about trustee and power to process it in a generalized way by applying tools of the statistical analysis. This information includes primary bases for the trustworthiness estimation that are

objective and based on the facts: reputation and performance. Processing those facts on a large sample enables further distribution of the results to all social actors with the same characteristics.

To summarize, the structure of trust includes trustor, trustee and the situation that is directed to the future and associated with the risk. Trust precedes social action, that is characterized by specific expectation, commitment and estimation of the trustee's trustworthiness. In social science, trust is attributable to interactions between social actors, both individuals and groups. There are 4 main types of trust based on the classification of the targets of trust.

For the purposes of the study the institutional trust towards social actors was defined as fundamentally new and challenging type of trust that requires specific approach.

SECTION 2
METHODOLOGICAL ASPECTS OF TRUST MEASUREMENT

In sociology, a trust metric is commonly considered to be "a measurement of the degree to which one social actor (an individual or a group) trusts another social actor" [23]. Different approaches to trust measurement have specific features that make them suitable in certain cases and ineffective in others.

In this section requirements for the trust measurement tools are highlighted in order to compare methods already used to measure trust with the alternative method called "scoring".

2.1. History of trust measurement

As a systematic approach, trust measurement was established in the first half of the twentieth century when scientific interest towards studying this concept evidently increased, and scholars started to test different instruments. Those instruments can be divided into two categories:

1. *Direct measures* used to let respondents self-report the degree of trust they believe they have.

2. *Indirect measures* used to identify trusting expectations through lab experiments and observation.

The use of self-report measurement approximately started in the 1940s and thus predated behavioral measurement [5]. Behavioral approach was generally assumed when actions of social actors were measurable, allowing to develop trust models based on statistics [19]. Another similar tendency was to study social actors decision-making process to model the emergence of trust.

One of the first commonly used systematic trust measurement tools was constructed by Morris Rosenberg in 1956. He combined multiple items and

constructed a Guttman scale to study the relationship between "faith in people" and individuals' political ideologies [5]. Subsequently, Gabriel Almond and Sidney Verba used Rosenberg's questions in the research on the civic culture. Modified versions of these questions are used nowadays especially in longitudinal and comparative surveys [5].

Few years later, Julian Rotter developed a measurement instrument for interpersonal trust. Whereas social psychologists were mainly focused on the prisoner's dilemma, Rotter aimed to measure trust as a factor of personality that predicts cooperative behavior (Cook and Cooper 2003, 214). Besides 25 main questions, his instrument contained 15 filler questions. However, Rosenberg's questionnaire remained more popular mostly because it was shorter [5].

Trust measurement enables trust modelling. One of the first trust models was proposed by Stephen Marsh in 1994. In his work he proposed a formal mathematical approach integrating different trust concepts. However, the model only takes into account direct interaction. It differentiates three types of trust [47]:

• *Basic trust* is a general trusting disposition independently of who is the agent that is in front. It is calculated from all the experiences accumulated by the agent. Good experiences lead to a greater disposition to trust, and vice versa. The author uses the notation $T_t x$ to represent the trust disposition of agent x at time t.

• *General trust* is the trust that one agent has on another without taking into account any specific situation. It simply represents general trust on the other agent. It is noted as $Tx(y)t$ representing the general trust that agent x has on agent y at time t.

• *Situational trust* is the amount of trust that one agent has in another taking into account a specific situation. The utility of the situation, its importance

and the 'General trust' are the elements considered in order to calculate the 'Situational trust'.

These trust values are used to help an agent to decide if it is worth it or not to cooperate with another agent. Besides trust, the decision mechanism takes into account the importance of the action to be performed, the risk associated to the situation and the perceived competence of the target agent. Finally, the model also introduces the notion of "reciprocation" as a modifier of the trust values. The idea behind reciprocation is that if an agent x had helped an agent y in the past and y responded that time by defecting, the trust x has on y will be reduced (and the other way around) [31].

Since then many attempts have been made to represent trust mathematically and a number of computational trust models, mostly based on Gambetta's definition have emerged for risk management mechanism [25]. Computational trust can be defined as a paradigm that deals with quantifying trust, mitigating risks and selecting trustworthy agents [55]. The goal of a computational trust model is to simplify decision-making process. Trust modelling demonstrated that the optimum level of trust that individual should exhibit is equal to trustworthiness of the other party [19].

Within the computational trust paradigm, different trust systems were presented. A typical trust system operates with quantitative trust values by collecting them, aggregating into a single score and distributing these scores. A trust model is required to interpret trust values, determine their validity and identify appropriate ones [55].

Direct experiences and witness information are the "traditional" information sources used by computational trust models. In addition to that, a few models have recently started to use information associated to the sociological aspects of agents' behavior. The use of several information sources

can increase the reliability of the calculated trust and reputation values but at the same time increases the complexity of the model. Moreover, scenarios that allow agents to obtain diverse information demand smarter (and, therefore, more complex) agents [31].

1. *Direct experiences* is the most relevant and reliable information source for a trust/reputation model. There are two types of direct experiences that an agent can include as part of its knowledge: the experience based on the direct interaction with the partner and the experience based on the observed interaction of other members of the community. The second type is not so common.

2. *Witness information* or indirect information is the information that comes from other members of the community. That information can be based on their own direct experiences or it can be information that they gathered from others. If direct experience is the most reliable source of information for a trust/reputation model, witness information is usually the most abundant. However, it is far more complex for trust and reputation models to use it. The reason is the uncertainty that surrounds this kind of information. It is not strange that witnesses manipulate or hide pieces of information to their own benefit.

3. *Sociological information* is based on the social relations between agents and the role that these agents are playing in the society. This kind of information is only available in scenarios where there is a rich interaction between agents. Currently, only a few trust and reputation models use this knowledge applied to agent communities to calculate or improve the calculation of trust and reputation values. These models use techniques like social network analysis.

Social network analysis is the study of social relationships between individuals in a society that emerged as a set of methods for the analysis of social structures, methods that specifically allow an investigation of the relational

aspects of these structures. The use of these methods, therefore, depends on the availability of relational data (Scott, 2000). Although currently the number of models that take into account this kind of information is reduced, the increase of complexity in multi-agent systems will make it more and more important in the near future.

Additional source of information is:

4. *Prejudice* is the mechanism of assigning properties (like for instance a reputation) to an individual, based on signs that identify the individual as member of a given group. However, this mechanism is not very common in current trust and reputation models.

A good analysis of the use of signs in trust is performed by Bacharach and Gambetta in 2001. As most people today use the word, "prejudice" refers to a negative or hostile attitude toward another social group, usually racially defined. However, the negative connotations that prejudice has in human societies has to be revised when applied to agent communities. Differently from the signs used in human societies that range from skin color to sex, the set of signs used in computational trust and reputation models are usually out of ethical discussion.

The trust model proposed by Schillo et al. in 2000 was intended for scenarios where the result of an interaction between two agents (from the point of view of trust) is a boolean impression: good or bad; there are no degrees of satisfaction. More concretely, to make the experiments they propose a Prisoner's dilemma set of games with a partner selection phase. Each agent receives the results of the game it has played plus the information about the games played by a subset of all players (its neighbors). The model is based on probability theory.

Another trust model developed by Abdul-Rahman and Hailes is based on four degrees of belief to typify agent trustworthiness: vt (very trustworthy), t (trustworthy), u (untrustworthy) and vu (very untrustworthy). For each partner

and context, the agent maintains a tuple with the number of past experiences in each category. Then, from the point of view of direct interaction, the trust on a partner in a given context is equal to the degree that corresponds to the maximum value in the tuple.

For instance, if the associated tuple of a partner in a given context is (0, 0, 4, 3) the trust assigned to that partner will be t (trustworthy) that corresponds to the third position in the tuple. If there is more than one position in the tuple with the maximum value, the model gives an uncertainty trust degree according to a table of pattern situations that cover this cases. There are three possible uncertainty values (and the corresponding patterns) to cover the situations where there are mostly good and some bad, mostly bad and some good and equal amount of good and bad experiences.

This is the only model analyzed where before combining the information that comes from witnesses, the information is adjusted according to previous information coming from that witness and the consequent outcomes that validate that information. The problem of this approach is that it is not possible to differentiate those agents that are lying from those agents that are telling the truth but "think" different. Although there are scenarios where this is not important, it is considered to be a limitation.

Contrarily to other trust models where witness information is merged with direct information to obtain the trust on the specific subject, this model is intended to evaluate only the trust on the information given by witnesses. Direct experiences are used to compare the point of view of these witnesses with the direct perception of the agent and then be able to adjust the information coming from them accordingly.

ReGreT is a modular trust and reputation system oriented to complex small/midsize e-commerce environments where social relations among

individuals play an important role. This model was proposed by Sabater and Sierra in 2001 and it already takes into account three different sources of information: direct experiences, information from third party agents and social structures [59].

The system maintains three knowledge bases:

1. *The outcomes data base* (ODB) to store previous contracts and their result

2. *The information data base* (IDB), that is used as a container for the information received from other partners

3. *The sociograms data base* (SDB) to store the graphs (sociograms) that define the agent social view of the world. These data bases feed the different modules of the system.

The first direct trust module deals with direct experiences and how these experiences can contribute to the trust on third party agents. Together with the reputation model they are the basis to calculate trust. The reputation model is divided in three specialized types of reputation depending on the information source that is used to calculate them:

1. *Witness reputation* is considered if the reputation is calculated from the information coming from witnesses.

2. *Neighborhood reputation* is considered if the reputation is calculated using the information extracted from the social relations between partners

3. *System reputation* is considered if the reputation value is based on roles and general properties. The system incorporates a credibility module that allows the agent to measure the reliability of witnesses and their information. This module is extensively used in the calculation of witness reputation.

All these modules work together to offer a complete trust model based on direct knowledge and reputation. However, the modular approach in the design

of the system allows the agent to decide which parts it wants to use. For instance, the agent can decide not to use neighborhood reputation to calculate a reputation value or rely only on direct trust to calculate the trust on an agent without using the reputation module.

Another advantage of this modular approach is the adaptability that the system has to different degrees of knowledge. The system is operative even when the agent is a newcomer and it has an important lack of information. As long as the agent increases its knowledge about the other members of the community and its knowledge on the social relations between them, the system starts using other modules to improve the accuracy of the trust and reputation values. This allows the system to be used in a wide range of scenarios, from the most simple to the most complex.

In the ReGreT system, each trust and reputation value has an associated reliability measure as well. This measure tells the agent how confident the system is on that value according to how it has been calculated. Thanks to this measure, the agent can decide, for example, if it is sensible or not to use the trust and reputation values as part of the decision-making mechanism [59].

The last element in the ReGreT system is the ontological structure. The authors consider that trust and reputation are not single and abstract concepts but rather multi-facet concepts. The ontological structure provides the necessary information to combine reputation and trust values linked to simple aspects in order to calculate values associated to more complex attributes. For example, the reputation of being a good flying company summarizes the reputation of having good planes, the reputation of never losing luggage and the reputation of serving good food. In turn, the reputation of having good planes is a summary of the reputation of having a good maintenance service and the reputation of frequently renewing the fleet. Each individual can have a different ontological structure to

combine trust and reputation values and a different way to weigh the importance of these values when they are combined.

Paul Bauer stated in his work "Measuring trust" that behavioral scholars, on the other hand, have gone a long way to construct lab experiments that allow for capturing behavior that is caused by trust and not by alternative motivations [5]. Although experimental research was viewed critically, in 1995 Joyce Berg et al. designed an investment game that later came to be known as the "classical trust game". The idea of the experiment was at controlling for alternative explanations of behavior such as reputation effects, contractual precommitments, and punishment threats. Currently the classic trust game is widely used, sometimes with the original rules being partially modified. However, this measurement doesn't concern the reasoning or expectations individuals may follow in their decision to trust [8].

Contrasting self-report measures with behavioral measures, Edward Glaeser et al. aimed to identify to what extent trusting behavior in an experiment is predicted by trust self-reports and self-reports of past trusting behavior. By using self-report measures including the General Social Survey, the Rottenberg's and Rotter's scales and questions querying past trusting behavior the authors found that self-report measures "of past trusting behavior are better than [the] abstract attitudinal questions in predicting subjects' experimental choices" [28].

Presumably the first to integrate a behavioral experiment into a large-scale survey was Ernst Fehr et al. Authors used decisions in an investment game to measure behavioral trust as well as different survey questions to measure self-reported trust. Consequently, the authors were able to identify which survey questions correlate with behaviorally exhibited trust. Developing a method manifested in implementing a sequential game within a survey in a simultaneous manner was a significant step forward in the trust measurement [5].

At the same time, classic self-report measurement was reinforced by so-called "wallet questions" proposed by Stuart Soroka et al. in 2007. Those questions were based on a field experiment described by Stephen Knack and Philip Keefer earlier. In the experiment wallets were dropped in a number of cities across the world, and as a result the percentage of returned wallets strongly correlated with answers to the "most-people" question on the country level. In turn, Soroka's survey was based on the questions about the likelihood of the wallet being returned by four different trustee categories. Since situation, expected behavior and specific groups of people were specified in his instrument, it was considered to be a major step toward measuring situational trust [5].

Computational models of trust have emerged in the last decade with the aim of predict and quantify the trustworthiness of digital entities in open and collaborative environments. The term Trust is used here to define a quantifiable prediction about user's expected ability to fulfill a task. A level of trust in this context is therefore a concept that overlaps competence, expertise and reliability [30].

According to Jordi Sabater-Mir and Carles Sierra, there are two main elements that have contributed to substantially increase the interest on trust and reputation: the multi-agent system paradigm and the spectacular evolution of e-commerce. In 2005 they emphasized that these systems are used by intelligent software agents both as a mechanism to search for trustworthy exchange partners and as "an incentive in decision-making about whether or not to honor contracts" [31, p. 1].

Reputation is used in electronic markets as a trust-enforcing, deterrent, and incentive mechanism to avoid cheaters and frauds (eBay, 2002; Amazon, 2002; Dellarocas, 2003). E-markets are not the single field of application, for example in (Barber and Kim, 2001), Barber and Kim use trust to improve the performance

of belief revision mechanisms. Another important area of application in agent technology is teamwork and cooperation (Montaner et al., 2002) [31, p. 2].

In 2011 Pierpaolo Dondio and Kuca Longo described a trust-based decision in a specific domain as a multi-stage process. According to Dondio and Longo, the first stage is the identification and selection of the appropriate input data. These data are in general domain-specific and identified thought an analysis conducted over the application. Dondio and Longo referred to this process as "evidence selection" and to the inputs used to compute trust as trust evidence [30, p. 116].

Evidence selection is driven by an underlying trust model that contains the notion of trust on which the entire system is centered. A trust model represents the intelligence used to justify which elements are selected as trust evidence, why some elements are selected and other discarded, and it informs the computation over the selected evidence. A trust model contains the definition of the notion of trust, its dynamics, how it evolves over time and with new evidences, and the mechanisms of trust used in the computation [30].

After evidence selection, a trust computation is performed over evidence to produce trust values, the estimation of the trustworthiness of entities in a particular domain. A trust computation requires the formalization of a computable version of those mechanisms defined in the trust model. Examples of such mechanisms are the past-outcomes one, reputation and recommendation, but also temporal and social factors, similarity, categorization and so forth. For instance, a classical trust system uses two set of evidence: recommendations and past experience. Each of them is quantified separately and then aggregated into a final value [30]. In this final aggregation stage, exogenous factors such as risk and trustier's disposition can also be considered. The output is presented as quantitative trust values and as a set of justifications.

In 2016 Tim Muller et al. introduced the three principles to capture the paradigm of computational trust. Those principles are:

1. A trust system is a (timed) process with partially observable states.

2. Actors' behaviour is dictated by a (probabilistic) strategy.

3. Trust values reflect the actor's possible behaviour based on evidence.

Muller et al. claimed that a variation of each of the principles is present in many trust systems. The last principle is basically a requirement for a trust model to provide trust values that reflect potential actor's behavior. Muller et al. emphasized, that for trust model it is essential to identify what certain past actions of an actor result in his or her certain future actions and that potential actors have to be categorized according to this information.

Computational models of trust emerged in the last decade with the aim of exploiting the human notion of trust in open and decentralized environments. Computational trust models are becoming now a popular technique across many applications such as cloud computing, p2p networks, wikis, e-commerce sites, social network [30].

The variety and ambiguity of trust measurement practices led to the **debates** in the scientific community concerning self-report measurement. According to Eric Uslaner, among them there is a *behavioral-relevance debate* that questions whether self-reports of trust are actually linked to behavior. The *item-number debate* contrasts single-item measures of generalized trust with multi-item or scale measures. A related *dimensions debate or forms debate* concerns whether there are different forms of trust or measuring trust can be reduced to a single dimension such as generalized trust. The *scale-length debate* surrounds the use of different answer scales: while the dichotomous version of the "most-people" question was the standard for a long time, several surveys have changed to longer answer scales when measuring generalized [67].

To summarize, there is a variety of self-report and behavioral measurement tools introduced since 1940s. However, trust measurement today is primarily based on the modified versions of questionnaires proposed by the pioneers in the field. At the same time, trust modelling and reputation management systems are becoming areas of constant improvements and innovations nowadays, since they provide a formal quantitative approach to trust measurement, reinforced by computational processing power that makes it possible to distribute results on larger samples.

Based on the diversified usage of the tools, a distinction can be made between measurement of the level of trust and trustworthiness. The main difference is that in first case trust measurement results into factual data about the actual trust, while in the second case it precedes the decision of trust and predefines the future level of trust.

Using trust modelling makes estimation of trustworthiness more accurate and less subjective, thus it moves the decision of trust from the ordinary face-to-face context to the context of a number of individuals or more abstract social actors grouped on the basis of the characteristics they share. Trust decision is still associated with risk, but the number of social actors it can be instantly applied to increases significantly making decision, different from the calculated one disadvantageous.

2.2. Types of trust metrics

Universally reliable sociological metrics are assumed to be controversial for the trust measurement due to the complexity of the process and the "embeddedness" of trust that makes it impossible to isolate trust from related factors [46]. Measurement is also complicated by the subjective nature of trust.

Considering the above, there is no generally agreed set of properties used to distinguish trust metrics as right or wrong, since each metric is designed to serve different purposes. For the purpose of the survey, classification for trust metrics provided by Cai-Nicolas Ziegler and Georg Lausen [25]. According to their classification, there are two **groups of trust metrics**:

1. *Empirical metrics* focus on the capture of level of trust in a reliable and standardized way.

2. *Formal metrics* focus on facilitating trust modelling by formalized data processing.

Empirical metrics are used to determine the perceived or expressed level of trust. Those methods combine theoretical background with defined set of questions and statistical processing of results. Those metrics are based on the assumption that willingness to cooperate, as well as actual cooperation are reliable trust indicators, so both the actual level of trust and trustworthiness can be assessed from the difference between observed behavior and hypothetical one that would have been anticipated in the absence of cooperation. Widely used empirical metrics are surveys and experiments or games.

Surveys capture the level of trust by means of both observation or self-reports, but without engaging into any experiments. Respondents are supposed to answer a set of questions or statements and responses are generally structured according to a Likert scale.

Another empirical method to measure trust is to engage participants in *experiments*, treating the outcome of such experiments as estimates of trust. Such experiments or "games of trust" are prudently designed to provide no opportunity for participants to enhance their profit by using selfish strategy, while cooperation is profitable. Therefore, trust is basically measured by the monetary gain that is attributed to cooperation.

Formal metrics are used for large scale trust models that represent trust as an abstract system. However, there is a wide range of simultaneously submitted approaches to attributing value to the level of trust, each of them has its own advantages and disadvantages. For instance, there are systems that use fixed scale where confidence range on a scale or is discrete or continuous, one-dimensional or with many dimensions, assume only binary values or an ordered set of values not converted into a particular numerical range etc.

Dondio and Longo stated, that current trust models can be divided in the following macro-areas: security-oriented approach; explicit-feedback systems; rule-based systems; probability-based systems, or past-outcomes, implicit learning systems; Game Theoretical; cognitive models and computational trust models [22].

According to the conceptual model of reference proposed by Sabater and Siera, trust and reputation models can be characterized as:

1. *Cognitive*, where 'trust and reputation are made up of underlying beliefs and are a function of the degree of these beliefs' (Esfandiari and Chandrasekharan, 2001). In the cognitive approach, the mental states that lead to trust another agent or assign a reputation, as well as the mental consequences of the decision and the act of relying on another agent, are an essential part of the model.

2. *Game-theoretical,* where trust and reputation are considered 'subjective probabilities by which an individual, A, expects that another individual, B, performs a given action on which its welfare depends' (Gambetta, 1990). Trust and reputation are not the result of a mental state of the agent in a cognitive sense but the result of a more pragmatic game with utility functions, and numerical aggregation of past interactions [31].

The trust model proposed by Castelfranchi and Falcone in 1998 is a clear example of a cognitive trust model. The basis of their model is the strong relation between trust and delegation. They claim that 'trust is the mental background of delegation'. In other words, the decision that takes an agent x to delegate a task to agent y is based on a specific set of beliefs and goals and this mental state is what we call "trust". Therefore, "only an agent with goals and beliefs can trust".

Trust and reputation of an individual can either be seen as a global property shared by all the observers or as a subjective property assessed particularly by each individual. In the first case, the trust/reputation value is calculated from the opinions of the individuals that in the past interacted with the individual being evaluated. This value is publicly available to all members of the community and updated each time a member issues a new evaluation of an individual. In the second case, each individual assigns a personalized trust/reputation value to each member of the community according to more personal elements like direct experiences, information gathered from witnesses, known relations between members of the community and so on. In the latter case, it is not considered to be the trust/reputation of an individual x, but rather the trust/reputation of an individual x from the point of view of an individual y.

The position of taking trust and reputation as a global property is common in online reputation mechanisms. These systems are intended for scenarios with thousands or even millions of users. As pointed out by Dellarocas (Dellarocas, 2003), the size of these scenarios makes repeated interaction between the same set of players unlikely and, therefore, reduces the incentives for players to cooperate on the basis of hoping to develop a profitable relationship. The robustness of these systems relies on the number of opinions available for a given partner. A great number of opinions minimize the risk of single individual biased perceptions.

In models that consider trust as a *global property*, the main problem is the lack of personalization of that value. Something that is bad for one actor could be acceptable for others and the other way around. Although this approach can be acceptable in simple scenarios where it is possible to assign a common "way of thinking" to all members of the community, it is not useful when agents have to deal with more complex and subjective affairs.

The antithesis of these models are the models that consider trust as a *subjective property*. Each agent uses its personal experiences and what the other agents have said to it personally, among other things, to build the trust of each member of the community. These models are indicated for medium and small size environments where agents meet frequently and therefore it is possible to establish strong links among them [31].

Within the formal approach, trust is considered to be context dependent property. However, adding to computational trust models the capability to deal with several contexts has a cost in terms of complexity and adds some side effects that are not always necessary or desirable. A single-context trust model is designed to associate a single trust value per partner without taking into account the context. A multi-context model has the mechanisms to deal with several contexts at a time maintaining different trust values associated to these contexts for a single partner.

Nowadays, there are very few computational trust models that care about the multicontext nature of trust and reputation and even fewer that propose some kind of solution. This is because current models are focused on specific scenarios with very delimited tasks to be performed by the agents. In other words, it is possible to summarize all the agent activities in a single context without losing too much versatility. However, and similarly to what the use of sociological information, as the complexity of tasks to be performed by agents will increase

in the future, an increase of the importance devoted to this aspect in trust modeling is expected [31].

The capacity to deal with agents showing different degrees of cheating behavior is the aspect considered to establish another classification. Generally, three levels are determined to categorize trust models from this point of view:

1. Level 0. Cheating behavior is not considered. The model relies on a large number of agents who offer honest ratings to counteract the potential effect of the ratings provided by malicious agents.

2. Level 1. The model assumes that agents can hide or bias the information, but they never lie.

3. Level 2. The model has specific mechanisms to deal with liars.

Sometimes, as important as the trust value itself is to know how reliable is that value and the relevance it deserves in the final decision-making process. Some models incorporate mechanisms that provide this kind of information [31].

There is also a disagreement regarding the attribution of values to levels of trust, specifically notable when it comes to interpreting zero or negative values: zero may indicate either lack of information or the lack of trust as well as distrust. Although, distrust is usually defined by negative values, there is a discourse whether distrust should be perceived as trust with a negative sign, or as a separate phenomenon [18].

At the intersection of empirical and formal metrics, there is a method called "**subjective probability**". It is based on trustor's self-assessment about his or her trust in the trustee, expressed in terms of probability. Such a probability is subjective as it is specific to each trustor and another trustor can express different level of trust in the same situation. As for the formal aspect, subjective probability processing is performed using statistics and probability tools. As for the empirical aspect, subjective probability is usually measured through one-side

bets: if potential gain is fixed, the amount that trustor bets is used to estimate subjective probability [18].

In addition to subjective probability, Audun Josang introduced the concept of the **subjective logic** defined as the logic for uncertain probabilities also called "subjective opinions". Josang combined probability distribution with uncertainty, so that "each opinion about trust can be viewed as a distribution of probability distributions where each distribution is qualified by associated uncertainty" [34].

According to Josang, the level of trust can be represented with the use of a four-tuple: trust, distrust, uncertainty and base rate. The particular value of a four-tuple related to trust is proven to be easily derived from a series of binary opinions about a particular social actor, thus providing a strong link between this formal metric and empirically observable behavior. Subjective logic is an example of computational trust where uncertainty is inherently embedded in the calculation process and is visible at the output [201].

Another method comprising the combination of empirical and formal metrics is **fuzzy logic,** that is used to link natural language expressions with a meaningful numerical analysis. Fuzzy logic is an approach based on "degrees of truth" rather than the usual "true or false" Boolean logic. The idea of fuzzy logic was first advanced by Lotfi Zadeh in the 1960s. Application of fuzzy logic to trust has been studied in the context of peer to peer networks [64] to improve peer rating.

The main characteristic of this model (Carbo et al., 2002) is the use of fuzzy sets to represent reputation values. Once a new fuzzy set that shows the degree of satisfaction of the latest interaction with a given partner is calculated, the old reputation value and the new satisfaction value are aggregated using a weighted aggregation. The weights of this aggregation are calculated from a single value that they call remembrance or memory. This factor allows the agent

to give more importance to the latest interaction or to the old reputation value. The remembrance factor is modeled as a function of the similarity between (1) the previous reputation and the satisfaction of the last interaction and (2) the previous remembrance value. If the satisfaction of the last interaction and the reputation assigned to the partner are similar, the relevance of past experiences is increased. If the satisfaction of the last interaction and the reputation value are different, then it is the relevance of the last experience what is increased.

The notion of reliability of the reputation value is modeled through the fuzzy sets themselves. A wide fuzzy set for a reputation value represents a high degree of uncertainty over that value while a narrow fuzzy set implies a reliable value. Recommendations from other agents are aggregated directly with the direct experiences. The weight given to each factor (old reputation value and new opinion) is dependent on the reputation that the recommender has. Recommendations coming from a recommender with a high reputation has the same degree of reliability as a direct experience. However, opinions from an agent with bad reputation are not taken into account. To calculate the reputation of recommenders, the agent compares the recommendation with the real behavior of the recommended agent after the interaction and increases or decreases the reputation of the recommender accordingly [31].

Considering the above, the set of requirements for trust metrics vary depending on the purpose of the study and its format. However, there is a list of universal ones, applicable to any trust metric:

1.   *Transitivity* is the ability of trust metric to be reliably extended in situations where A trusts B and B trusts C to a conclusion that A trusts C.

2.   *Scalability* is the ability of trust metric to be calculated for large sample with the same reliability.

3.   *Attack resistance* is the ability of trust metric not to be manipulated.

To summarize, there are different approaches to trust measurement that can be roughly divided into empirical and formal metrics. There are as well metrics that combine both empirical and formal features and provide more profound results. Considering advantages and disadvantages of the reviewed trust metrics, it is assumed that there is still a need for an alternative trust measurement tool for the institutional trust towards social actors.

2.3. Scoring as trust measurement method

In the Cambridge dictionary, the term "score" is defined as "the number of points, goals, etc. achieved in a game or competition". Someone's score in a game or test is a number of points, that shows what he or she has achieved or which level they have reached. If there is a group of participants, a ranking system can be based on the scores to identify whose results are above or below average to define the winner or the best student in the class. After a few rounds in a game or several tests, it can be possible to predict participants' performance with a certain level of accuracy.

In sociology, **scoring** can be defined as a model for classifying respondents into different groups. Scoring is used if the exact characteristic that defines these groups is unknown, but a number of factors related to the characteristic of interest (i.e. trust) are known. It is based on the assumption that people with similar social characteristics (e.g. gender, age, place of residence, etc.) behave identically in a specific context and thus can be trusted more in comparison with others. Thus, scoring is used as a quantitative measure of characteristics of past events to predict future events with similar characteristics.

The enhancing pressure in the postmodern society to make sound decisions faster are driving social actors to use scoring models in a wider range of situations. **Scoring model** can be described as one in which a number of

variables is weighted resulting in a score that subsequently forms the basis for a decision, thus scoring becomes a common component of the decision-making process [31].

Scoring model is based on **a scorecard**. Scorecard is a mathematical model which attempts to provide a quantitative estimate of the probability that a defined outcome will happen with respect to the current context. A scorecard is a table in which all elements that influence the outcome are separated into individual characteristics, each with its own value. The various individual characteristics can, therefore, have varying influences on the overall assessment [58].

To develop a scoring model, the factors that affect the characteristic of interest have to be determined. In sociology those factors are mostly different socioeconomic and demographic characteristics. Based on the already available as well as additionally collected secondary data about respondents, certain weights should be assigned to those characteristics to create a scorecard. Thus, depending on the characteristics, social actors will be assigned an integer rank that indicates the degree of trust they should be exerted in comparison with other respondents in the sample.

There are 2 main approaches to the scoring model development [38]:

1. Statistical model can be applied in case there is a large pool of available data with at least 1,000 "bad" outcomes. The actual factors that influence the outcome are determined by testing. Such a model can be validated prior to use.

2. *Judgmental model* is a customized rules-based model. This model can be set up to consistently weight the key factors and rank survey objects from low to high risk by assigning a risk rating.

Statistical models are considered to be more powerful than judgmental ones. However, focusing on a narrowly defined group of factors that best describe the risks specific to the context can help to reduce lengthy analysis of a large pool of data. While a rules-based model can significantly reduce assessment time and improve the profitability, it can also be used as an intermediary step to the construction of a more powerful statistical model. In the latter case, data should be systematically collected and analyzed over an adequate time-period, which depends on the survey objectives [38].

Nowadays scoring models are becoming increasingly **automated**. The model can extract all data that contributes to the scoring from a database and automatically follow the defined steps of the decision-making process. This does not affect the outcome of the scoring model but does offer opportunities to further optimize the decision-making process [58]. Scoring models can be developed not only to process the entered data, but also being capable of self-learning, e.g. taking into account the behavior of the already processed social actors in order to adjust their assessment of potential future social actors.

Scoring technologies are **commonly used** in the banking sector, as well as in marketing research, in insurance and telecommunications sectors. For example, scoring model allows to calculate an individual rate on an insurance product, establishing a risk tolerance. IT is also an upcoming trend in management and particularly in human resources since HR possesses large quantities of people data. By applying scoring to this data, HR is able to track and measure efficiency of hiring, training, apprising, promoting and other organizational activities, analyze reasons and forecast impact of different organizational decisions, policies and actions on such features as turnover, loyalty, satisfaction, performance, engagement etc. and improve efficiency of the decision-making process.

In terms of trust, HR scoring is used in a points-based employee **recognition** system that is similar to a reputation system. It is considered to be an effective way to engage employees and encourage positive behaviors that are aligned to the company's values. Points-based recognition scheme gives employees the opportunity to earn rewards for the behavior that is defined as reliable and trustworthy in context of job commitment (e.g. outstanding performance, long service, work anniversaries) [15].

Scoring systems designed to measure employee **satisfaction** and loyalty within their organizations are considered to be an example of impersonal trust measurement instruments. Mainly such systems consist of a two-question surveys: the first question asks employees to rate, on a scale from zero to ten, how likely it is they would recommend the organization as a place to work; the second is an open-ended question asking why they chose the rating they did. The system generates a score using the responses to the first question by sorting ratings into categories: highly satisfied, with ratings of nine or ten, satisfied enough, with ratings of seven or eight, and unsatisfied, with ratings of six or below [66]. Willingness to recommend organization is an indicator of the level of trust extended to the organization.

An efficient way of using scoring to reduce turnover rates is described in APPENDIX A.

Scoring is also used as a part of the **recruiting and employee assessment process** to estimate the degree of trust to employees or job applicants within their ability to meet job requirements based on their competencies, assessable performance parameters or personality traits. For these purposes, scorecards are usually developed for the particular roles and positions in the organization.

Competency scoring is an assessment of employees' or job applicants' competencies. A job competency can be defined as the skills, traits, qualities or

characteristics that contribute to a person's ability to perform responsibilities in an organization. The most important use of competencies is for selection interviewing. Scorecard is usually designed by listing competencies and assigning weights to the competency's development level required for the specified position [6]. Basically, competency scoring is ranking people by the level of their skills to enable more accurate prediction of the level of task that they will be able solve.

A distinctive feature of the competency scoring is that competencies assessment of a particular individual is based on the subjective assumptions of the individual conducting it (e.g. interviewer, hr-manager, leading specialist). To reduce subjectivity, competencies have to be clearly defined and described.

In theory, if an organization is appraising employees on competencies then managers or supervisors should be observing behavior over the course of the year and carefully documenting it. However, managers faced with scoring someone on a competency scale usually make an overall judgement on how they rate that is likely to be biased and inaccurate.

Scoring based on the assessable *performance parameters* allows to estimate trustworthiness based on the objective factors. Performance parameter are mostly referred to as Key Performance Indicator (KPI). A common definition for KPI is "a quantifiable measurement that shows how well an individual is performing against a predetermined objective". Organizations use KPIs at multiple levels mainly to evaluate their success at reaching goals in different areas. Employee KPIs are intended as high-level markers to characterize overall employee productivity.

A KPI scorecard is a term used to describe a statistical record that measures progress or achievement towards a set of performance indicators. It allows to rank employees by their ability to reach working standards and work

efficiency. Among the most universal KPIs there are revenue per employee, employee billable percentage, average task completion rate, overtime per employee, employee capacity etc. Although scorecards are developed for the KPI assessment, KPIs are mainly based on planning patterns rather than large pool of data.

Both competency scoring and KPI scoring are used to facilitate management decision, associated with risk. In first case, it is a risk of hiring an individual, who will not be able to perform his or her duties efficiently despite the commitment. In the former case, it is a risk of a cost of performance being higher than a benefit for an organization. As it was discovered in paragraph 1.2., by signing for a job individual may intend to perform well, however, he or she may be unaware of the limits of his or her capabilities.

A relatively new method used for the hiring and promotion purposes is based on the assessment of *personality traits*. At its core is an assumption, that individual's trustworthiness can be estimated by measuring his or her personality. A detailed overview of this approach is presented in the section 3.

Although, scoring is becoming applicable for decision management in organizations, only a few of them are using scoring for HR. According to Deloitte's 2018 People Analytics Maturity Model, only 17% of organizations worldwide had accessible and utilized HR data. This is up from 8% in 2015, and 4% in 2014. Of this 17% in 2018, only 2% qualified as having business-integrated data, meaning they use real-time, advanced AI-aided tools to collect, integrate, and analyze data. The other 15% is able to do predictive analytics on a specific basis [68].

However, management is not the only area where the idea of applying scoring emerged recently. As for the marketing research, scoring is now seen as one of the methods for predicting the probability of losing customers and

formulating an effective strategy to save accounts. An overview of the socio-demographic characteristics of customers as well as information about what they often buy is obtained through discount cards, polls and questionnaires. Based on these data, a scoring model is built dividing all customers into groups depending on the objectives of the marketing research. This allows to form an objectified indices of population groups in line with the goods or services defining trustworthy customers or customers whose buying behavior is more predictive.

Considering the fact, that number of leads actually becoming customers is only around 10 percent, marketing specialists intend to create highly targeted marketing messages rather than trying to reach every potential customer. Understanding the behaviors that are most often exhibited by customers helps to identify the most promising leads and refine marketing message to reach only those customers who are most likely to commit to buying [32].

Behavior scoring, used in marketing is also sometimes called **lead scoring**. It comprises assigning a numerical score or grade to potential customers based on certain behaviors they exhibit. It starts with the analysis of the behaviors of existing customers. The next stage is to create a "composite sketch" of the ideal customer. Those customers who do X, Y, and Z convert a high percentage of the time, so the potential customers who do those same things are given a high behavior score, since they are the people the marketing strategy should be focused on.

Behavior scoring is mainly a feature that looks at a potential customers' engagement in terms of 'ready to buy' behavior. Over time, the 'engagement model' learns what patterns of behavior lead to a purchase, and when it spots these positive insights with other potential customers, increases their score too. In short, such models learn what combination of customer engagement leads to

purchase. Scoring the behaviors that make someone a promising lead lowers the cost (e.g. Customer Acquisition Costs) and increase the benefit (Customer Lifetime Value) for the organization [32].

However, scoring was initially used by banks and lending organizations to identify trustworthy borrowers and manage loan default risk. Lenders use credit scores to determine who qualifies for a loan, at what interest rate, and what credit limits. **Credit scoring** is a scientific method of assessing the credit risk associated with new credit applications. It is an objective risk assessment tool, as opposed to subjective methods that rely on a loan officer's opinion.

Credit scoring is a statistical analysis performed by lenders and financial institutions to access individual's creditworthiness. Creditworthiness or the probability of loan repayments is mainly obtained by analyzing the credit history of a large sample. Credit history can be referred to as applicant's reputation in terms of Sztompka. Analysis is based on the assumption that there is a correlation between certain social characteristics (e.g. gender, age, marital status, education etc.) and the integrity of the borrower. Credit scoring models derive predictive relationships between application information and the likelihood of satisfactory repayment. The use of credit scoring prior to granting credit is an implementation of a trusted system.

Credit scoring typically uses observations or data from clients who defaulted on their loans plus observations on a large number of clients who have not defaulted. The default probabilities are then scaled to a "credit score" between 300 and 850, 850 being the highest credit rating possible. This score ranks applicants by riskiness without explicitly identifying their probability of default [36]. However, credit scoring doesn't predict individual loan loss; rather it predicts the likelihood or odds of a "bad" outcome.

There are different types of credit scoring:

1.   *Application scoring* facilitates customer acquisition decisions by quantifying risks, associated with loan applications. It helps to automate the whole process of loan origination.

2.   *Fraud scoring* facilitates fraud prevention by ranking applicants according to the probability of them being fraudulent. It is often used as addition to application scoring.

3.   *Collection scoring* facilitates debt management decisions by statistically estimating debtor's willingness and ability to repay. It helps to improve collection and recovery efficiency.

4.   *Behavioral scoring* facilitates customer management decisions by rating customers according to their financial behavior. It helps to efficiently analyze particular borrower's credit account as well as the entire credit portfolio.

There are also credit scores designed for specific kinds of lending, such as auto loans, mortgages, and credit cards as well as for insurance products, utility services, cell phone service, and more - credit scoring is not limited to banks. Other organizations, such as mobile phone companies, insurance companies, landlords, and government departments employ the same techniques. Digital finance companies, such as online lenders, use alternative data sources to calculate the creditworthiness of borrowers. More detailed overview of alternative data used for credit scoring is provided in the Section 3.

A typical mistaken belief about credit scoring is that the only trait that matters is whether individual have actually made payments on time as well as satisfied all monetary obligations. While payment background or credit history is essential, it influences only one-third of the most credit rating score. Empirically derived credit scoring systems have between 10 and 20 variables on the average. The exact formula for each type of score is kept secret by every organization that

produces one. However, the main ingredients of some credit scores are known, since they were released to the public [20].

The first models of credit scoring developed by the Fair Isaac Corporation more than 50 years ago were named after the company as FICO scores and are well-known today (see APPENDIX B).

Since FICO's first model, more than a hundred different models and scores have been developed for and used by lenders, insurance companies, and utility providers [20]. For instance, the **5 C's** of credit is a framework used by many traditional lenders to evaluate potential small-business borrowers summarized by Peavler in 2013. This framework includes 5 characteristics of a potential borrower:

1.   *Character* is borrower's characteristic proving he or she is responsible and willing to keep commitments, particularly an obligation to repay the loan. It is basically lender's opinion of a borrower's general trustworthiness, credibility and personality. It is assessed from reputation: work experience**,** credit history, credentials, references, interaction with lenders, lien and judgments report, education.

2.   *Capacity* also referred to as *Cash flow* is borrower's ability to repay the loan. It is assessed from financial metrics and benchmarks (debt and liquidity ratios, cash flow statements), credit score, borrowing and repayment history, comparing income against recurring debts (debt-to-income (DTI) ratio), contingent sources for repayment (these could include personal assets, savings or checking accounts; for small businesses, the income of a spouse employed outside the business is commonly considered)

3.   *Capital* is the amount of money owned by borrower or invested by business owner or management team. It is assumed that a large contribution by the borrower decreases the chance of default**,** thus banks are more willing to lend

to owners who have invested some of their own money into the venture. Down payment size can also affect the rates and terms of a borrower's loan. It is assessed from the amount of money the borrower or management team has invested in the business.

4. *Conditions* is a state of borrower's finances or the business — whether it is growing or faltering — as well as what borrower will use the funds for. It also considers the state of the economy, industry trends, or pending legislative changes and how these factors might affect the ability to repay the loan. To ensure that loans are repaid, banks want to lend to businesses operating under favorable conditions. They aim to identify risks and protect themselves accordingly. It is assessed from a review of the competitive landscape, supplier and customer relationships, and macroeconomic and industry-specific issues.

5. *Collateral* includes assets that are used to guarantee or secure a loan. In short, it is a backup source if the borrower cannot repay a loan. It is assessed from hard assets such as real estate and equipment; working capital, such as accounts receivable and inventory; and a borrower's home that also can be counted as collateral. Often, the collateral is the object one is borrowing the money for.

However, there aren't any strict guidelines for how lenders weigh these attributes, thus different lenders may place more value on one over another. For example, online lenders may be more willing to consider a borrower's personal credit score on a loan application, while banks may care more about collateral and money borrower have invested in the business.

Another commonly used credit scoring frameworks are:

1. **5P's** is a method of evaluating credit applications developed by the Federal Reserve Center (Fed 2004). It includes *People, Purpose, Payment, Protection* and *Prospective (also referred to as Plan).*

2.   The **CAMPARI Model** represents 7 variables the bank can use to evaluate credit applications. Some of them are similar to the 5C's, and some to the 5P's (Business coaching 2008).

3.   **LAPP Method**, developed by Benz in 1979, is rather used for evaluating corporate credit applications than individual borrowers. It includes such characteristics, as *Liquidity, Activity, Profitability and Potential.*

As a traditional approach to credit risk analysis, credit scoring is most effective for small owner-operated businesses and individuals. A similar concept, credit ratings, should not be confused with credit scoring. Credit ratings apply to companies, sovereigns, sub-sovereigns and those entities' securities, as well as asset-backed securities [36].

Roughly speaking, companies that produce credit scores calculate them in several steps [20]:

In step one, they analyze data on each applicant, such as payment history, the amount owed at the moment etc., by plugging these data into statistical or judgmental model. The model produces an odds ratio for each applicant. Odds ratios are the sum of applicant's good credit behaviors divided by the sum of his or her bad credit behaviors.

In step two, applicants are organized into scorecards with others who have similar events in their credit histories. For example, if applicant has missed a mortgage payment, his or her information enters a scorecard with other applicants who also missed a mortgage payment. Applicants with behaviors that are deemed most harmful to their creditworthiness enter a scorecard with a lowest range of credit scores assigned to it. Applicants who have the best behaviors enter a scorecard with the highest ranges of scores. All the applicants in between these extremes enter scorecards with score ranges in between,

ranking from the worst to the best, that is, from the lowest to the highest. In this way, the ranking of scores in terms of applicants' riskiness is always preserved.

In step three, the odds ratio is mapped to a credit score for each applicant, based on scorecard positions, to create the score-odds relationship. Lenders must have the entire relationship to make lending decisions, not just the scores but also the translation of those scores into odds ratios (what the scores mean in terms of the riskiness of potential borrowers).

It is important to note that the scores and the odds ratios are calculated at a certain point in time. Later, as information is updated, both can change. If individuals change their credit behavior, their likelihood of future default (the odds) will change as well. But whether and how a different odds ratio will affect a consumer's score depends on the credit behavior of everyone else in the population, as it determines what scorecard those consumers enter.

The rank-ordering of consumers' creditworthiness means that individuals with higher scores are anticipated to manage their debt better than those with lower scores and thus are more trustworthy. However, it is still associated with risk: a score of 750 does not guarantee that individuals with that score will not default on their loans. It only means that they are less likely to default than those with a score of 700.

While rank-ordering is valid at any point in time a score is considered, scores should not be compared across different points in time. A score of 750 is always expected to perform better than a 700 calculated at the same time, but 750 today does not indicate the same level of riskiness as 750 two years ago. At the same time, a consumer with a score of 750 is still less risky than a consumer with a score below 750. In other words, higher scores are always expected to perform better than lower scores, but each score may not mean the same level of creditworthiness compared between one time period and another.

Considering that individuals' credit scores can't be compared across time, lenders need additional data to use them. To choose a score below which a loan will be originated at a higher price or will not be originated at all lenders receive not only the credit scores of potential borrowers, but also their translation into the level of riskiness they represent at the current time called the *score-odds relationship*. Analyzing both, the score and what it means in terms of risk, a lender can make a decision about what risk is acceptable at that point in time [20].

Although credit scoring ranks a borrower's credit riskiness, it does not provide an estimate of a borrower's default probability. As an ordinal ranking, it only assesses a borrower's riskiness from highest to lowest. As such, credit scoring suffers from its inability to determine whether Borrower A is twice as risky as Borrower B [36].

Another interesting limit to credit scoring is its inability to explicitly factor in current economic conditions. For instance, if Borrower A has a credit score of 800 and the economy enters a recession, Borrower A's credit score would not adjust unless Borrower A's behavior of financial position changed [36].

In addition, around 2 billion people in the world are categorized as unbanked. This means that they have little to no opportunity of securing credit. Populations in the poorest countries, migrants, refugees and those from low-income families all struggle to get a foot on the lending ladder. Even millennials are often underbanked, too: in some countries including the United Kingdom and the United States, age biases in current credit scoring systems mean that many younger people don't have fair access to credit.

For people who are currently able to get or already have a loan, it's possible that they may not be getting the best deal available. This is particularly apparent for individuals who are new to credit products since credit rating

agencies give a lower score to people without an established credit history. People with a short credit history may struggle to get good interest rates that are fair to their personal financial management and lifestyle patterns since it takes such a long time to build up a good rating.

In 2016, almost 5 million people moved to OECD countries. As an increasing number of people move around, whether part-time or permanently, we are heading towards a truly globalized world. Currently, credit scores and the associated history for an individual are limited to the country where that particular person is applying for credit. Although some options for foreign credit analysis is possible (e.g. if you're looking to buy a home in another country), most people who move to a new country will have to start from scratch. With increasing numbers of global movers, financial services will need to respond to these new challenges.

One way to improve financial inclusion is to use machines and systems where unfair factors like demographic or age are ignored. Algorithms decrease human bias because machines do not have the sociological biases that humans do. By using machines and algorithms, it is possible to create systems that are truly equal to all ages and nationalities.

There are a number of credit scoring techniques such as: hazard rate modeling, reduced form credit models, weight of evidence models, linear or logistic regression. The primary differences involve the assumptions required about the explanatory variables and the ability to model continuous versus binary outcomes. Some of these techniques are superior to others in directly estimating the probability of default. Despite scientific research, no single technique has been proven superior for predicting default in all circumstances. In the future, scoring technologies can find their application in other areas of society.

To summarize, scoring is mainly used to facilitate decision-making process for institutions. It provides a simplified trustworthiness estimation system, which eliminates subjectivity and increases the speed of decision-making, reduces the level of internal fraud. Although trust decision is still to be made by individuals holding corresponding positions, based on the scoring results it is more likely to be unbiased and objective.

Scoring significantly increases efficiency of the risk management: trust decision is still associated with risk; however, it is based on more precise estimation of trustworthiness. Individual's trustworthiness is mostly assessed by his or her past behaviour or reputation, but this assessment is conducted concerning specific group of individuals sharing common characteristics rather than a specific individual.

SECTION 3
ALTERNATIVE TRUST MEASUREMENT TOOL

Nowadays past performance is no longer considered a reliable predictor of future results. New approaches look to rely on other sets of information to better predict human behavior and trustworthiness. Progress in managing and analyzing huge data sets makes this assessment possible. Access to big data on customers, data analytics and social media footprints yields behavioral analytics that lead to positive trusting decisions.

In this section methodological basis for an alternative trust measurement tool development was presented.

3.1. Alternative scoring general overview

Across the emerging world, institutions are realizing the potential of alternative data to transform decision-making process associated with trust. Mostly those are innovative financial institutions. For instance, Richard Cordray, director of the Consumer Financial Protection Bureau in the USA, emphasized that "A limited credit history can create real barriers for consumers looking to access the credit that is often so essential to meaningful opportunity – to get an education, start a business, or buy a house. Further, some of the most economically vulnerable consumers are more likely to be credit invisible" [50].

Although those people are credit-invisible for the traditional sector, their everyday activity and alternative records represent a meaningful and vast source of precise hallmarks of their level of sustainability, resilience and credibility. As user-generated content is no more regarded as a second-class source of information, but rather a complex mine of valuable insights, it is critical to

develop techniques to effectively filter and discern good and reliable content [10].

As part of the assessment, institutions tend to look at the data hierarchy. Although, the most powerful data on credit performance is credit data, where that's not available, bill payment data, non-financial data, or consumer-contributed data is becoming more relevant. Any new solutions using alternative data require an empirical analysis of the value that data will bring.

Alternative data can mean anything and everything beyond the traditional past performance data. However, three data sources have garnered particular attention recently: online, mobile and psychometrics. Data from online social networks, mobile phone records, and psychometrics are helping to illuminate the potential of borrowers where traditional information used for trustworthiness assessment is scarce, enabling greater control over risk. But as these alternative sources of data find traction, it is important to recognize that not all data sources are created equal. Rather, they possess important strengths and weaknesses with major implications for institutions and social actors they serve.

There are two metrics by which an alternative credit scoring data source is mainly considered:

1. *Availability* is referred to the amount of people this source of data able to capture.

2. *Predictive power* is referred to practical value of the sources in measuring risk.

Evaluated online, mobile, and psychometric data by both of these metrics, enables comparable, quantitative and objective analysis of all three data sources.

Generally, a digital footprint is meant by **online data**. Digital footprint refers to one's unique set of traceable digital activities, actions, contributions and

communications manifested on the Internet or on digital devices [57]. The digital footprint has strong predictive powers when it comes to determining their credit behavior. It was statistically proven that an efficient credit scorecard can be built based only on data gathered from Facebook. It can be used to evaluate variables like stability, income or size of professional network.

During the study, conducted by the EFL company in 2012, about 80 features were selected from thousands of lines of raw data on average (average profile contains 5,000-10,000 lines of data) as predictive for the credit repayment behavior. Some of the examples of these features are: age, gender, hometown, marital status, number of jobs, work location, time spent on Facebook, moreover volume information such as number of likes, groups, interests, events, videos and so on were used. In addition, the selected features contained information about users' friends such as their education, average work time, number of languages etc. [61].

Although Facebook data is not verified, the probability of a client faking years of Facebook usage is extremely low, therefore data can be assumed to be valid in majority of the cases .The data from the social networks can be processed real-time and the score for the applicant can be received within seconds [61].

However, Facebook started to limit access to its user data and amended its terms of service so that these days, it is explicitly stated that one shouldn't "use data obtained from Facebook to make decisions about eligibility, including whether to approve or reject an application or how much interest to charge on a loan." This made it virtually impossible for any respectable lender to even consider using Facebook data in credit scoring.

As for availability, online data is growing quickly and is inexpensive to gather, but still scarce in emerging markets and skewed towards the young and

educated. The percentage of people using the internet around the world has more than tripled in the last 10 years, and as access grows so do individuals' digital footprints, capable of providing previously inaccessible trust insights. Furthermore, because online data is publicly available or obtainable through simple user authentication and permission, it is inexpensive to collect.

However, the fact remains that 60% of the world remains offline, and that 60% is heavily concentrated in developing economies. In South Asia, for example, less than 1 in 7 people are online, and even fewer are on social networks and e-commerce sites. Furthermore, digital footprints are richer among the young, educated, and tech savvy, meaning in many markets online data will only apply to a small and skewed portion of the population.

The predictive power from online data depends on the size and maturity of an individual's digital footprint. More extensive data sets provide more features for modelling and enable a more complete snapshot of one's online behavior. It was found that simple things like the frequent use of slang and contractions in Facebook posts can relate strongly with default risk.

If implemented carelessly, however, online data can be misleading, as it is relatively easy to "game" over short periods of time. For this reason, it is all the more important to work with large, mature digital footprints, preferably across multiple platforms. Thus, obtaining valuable information from the social networks became more difficult, but it is still possible to use digital footprint as an alternative data for the scoring.

Mobile phones are proving to be one of the most important devices that have information that can be tapped to develop alternative credit scores. Mobile phone penetration globally is huge – over 100% as many people have more than one phone. In the developing markets of Asia, the penetration is over 90% and the devices are used for more than just phone calls and messages.

In addition to mobile phone penetration, phones now contain a wealth of valuable information that can be analyzed. Beyond calls and messaging, users are now using their mobile phone for contact lists, calendars, internet surfing and social media. All that activity provides data on people's personalities and can be used for behavioral analytics.

Features include measures of usage: intensity and distribution over space and time, top up and depletion patterns, mobility, the pattern of handset use, and strength and diversity of social network connections. The performance of these features is additionally compared against a benchmark using the characteristics that the bank recorded at the time of the loan: gender, age, loan size, and the loan term in days.

For example, a responsible borrower may keep their phone topped up to a minimum threshold so they have credit in case of emergency, whereas one prone to default may allow it to run out and depend on others to call them. Or, an individual whose calls to others are returned may have stronger social connections that allow them to better follow through on entrepreneurial opportunities. However, some indicators are 'gameable' in the sense that a subscriber may be able to manipulate their score if they knew the algorithm; it is preferable to use indicators that are less susceptible (for example, manipulating spending or travel can be costly).

In the past decade, mobile phones have become nearly ubiquitous around the world. More than 90% of people have a mobile phone, and there are more cellular subscriptions in developing countries than in developed ones. As mobile phones become the essential mode of communication in emerging markets, the data that can be collected and analyzed from them becomes richer and more descriptive.

Unlike online data, however, mobile data requires significant up-front investment. Required data is generally owned by Mobile Network Operators (MNO) which are rightfully protective of their users' data and privacy. Furthermore, some MNOs are becoming lenders themselves, making them less willing to share user data with lenders that may be competing for the same clients. Finally, in many countries, mobile users hold pre-paid subscriptions to multiple MNOs, making it necessary to amalgamate multiple data sources to build a comprehensive picture of an individual's mobile behavior. To gather complete mobile data for just 80% of Indonesia's population, for example, one would need to obtain agreement from 5 separate MNOs.

Considering predictive power, mobile data sets provide intricate detail on a range of attributes including who person communicates with, how often and for how long, as well as account payment history. Simple features like average days between calls, continuity of account service, balance inquiry frequency, and call durations can be used to create a relatively powerful model.

Mobile phone data also has some practical advantages over online data, namely that it is easier to match to individuals because telephone numbers are unique. Like online data, lenders must be careful to limit their analysis to large, mature data sets in order to mitigate the risk of user manipulation.

The third alternative data source is **psychometrics**. Psychometrics is a field of study concerned with the theory and technique of psychological measurement. As defined by the US National Council on Measurement in Education (NCME), psychometrics refers to psychological measurement. Generally, it refers to the field in psychology that is devoted to testing, measurement, assessment, and related activities [35].

The field is concerned with the objective measurement of skills and knowledge, abilities, attitudes, personality traits, and educational achievement.

Some psychometric researchers focus on the construction and validation of assessment instruments such as questionnaires, tests, raters' judgments, and personality tests. Others focus on research relating to measurement theory (e.g., item response theory; intraclass correlation).

Psychometric tests are a standard and scientific method used to measure individuals' mental capabilities and behavioral style. Psychometric tests are designed and applied in different areas, including management, HR and lending, described in paragraph 2.3. For instance, there are tests used to measure candidates' suitability for a role based on the required personality characteristics and aptitude or cognitive abilities, as well as individual's reliability and willingness to repay. It's an ideal approach for applicants who do not have a credit history and therefore cannot be scored using traditional methods.

Score can be created through a dynamic behavioral design and personality assessment that analyzes character traits with a proven relationship to risk. Trustworthiness assessment using personality and behavioral data started as a multiple-choice test taken with pen and paper and developed into a gamified, digital assessment tools used by institutions today. The most recent versions of such tests usually have a median completion time of 15 minutes.

Personality data is universally available and can be implemented easily, but it is actively captured and thus incurs higher marginal costs than the other data sources. Personality assessment does not rely on retrospective information and therefore is not limited to small sub-sets of the population or dependent on third party information providers. Rather, such data is collected through questions in a survey, and therefore can be made available for anyone, anywhere.

However, active data collection also means higher data collection costs. Lenders using personality tests for loan decision-making often choose to

administer credit applications in person, rather than remotely online, which requires time and energy on the part of both loan officers and loan applicants.

Personality assessment offer a broad variety of features for modeling, enabling a holistic view of an individual's character and willingness to pay. The ability of personality test to measure risk, however, is highly dependent on the quality of the questions asked. Factors like language, culture, age, and industry can influence one's survey responses, so care must be taken in crafting questions that are impartial and universally applicable. Furthermore, particular attention must be paid to tracking and preventing user manipulation, as this data is self-reported, rather than observed.

When implemented carefully, personality tests offer robust predictive power. This is particularly true when the application is administered electronically, rather than on pen and paper, because it allows one to observe not just what an individual answered, but how they interacted with the application, i.e. how long they spent on each question, if they changed responses, and so on. This meta-data provides additional features that are very valuable for modeling directly, as well as for detecting gaming and fraud on behalf of either applicants or loan officers.

Alternative data has the potential to fundamentally change resources trust measurement and decision-making process in emerging markets. Institutions looking to better understand their customers and control risk should look to alternative data as a source of opportunity, but also be careful to consider the distinct advantages and disadvantages inherent to each data source. However, institutions should consider that in some cases these sources of data may be used as complements rather than substitutes, layered to provide a more nuanced understanding of risk and potential. Furthermore, financial institutions should recognize that credit scoring, based on alternative data or otherwise, is only one

component of the lending process and therefore that a good credit score cannot guarantee strong portfolio performance.

While some kinds of alternative data could help certain consumers get access to resources, others might be newly tagged as too risky. Collecting increasing amounts of alternative credit data – especially data about short-term loans and utility payments – could lead to more adverse outcomes for some, especially in disadvantaged communities, says Christopher Peterson, a professor at the University of Utah's College of Law and director of financial services at the Consumer Federation of America. "With respect to discrimination and potential issues there, I have real concerns that alternative data sources may just end up creating new ways to replicate the same legacy of discrimination that's already baked into a lot of the socioeconomic structures in our society," he says.

One of the main challenges associated with alternative data usage for trustworthiness assessment concerns how to effectively mine a large set of complex data represented by non-pertinent, untrustworthy or even malicious data. The proposed solution has to resist malicious attacks, spot low quality information and preserve privacy. Computational model of trust appears to be essential candidates to enhance and support an effective analysis of alternative data. These mechanisms could help filter, interpret and rank individuals' behaviour to deliver the most reliable and adequate results. Similarly, they may be helpful in defining user-based anti-spam techniques, in supporting web-analytics applications that mine only trustworthy sites and users' activity, and helping users' segmentation and decisions support tools for online marketing [30].

To summarize, there are three main alternative data sources: online, mobile and psychometric data which is data concerning individuals' skills, attitudes and personality traits. Assessing personality traits in order to estimate

trustworthiness was widely used in HR practices for decades. Nowadays it is becoming an essential tool for credit scoring as well. The main advantage of this alternative data source lies in its availability and predictive power. However, the tool designed for trust measurement based on personality traits assessment have to meet reliability and validity requirements, as well as implement fraud prevention mechanisms and consider cultural characteristics.

3.2. Methodologies and techniques of alternative scoring

Although alternative scoring technology is commonly used in lending and HR areas, similar tools for trust measurement can be designed for any domain. Those tools are developed considering specific source of data, used for assessment (i.e. online, mobile, psychometric), since it influences the way information is collected and processed. Some tools allow to combine different sources of information, but it is not that common.

Unlike online and mobile data which already exists, personality data is actively captured at the time of assessment. While there is a limited range of data that can be possibly collected from digital footprint or mobile, personality data collection is only limited by the tool used for this purpose. This distinguishing feature makes personality data specific in comparison with other sources, thus a more detailed overview of its collection methodology is required.

The first step in developing a trust measurement tool based on alternative data is to clearly define its objective and area where it will be further implemented. This will determine whether to use statistical or judgemental approach for the scoring model development.

Generally, questionnaires are used to measure personality attributes and characteristics. The most common examples are:

1. *Knowledge-based* questionnaires (i.e. questionnaires of ability, aptitude and achievement)

2. *Person-based* questionnaires (i.e. questionnaires of personality, clinical symptoms, mood and attitude)

Several types of items are used in questionnaires, the most common of which are alternative-choice items, multiple-choice items and rating-scale items. Different item types are suitable for different purposes and consideration of the attribute or characteristic that the questionnaire is intended to measure is a guide towards an appropriate choice. In general, multiple-choice items are best for knowledge-based questionnaires, and rating-scale items are best for person-based questionnaires unless there is a special reason such as speed or simplicity, for choosing alternative-choice items.

The most appropriate number of options to choose will also depend on the nature of the questionnaire. It is important to provide a sufficient number for respondents to feel able to express themselves adequately while ensuring that there are not so many that they have to make meaningless discriminations. In questionnaires using rating-scale items where strength of response should be reflected in the respondent's score, it is usual for at least 4 options to be used.

It is sometimes necessary to use different types of item in questionnaire because of the nature of the material to be included. However, it is preferable to use only one item type wherever possible to produce a neatly represented questionnaire. Each item should ask only one question or make only one statement. It is recommended to avoid subjective words (i.e. "frequently") as these may be interpreted differently by different respondents.

The following habitual ways of responding should be considered when designing a new trust measurement tool:

1.   *Acquiescence* is a tendency to agree to items regardless of their content.

2.   *Social desirability* is a tendency to respond to an item in a socially acceptable manner.

3.   *Indecisiveness* is a tendency to the "I don't know" or uncertain option.

4.   *Extreme response* is a tendency to choose extreme option regardless of direction.

Good design is crucial for producing reliable and valid questionnaire. Respondents feel less intimidated by a questionnaire that has a clear layout and is easy to understand and take their task of completing the questionnaire more seriously. Questionnaire structure should include background information (headings, sufficient space to fill required personal information, date etc.); instructions; items layout design (items arranged in a way they are easy to read).

To score questionnaire, it is necessary to allocate a score to each response option and then add up the score for each item to give a total score for the questionnaire. It is essential not to confuse questionnaire scoring, standardisation and general scoring results. Standardization involves obtaining scores on the final version of the questionnaire from appropriate groups of respondents. These scores are referred to as norms. General scoring results will be further calculated based on the degree of deviation from the norms considering the outcome associated with the norms.

There are different approaches to personality assessment:

1.   *Personality type or traits*

Personality type refers to the psychological classification of different types of individuals. They are distinguished from personality traits, with the latter embodying a smaller grouping of behavioral tendencies. Types are sometimes

said to involve qualitative differences between people, whereas traits might be construed as quantitative differences [9]. According to type theories, for example, introverts and extraverts are two fundamentally different categories of people. According to trait theories, introversion and extraversion are part of a continuous dimension, with many people in the middle.

2. *Implicit or explicit approach*

Associative (implicit) processes are based on automatic affective reactions resulting from associations which are activated whenever a particular stimulus is encountered. A very important characteristic of associative processes is that they can be activated regardless of whether the individual considers them to be true or false. Propositional (explicit) processes are evaluations based on syllogistic inferences which assess the validity of the propositions. Hence, an important feature that distinguishes propositional processes from associative ones is their dependency on the truth value.

3. *Determinism or free will*

The determinist approach proposes that all behavior has a cause and is thus predictable. Thus, free will is an illusion, and our behavior is governed by internal or external forces over which we have no control. Free will approach assumes that people are free to choose their behavior.

4. *Nature or nurture*

The nature versus nurture debate involves the extent to which particular aspects of behaviour are a product of either inherited (i.e., genetic) or acquired (i.e., learned) influences. Nature is what is considered as pre-wiring and is influenced by genetic inheritance and other biological factors. Nurture is generally taken as the influence of external factors after conception, e.g., the product of exposure, life experiences and learning on an individual.

5. *Instinct or intrinsic motivation*

According to the instinct theory of motivation, all organisms are born with innate biological tendencies that help them survive. This theory suggests that instincts drive all behaviors. Intrinsic motivation refers to behavior that is driven by internal rewards. In other words, the motivation to engage in a behavior arises from within the individual because it is naturally satisfying to him or her.

It is also assumed, that the context in which a respondent completes the questionnaire influences the answers. Answers change depending on whether the questions were answered in high-stakes or low-stakes circumstances. Although low-stakes testing for building and validating scoring models is faster and quite common, it actually has no predictive validity in a real-world high-stakes situation. Most trustworthiness assessment tools are built using low-stakes data: many of the tools used in HR are developed by researchers testing volunteers; many lenders want to do a validation of their newly implemented alterative scoring tools on their clients through back-testing giving the application to existing clients and comparing scores to their repayment history. These approaches are only valid if low-stakes data can be applied to the real world of high-stakes implementation, where access to resources of the institution is on the line for individual.

Reliability of the tool is an estimate of the accuracy of a questionnaire. For example, a questionnaire is reliable if a respondent obtains a similar score on different occasions, providing the respondent has not changed in a way that affects his or her response to the questionnaire. There are several ways of measuring reliability: test-retest; parallel forms and split half.

The validity of a questionnaire is the extend to which it measures what it is intended to measure. Validity have to be determined in relation to the purpose of the questionnaire. There are several types of validity of which the

straightforward are: face validity, content validity, criterion-related validity and predictive validity.

To summarize, there is a number of properties, that have to be taken into consideration before an alternative scoring trust measurement tool development, including its purpose, scoring model development approach, personality theory paradigm, items type, design, reliability and validity.

3.3. Cultural characteristics impact on trust measurement results

As it was stated in paragraph 3.1., cultural characteristics may influence scoring results if standardisation and validation of the tool was conducted on the specific group of respondents, but the tool itself is used to assess trustworthiness of people from a different cultural context. For this reason, the main cross-cultural markers were determined, for which it is advisable to analyze the trust measurement tool to be unbiased.

Bias occurs when scores on a test vary depending on group membership. Groups can be defined in many ways but becomes particularly significant in areas where anti-discrimination legislation is in force, such as gender, ethnicity, social circumstance, disability, sexual orientation and now, age. There are three principle types of bias:

1. *Item bias* occurs when some items within a test show group differences that are disproportionate with the test as a whole. It might occur, for example, where a particular item contains English that is far too colloquial when addressed to respondents for whom English is not their first language. Item bias is, in principle, fairly easy to identify, but much more could be done to ensure that procedures are in place to keep it to a minimum.

2. *Intrinsic test bias* occurs where a test or questionnaire has differential reliability or validity for different groups, and much of the research on intrinsic

test bias was associated with attempts to introduce positive discrimination policies, particularly in the US. But latterly there has been an increased recognition that, apart from item level bias, most of the bias found in assessment is extrinsic to the test or questionnaire itself.

3. *Extrinsic test bias* occurs when differences in test scores between groups come about as a result of the impact of real differences in society. Bias in, and the consequent adverse impact of, trustworthiness assessment results can to a large extent be accounted for by differences between localities in the quality of education, level of income or any other social environment characteristics. These are themselves dependent on the impact of social policy on local demographics.

Cross-cultural barriers are manifested at the level of content as a lack of understanding, which is usually determined by low level of intercultural competence. Communicative competence here involves not only grammatically correct spoken or written language, but also the acceptability of statements and behavior in accordance with the culture in the system of rules [60]. The following types of cross-cultural barriers can arise in the process of biased trustworthiness assessment:

1. *Language barriers*. Representatives of different cultures use different models of perception of social reality through symbolic systems, and this is reflected in their use of language structures, styles of oral and written communication. According to scientists, linguistic problems are often the first difficulties in dealing with other cultures [48]. Thus, formation and development of linguistic competence is viewed as important for development and effective implementation of cross-cultural trustworthiness assessment tool. Language competence lies in the skillful use of common language forms, understandable and accessible to respondents.

2. *Stereotypes*. Features of national and ethnic awareness of different cultures often are the hurdles of intercultural interaction. In this context the following aspects of consciousness are of particular interest: the trend towards ethnocentrism, i.e. negative evaluation of the propensity of other cultures through the prism of one's own standards; stereotyping of ethnic consciousness, which manifests itself in the formation of a simplified view of other cultures and their representatives; prejudice as a result of selective inclusions in the process of cross-cultural contacts, including sensory perception, negative past experiences, etc. These effects are particularly important as potential barriers in a situation of incomplete information about the identity of the respondents [39]. It is in the context of the masses that they can unduly reduce the effectiveness of cross-cultural communication.

3. The differences in *value orientations* or ethnic and cultural barriers. There is an axiomatic assertion that the behavior of social actors is determined by the values of their cultures [33]. One of the phenomena that is due to human nature inevitably accompanies intercultural relations, is ethnocentrism, defined as a tendency to consider the norms and values of their own culture as a basis to evaluate and make judgments about other cultures" [40].

Ethno-cultural barriers are based on social, cultural, ethnic and religious differences. Here, the main reason for bias is a poor knowledge of another culture. According to the scientists, "the barriers of this type due to the peculiarities of ethnic consciousness, mainstream values and stereotypes are manifested in communion. They also generated social factors associated with the ownership of the participants of communication to various socio-cultural groups' [39].

4. *The locus of control*. The main point of Rotter's theory of the locus of control is this: if a person perceives him or her responsible for everything that

happens to him or her, the positive consequences of such behavior increase, and negative respectively weaken the possibility of similar behavior in similar situations in the future. If one accepts the consequences of behavior as independent of his or her control, but depending on the Fate, chance or other people, the previous model of behavior does not receive any reinforcements. The locus of control, as, no doubt, a profoundly personal feature, depends, however, on the culture to which a person belongs [29].

5. *Context*. An American anthropologist Edward Hall compares cultures depending on their attitude to the context, which is understood as the information that surrounds and accompanies the event, i.e. something that is woven into the significance of what is happening. Most of the information in highly contextual communication is already known to person, and only a small part of it is represented with words (coded, externally marked communication). Low-contextual communication is the opposite: most of the information is transferred through a sign code.

Accordingly, all cultures can be divided with this marker into high- and low-contextual. High-contextual cultures can be considered similar in terms of the accumulated historical experience, informational facilities and so on. By virtue of tradition and historical development of these cultures they do not change much over time, so the interaction with the world around the same incentive always causes the same reaction (e.g., cultures of the Arab world, Africa, Latin America, and Asia).

For members of a highly contextual cultures a lot is said and specified through non-linguistic context: the hierarchy, status, appearance of the office, its location and layout etc. All the necessary additional information is already laid in people's minds, and the interpretation of the message, without the knowledge of such hidden factors, is incomplete or incorrect, so the languages of highly

contextual cultures use a lot of hints and subtext, figurative expressions, etc. High-contextual cultures are more often than not collectivistic [29].

Low-contextual cultures are less homogeneous, interpersonal contacts are strictly separated, so, according to Hall, whenever people come into contact, they need information about everything happening around. The bulk of the information is contained in the words, not in the context of communication; people often express their desires verbally without assuming that it will be understood from the communicative situation. In such societies, the greatest importance is attached to the speech (written and oral), as well as to discussing the details: nothing remains unnamed and unsaid. In such cultures people prefer direct and open communication style when things are called by their names. Examples of such cultures are Germany, the UK, the Nordic countries, North America, Australia and New Zealand.

It should be noted that the scale of the Hall does not explain all intricacies of behavior: within the framework of the same culture one can find both high and low-contextual messages, people or demeanor. It is only the most typical or dominant type of interaction [29].

6. *Perception of space*. Different cultures have their own idea of the "personal comfort zone", which is combined with the appropriate emotional expressiveness and restraint. "People from different cultures have different understandings of body language as well as speech, oral or written. Despite the obvious differences of nonverbal behavior of different cultures, it is not always perceived as serious" [27].

Experts of cross-cultural communications believe that the differences in the following four aspects of body language are potentially the most explosive in the negotiations: proxemics (the behavior in space, the physical distance between

the interlocutors), haptics (behavior of touches), ophthalmology (eye contact), kinestetics (body movements, gestures).

7. *Perception of time*. As it is noted, "a different perception of time often leads to confusion" [33]. In this context, Hall distinguishes monochronic and polychronic cultures. In monochronic cultures, people at any given length of time are busy with one thing, they strictly follow the plans, schedules and arrangements, to avoid wasting time. Punctuality is important to them, and delay is considered a serious violation of social norms. In polychronic cultures, people do several things at the same time, the relationship between people is more important than plans and schedules [29].

Robert D. Lewis in his comparison of cultures also uses similar categories. He divides culture into three types: monoactive (or linearly arranged) polyactive and reactive. Monoactive do one thing in the period of time, fully focused on it and operate on a predetermined schedule. Representatives of polyactive cultures easily rearrange and can do several things at once, but do not like to break off the conversation. Finally, reactive culture, typical for Asian countries, organize activities not on a strict and immutable plan, but according to the changing context in response to the changes. Lewis describes reactive culture as those, who "listen", as the representatives of these cultures rarely initiate action or discussion, preferring first to listen and find out the position of the other [42].

8. *Religious beliefs*. To single out and clearly define certain basic concepts of a given culture and the factors influencing the attitude of this culture to its members, to others, to events in their environment, presents one of the major challenges to a researcher. The researchers recorded the fear of the supernatural in all cultures, and this is manifestly expressed in religions and religious beliefs.

Religious beliefs are reflected in the demeanor and manners of subjects of communication. Ignorance of the religious beliefs of other cultures, lack of

knowledge concerning their specific features can cause misunderstandings and misleading assessment results.

To summarize, there are eight major barriers that have to be considered when developing a trust measurement tool in order to keep it unbiased. Their analysis applied to items content as well as design will help to evaluate its efficiency and provide more solid foundation to obtain reliable results.

CONCLUSION

Luhman once noted in his work, that "trust is only involved when the trusting expectation makes a difference to a decision" [43]. Making efficient decisions is becoming one of the modern challenges in the context of globalization, especially when it comes to resources allocation process.

Uncertainty of the future raises the role of trust, a social phenomenon studied by many scholars across different disciplines. Analysis of classical and modern sociological theories of trust allowed to identify the fundamental differences between them and define an approach relevant in current social reality.

In Section 1, the paradigm for the further development of the topic was determined, allowing to highlight the essential elements of the structure of trust, as well as its functions and basic properties. The structure of trust includes a trustor, a trustee and a situation oriented towards future. The role of trustworthiness assessment in the context of trust measurement and the features of this process were also indicated. Trust decisions are mainly based on the estimation of one's trustworthiness, assessed mainly by his or her reputation, performance and appearance.

In addition, different types of trust were defined throughout the entire process of studying this phenomenon, however there is no in-depth analysis of the institutional trust. It was distinguished as a specific type of trust, characteristic mainly for the context of globalization.

Institutional trust is the trust granted by social structures or organizations towards social actors who interact with them in order to reciprocally meet their needs. Although legal obligations clearly indicate commitments of both the

institution and the social actor, for the institute there is still a risk that the outcome will be different from expected.

In order to identify an appropriate method for measuring institutional trust, the most common and widely used trust measurement methods were thoroughly studied. In Section 2, existing trust measurement methods were reviewed, as well as their modifications and application specifics. Meticulous analysis of existing types of trust measurement instruments has revealed the need for new methods development to measure institutional trust. This led to analysis of the capabilities of such a method as scoring developed for the purpose of risk assessment in the first place.

Scoring allows to measure social actors' trustworthiness by applying statistical analysis and making results scalable to a large group of people. In sociology, scoring can be defined as a model for classifying respondents into different groups. It is based on the assumption that people with similar social characteristics behave identically in the same context. Scoring is used as a quantitative measure of characteristics of past events to predict future events with similar characteristics.

The key features of this method were identified after analyzing the specifics of its application in various fields (management, marketing, lending). In addition, the most common scoring models were describes identifying their structural features and characteristics of the assessment process itself. However, there are some limitations of the traditional scoring models, thus the potential of alternative scoring technologies was unleashed.

In Section 3, a methodology for institutional trust measurement tool using alternative scoring technology was proposed, regarding the fact that reputation or past behavior is no longer considered to be the most reliable indicator for

predicting the future behavior. Alternative scoring is scoring based on alternative data sources, such as online, mobile and personality characteristics.

The main features of alternative scoring were examined, considering its advantages and disadvantages as a method of trust measurement, as well as the main methodological requirements for using this method to measure institutional trust by assessing the personality characteristics of an individual. In addition, the influence of cultural diversity on the results of such a measurement were presented along with the ways to adapt the tool to the context of different cultures.

As a result, a methodological basis was proposed for developing a tool for measuring institutional trust using alternative scoring technology.

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APPENDIX A

Scoring technology in HR: turnover prevention

One of the real cases that proves the efficiency of the scoring usage in HR was predicting and preventing turnover at Hewlett-Packard (HP). Some of HP sales divisions showed a turnover rate of 20% meaning that people stayed there on average between 4-5 years. High turnover generally leads to high recruitment costs and lost revenue due to productivity loss and onboarding.

To solve this problem, HP combined data of the previous 2 years to predict likelihood of leaving of each of HP's 300,000 plus employees and understand the reasons why. By using scoring models, they generated what they called a "Flight Risk". According to their findings, higher pay, promotions, and better performance ratings where, for instance, negatively related to "flight risk" yet when someone received a promotion but did not get a substantial raise, this person would still be much more likely to quit.

In the end, Flight Risk scores acted as an early warning system. It prompted well-trained managers to intervene before it is too late. Or, when the loss of an employee was unavoidable, to react accordingly. According to Siegel (2013), HP was able to save an estimated $300 million by applying predictive analytics to calculate this flight risk

APPENDIX B

Table 1

General overview of the traditional FICO score

Factor	Percent	Explanation
Payment history	35	Payment history is the most important factor affecting credit score. Lenders are interested in: payment history; the length of a positive credit history; whether there are any severe unpaid debts like bankruptcies or foreclosures; and the number and severity of delinquencies in credit history.
Amount owed	30	The extent of indebtedness plays a large role in determining credit score. Too many credit accounts and a high ratio of credit balances to credit limits can affect score significantly as well as the amount of debt on each account and the level of debt paid off on term accounts. Individuals can demonstrate responsibility by making scheduled payments and paying down installment loans.
Length of credit history	15	Longer credit histories result in higher scores. Important factors incorporated into credit scores are: length of credit history, length of time specific accounts have been open, and the duration of time since each account was last used.
How much new credit	10	Credit scores also incorporate information about how much new credit individual is taking on. Credit scores track applicants who suddenly take on new debt and potentially overextend themselves, by checking to see when the last time a individual opened an account and how many accounts were opened and by

Factor	Percent	Explanation
		looking at the number of inquiries on the individual's credit reports.
Type of credit	10	The type of credit individual plays an important role in determining credit score. A "healthy mix" of installment loans and revolving credit from banks is considered better for the score.

Source: *Credit Scores & Credit Reports. How the System Really Works, What You Can Do*, by Evan

Annotation

The research is devoted to analysis of institutional trust in the context of globalization and its modern measurement tool methodology development.

Object – trust in the context of globalization.

Subject – alternative scoring as a modern tool for measuring institutional trust.

The goal is to prove the possibility of measuring institutional trust by applying alternative scoring technology.

The research consists of introduction, three sections, nine paragraphs, conclusion and the list of used sources.

In theoretical part of the research classical and modern approaches to interpretation of trust were described, defining the paradigm of trust in the context of globalization for the further development of the topic. Following the analysis, definition of the term "institutional trust" was provided in line with its main characteristics.

Methodology for the modern trust measurement tool development was described following the theoretical analysis, considering capabilities of such measurement method as scoring, its application specifics and general overview.

Overall volume of the research is 94 pages, 81 of them compose the content of the research. The number of used sources – 71.

KEY WORDS: TRUST, TRUST MEASUREMENT, MODERN TRUST THEORIES, SCORING, ALTERNATIVE SCORING, INSTITUTIONAL TRUST, GLOBALIZATION.

Аннотация

Работа посвящена анализу феномена институционального доверия в условиях глобализации и разработке методологии для современного инструмента измерения такого типа доверия.

Объект – доверие в условиях глобализации.

Предмет – альтернативный скоринг как современный инструмент измерения институционального доверия.

Цель – обосновать возможность измерения институционального доверия, применяя технологию альтернативного скоринга.

Работа состоит из введения, трех разделов, девяти подразделов, общего заключения и списка использованных источников.

В теоретической части исследования были описаны классические и современные подходы к интерпретации доверия, определяющие парадигму доверия в условиях глобализации для дальнейшего развития темы. В рамках анализа было дано определение термина «институциональное доверие» и его основные характеристики.

В рамках теоретического анализа была предложена методология разработки современного инструмента для измерения доверия с применением технологии скоринга, общий обзор данной технлогии, а также рассмотрены возможности такого метода и особенности его применения.

Общий объем работы – 94 страниц, из них общего текста – 81 страницы, количество использованных источников – 71.

КЛЮЧЕВЫЕ СЛОВА: ДОВЕРИЕ, ИЗМЕРЕНИЕ ДОВЕРИЯ, СОВРЕМЕННЫЕ ТЕОРИИ ДОВЕРИЯ, СКОРИНГ, АЛЬТЕРНАТИВНЫЙ СКОРИНГ, ИНСТИТУЦИОНАЛЬНОЕ ДОВЕРИЕ, ГЛОБАЛИЗАЦИЯ.

Анотація

Роботу присвячено аналізу феномена інституційного довіри в умовах глобалізації та розробці методології для сучасного інструменту виміру такого типу довіри.

Об'єкт – довіра в умовах глобалізації.

Предмет – альтернативний скоринг як сучасний інструмент вимірювання інституційної довіри.

Мета - обґрунтувати можливість вимірювання інституційної довіри, застосовуючи технологію альтернативного скорингу.

Робота складається з вступу, трьох розділів, дев'яти підрозділів, загального висновку та списку використаних джерел.

В теоретичній частині дослідження були описані класичні та сучасні підходи до інтерпретації довіри, що визначають парадигму довіри в умовах глобалізації для подальшого розвитку теми. В рамках аналізу було дано визначення терміна «інституційна довіра» і її основні характеристики.

В рамках теоретичного аналізу була запропонована методологія розробки сучасного інструмента для вимірювання довіри із застосуванням технології скорингу, загальний огляд даної технлогії, а також розглянуті можливості такого методу і особливості його застосування.

Загальний обсяг роботи - 94 сторінок, з них загального тексту – 81 сторінки, кількість використаних джерел – 71.

КЛЮЧОВІ СЛОВА: ДОВІРА, ВИМІР ДОВІРИ, СУЧАСНІ ТЕОРІЇ ДОВІРИ, СКОРІНГ, АЛЬТЕРНАТИВНИЙ СКОРІНГ, ІНСТИТУЦІЙНА ДОВІРА, ГЛОБАЛІЗАЦІЯ.