The mastering of even simple Physics models - a social strategic advantage for legal professionals

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- The main contributor, **Ioana-Roxana CHISLEAG LOSADA** regrets and apologizes for not being able to personally attend the **“Econophysics and Sociophysics” Workshop, University of Pitesti, June 29, 2013**

I. Newtonian Mechanics Models to Assist in 2013 Revision of Romania's 2003 Constitution

- This is a scientific contribution
- The authors are not implied in political debates or in the activity of any political party.
- They introduce Physics tools able to offer useful social conclusions, as objective as possible, subject to competent criticism.
- The authors welcome such critics and shall try to improve their research.
- The authors are waiting for participants in the debates make all use of Physics models.

Key words

- Newtonian Physics Models,
- Action and Reaction, Inertia, Proportionality, Conservation principles, Dimensional Analysis, Dimensional homogeneity, Error Estimation,
- Socio-physics,
- Socio-optics.

- The humans interact with Nature, subject to the Principles and Laws of Natural Sciences – Physics, Chemistry, Biology a. s. o.
- All the above mentioned principles and laws are natural ones, independent of the human wish.
- The humans interact between them subject to the principles and Laws of Sociology and Psychology

- The functioning of the Human Society is governed, besides natural laws, by laws generated by humans themselves – the Law System (when including institutions – the Judicial System), developed along the History of Mankind, with local variations in space, vicinity, time, time horizon, available resources and environmental conditions, technologies, but aiming, more or less, to the best functioning of a given society in the present and for a shorter or even longer run.

- Particularly, because Physics has large spectra of models and it is studied from the school age as a component of scientific literacy, Physics is called to suggest scientists and to help them to apply laws, principles, methods, structures, models and ways to understand, identify, describe, manage and control social, political and economic phenomena, by analogy with physical natural phenomena.

- If we refer to the social behavior of an individual, the Quantum Physics seems to the authors as being adequate.
- If there is considered the Human Society as being composed of many individuals (its members), relatively similar, the Principles of functioning of the given Society composed of members - humans are somehow analogous to the Principles of Classical, Newtonian (Macroscopic) Physics, valid for bodies composed of many molecules (mono- or polyatomic).

- The simple Physics models when applied to society, might have some characteristics a little different from those of the Physics laws:
- social laws and the definitions or the conditions for space, time, objects, and interactions are relatively less rigorous than in Physics.
- The authors consider social laws, when possible, as being postulates (acceptable, based upon partial check), but less rigorous.

- Physics models may and must help, in the authors' opinion, to have a better and future oriented revision of the 2003 Romania's Constitution, subject to public debates, opened these days, based on the Project of Revision of Constitution of Romania, issued by the Parliament of Romania on June 19, 2013.
- Physics models and those mastering them, socially committed scientists and particularly, professors of Physics may assist members of the Revision Commission and all those interested to design, to evaluate and improve, using Socio-Physics, every proposal and suggestion and find better solutions, to the benefit of the people of Romania and of the European Union.

- There are two complementary approaches useful for socially committed scientists:
- - to find a Physics model to explain a chosen type of social, politic or economic phenomenon - like in the next part of this paper or
- - to start from an existing Physics model and to find social, political, economic phenomena where that Physics model may, eventually, fit successfully - like in some previous papers of the authors (see References).

- The most general Tools, Principles and Laws of the Macroscopic Physics which have correspondents in Social Sciences and in Physics modeling of the functioning of the Human Societies, as Postulates, used by the authors, in their present research, are:
  - Newton Laws, next referred as: I st, II nd and III rd Newton.s Postulates (NP):
    - I NP - Status quo antem
    - II NP - Postulate of Proportionality
    - III NP – Postulate of Action and Reaction or Postulate of Rights (fredoms) and Duties (obligations)

- Models of equilibrium of a body
- Postulates of Conservation (PC), mainly referring to non renewable resources
- Dimensional Analysis (DA), particularly the observance of dimensional homogeneity in comparing social "quantities"
- Basics of Processing of Experimental Data

- In this paper, the authors, comment and eventually make suggestions, in the text, objectively resulting from the analysis of the proposals in the Draft Revision Law, of June 19, 2013, modelling the proposed amendments by using the introduced in the paper Classical Physics models, to suggest how to improve them to eventually forecast and prevent some types of errors when considering different world sceneries for different social, legal and economic phenomena at different levels, thematic, space and time horizons.

Newton's laws of motion

- The three laws of motion were first compiled by Sir Isaac Newton in his work *Philosophiæ Naturalis Principia Mathematica*, first published on July 5, 1687.
- Newton used these 3 laws to explain and investigate the motion and of equilibrium of many physical objects and systems.
- These laws describe the relationship between the forces acting on a body and the motion of that body due to those forces.
- These laws have been expressed in several ways over more than three centuries and may be summarized as follows:

I st Newton Law – Law of inertia, Status quo antem

- Every body persists in its state of being at rest or of moving uniformly straight forward, except insofar as it is compelled to change its state by the force impressed.
- If the resultant force (the vector sum of all forces acting on an object) is zero, then the velocity of the object is constant:

$$\sum \mathbf{F} = 0 \Rightarrow \frac{d\mathbf{v}}{dt} = 0.$$

- Consequently, an object that is at rest will stay at rest unless an unbalanced force acts upon it; an object that is in motion will not change its velocity unless an unbalanced force acts upon it.
- Newton's first law is often referred to as the law of *inertia*. It is a restatement of the law of inertia which Galileo had had already described. It permits the introduction of inertial reference frames.

- The I st N.P. is well represented in the Draft of the Revision Law, the major part of the paragraphs remaining unchanged, – "nemodificat" in RO.
- Therefore, the authors will not indicate in the text of the Draft Law, the use of I N.P.

Second Newton Law (II nd NP) – Law of Proportionality

- The net force acting on a particle is equal to the time rate of change of its linear momentum **p**, in an inertial reference frame:

$$\mathbf{F} = \frac{\mathrm{d}\mathbf{p}}{\mathrm{d}t} = \frac{\mathrm{d}(m\mathbf{v})}{\mathrm{d}t},$$

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- where, for constant-mass systems, the mass can be taken outside the differentiation operator by the constant factor rule in differentiation. Thus,

$$\mathbf{F} = m\frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} = m\mathbf{a},$$

- where **F** is the net force applied, m is the mass of the body, and **a** is the body's acceleration. Thus, the net force applied to a body produces a proportional acceleration.
- Any mass that is gained or lost by the system will cause a change in momentum that is not the result of an external force.
- A different equation is necessary for variable-mass systems.

- Consistent with the first law, the time derivative of the momentum is non-zero when the momentum changes direction, even if there is no change in its magnitude; such is the case with uniform circular motion.
- The relationship also implies the conservation of momentum: when the net force on the body is zero, the momentum of the body is constant.
- Any net force is equal to the rate of change of the momentum (as a vector, in magnitude or in direction).

Third Newton's Law (III NP) – Law of Action and Reaction – Law of Rights and Obligations

- To every action there is always an equal and opposite reaction; or the forces of two bodies on each other are always co-linear, equal in magnitude and are directed in opposite directions.

- The Third Law means that all forces are interactions between different bodies and thus that there is no such thing as a unidirectional force or a force that acts on only one body.

- Whenever a first body exerts a force **F** on a second body, the second body exerts a force −**F** on the first body. **F** and −**F** are equal in magnitude and opposite in direction. This law is sometimes referred to as the action-reaction law, with **F** called the "*action*" and −**F** the "*reaction*". The action and the reaction are simultaneous.
- A force means an interaction; it acts between a pair of objects, and not on a single object. So, each and every force has two ends.

- Each of the two ends is the same except for being opposite in direction. The ends of a force might be considered as mirror images of each other.
- Newton's third law may be stated, also, as:

"Given two objects A and B, each exerting a force on the other,

$$\sum \mathbf{F}_{a,b} = -\sum \mathbf{F}_{b,a}$$

- where **F**a,b are the forces from B acting on A, and **F**b,a are the forces from A acting on B.

- Newton used the third law to derive the law of conservation of momentum; however from a deeper perspective, the conservation of momentum is the fundamental idea.

Laws of conservation

- In modern physics, the laws of conservation of linear momentum, angular momentum and energy are of more general validity than Newton's motion laws, since they apply to both light and matter, and to both classical and non-classical physics. This can be stated simply, "Momentum, energy and angular momentum can neither be created nor destroyed."
- Conservation of energy was discovered nearly two centuries after Newton's lifetime, the long delay occurring because of the difficulty in understanding the role of microscopic and invisible forms of energy such as heat and infra-red light.

Social applications of Newton's Laws

- To Newton Laws (in social applications - Postulates") corresponds causality, which is the relationship between an event (the cause) and a second event (the effect), where the second event is a consequence of the first, in the special situation when antecedence is reduced to simultaneity, understood as for social phenomena (as having a much larger time constant).

- Though cause and effect are typically related to events, candidate quantities in social life include: objects, resources, processes, properties, variables, facts, rights, actions.
- The quantitative analysis of causes and effects of a process, based on these three Laws (social Postulates) may stay at the basement of any social analysis.
- "Status quo antem" corresponds to 1st Postulate: "no action leads to no change in motion".

- To the 2nd Postulate may correspond principles and rules of proportionality

- *Proportionality* is an accepted principle in law which covers two distinct (although related) concepts: within Criminal law (at national levels) and International. Law.

- In Criminal law, the punishment of a certain crime should be in proportion to the severity of the crime itself. In practice, systems of law differ greatly on the application of this principle. In some systems, this was interpreted as lex talionis, (an eye for an eye). In others, it has led to a more restrictive manner of sentencing. For example, all European Union countries have accepted as a treaty obligation that no crime warrants the death penalty, whereas some other countries in the world do use it.

- The proportionality principle, moreover, is regarded as a fundamental element of regulatory policy and public administration.
- Over the past fifty years, it has become a preferred procedure for managing disputes involving an alleged conflict between two rights claims, or between a rights provision and a legitimate state or public interest.

- The principle of proportionality has played an important role in preventing undue invasions of basic rights for the purposes of countering terrorism.
- The characterizing of the causal relationship may be the subject of much debate, in each case.
- Contiguity, implied in causality, postulating that cause and effect must be in spatial contact or connected by a chain of intermediate things in contact (Born, 1949); is always implied.

- The Postulate of Proportionality may be used to settle debates on some topics. F. e.:
- In new paragraph:
- **Art.1.-** ***(1[1]) of the 2013 Draft Revised Constitution of Romania is intensely debated: « România recunoaşte rolul istoric, în constituirea şi modernizarea statului român, al <u>Bisericii Ortodoxe şi al celorlalte culte religioase recunoscute de lege</u>, al Casei Regale şi al minorităţilor naţionale ».***

- *BUT, if there is considered the number of signs relatively proportional with the importance of topics,*
- THE NEW (underlined) TEXT IS RATHER DISADVANTIGING B.O.R. (18 LETTERS, ~9/10 BELIVERS) when COMPARED (FROM THE POINT OF VIEW OF The PRINCIPLE OF PROPORTIONALITY) WITH ALL OTHER CULTS TOGETHER (48 LETTERS, but only~1/10 BELIEVERS). THE CRITICS ASK FOR A LARGER DISEQUILIBRIUM !

The III rd N. P. applications

- The Physics action-reaction Law, as an *action-reaction postulate* (ARP), may model many non physical phenomena. These phenomena might have some characteristics different from those of the Physics law of action–reaction, but not, essentially, affecting it. For example, the time constant might be different, the nature of the reaction might be also different.

- 3rd Newton's action-reaction Law has analogies in many non physical issues:
- In the theories on Law, the rights are always accompanied and conditioned by obligations. If the action means more rights, the reaction would mean more obligations. The reverse allegation is also valid.
- A civic principle asks that one should take responsibility for his own mistakes.
- Complying with the Action – Reaction Postulate (rights vs. obligations) is at the basement of judges' reasoning.

- The observation of the action-reaction Postulate is evident in the major part of provisions of national Constitutions, but, due to disequilibrium in the obligations and the rights in the past, many constitutions explicitly mention more rights than duties, proving a disequilibrium between rights and duties, tempting many citizens to think only to their rights, neglecting to comply with their duties.

- There are to be mentioned here the unhappy titles of some important international treaties like ‘‘Human Rights Charter’’ or name of prestige institutions like ‘‘Courts of Human Rights’’ which encourage the abuse of requiring more rights by those who do not observe their correspondent obligations.

- In Constitution of Romania, for example, the Chapiter II - “Fundamental rights and obligations” of Title 2 “Fundamental rights, freedoms and duties” contains 31 different rights and freedoms (Art. 22-52) but the Chapter III - Fundamental duties contains only 4 duties (Art. 54-57).
- Rarely there is approached a pair – a right vs its corresponding obligation.

- Typical examples of breaking action-reaction Postulate (ARP), using constitutional provisions are offered by political parties which, during electoral extended campaigns, to gain votes, do pass laws providing for uncovered budgetary future expenses, which shall lead to future chronic State Budget Deficits.

- Some constitutional provisions may be infringed by other laws, previously passed by Parliaments, generating „fraud on law”.
- The solutions for the Parliaments would be to amend those laws making possible “fraud on law”, through an adequate revision of the Constitution.

- For the Revision of the Constitution, it seems necessary, as regards legislation procedures, to improve the legislation regulations leading to the passage of laws in Parliament or of adopting Ordinances by the Government or of issuing institutional advices and reports and to increase the personal responsibility of all legislators, including the Parliament members which, must decide in the favour of public interest: "In the exercise of their mandate Deputies and Senators shall be in the service of the people" (Constitution of Romania),
- but not in the private interests of some individuals or groups, deeply interested to be favoured, as have been accused, sometimes.

- An analysis of the Constitutional content, at the Revision, by systematically considering the mentioned Postulates (of proportionality and of rights and obligations) seems necessary.
- For educating a responsible citizen, there is important to teach the citizens to try to be inventive, creative in observing the action-reaction and proportionality postulates, not creative in finding ways to infringe them.

Application of Conservation Laws (as social Postulates)

- The 3rd Newton's law, the action-reaction law is, in Physics, the result of conservation laws of quantities non regenerative and non perishable in a conservative system (referring to total energy, total linear or/and circular momenta), to ensure the stability of the system in its stationary evolution.

- Conservation laws are present, too, in human social life, when having a limited non renewable resource for a defined social group, under specified conditions, subject to defined space and time horizons. The conservation postulates might limit the social development, particularly at global level (industry, agriculture, tourism) mainly due to the consumption of limited, non-renewable world resources (fossil fuels, f. e.).

The conservation laws impose that a further development of developed countries observing traditional patterns is not a solution, on the actual pattern, if we consider a worldwide homogenizing of the level of development. Some world finite resources may limit the world development to a couple of years, only.

- May be, it is the case to introduce into Constitution the concept of ‘’re-development’’ and of other ‘’intelligent’’ ways of development.
- In case of being possible a sustainable increase of known resources, the speed of this possible increase of available resources put limits to a sustainable rhythm of development. Of course, progress in science, technology and management in replacing limited resources with others, renewable or less scarce ones, make a sustainable development possible on a longer run, on a larger human and geographical scale, for those advanced in research and development.

- The conservation laws may require redistribution of world resources or of their rhythms of consumption and these requirements may generate conflicts and the participation in defending treaties is essential and is to be mentioned in the Constitution in the right position.
- A debt on the Future is not an unlimited resource as it is seen by some governments, but it is leading to a spiral of debts, taxation, discouraging business but promoting corruption and regress in the middle run and more, in the long run. These debts generated by an egocentric generation are to be paid by future generations. The Constitution might put a superior limit to debts.

Dimensional Analysis

- Dimensional Analysis (D. A.), largely used not only by physicists but by almost all scientists, is easy to be understood and applied, allows and stimulates creative approach, may be largely applied almost everywhere, including in analyzing the proposals for the revision of Constitution.

- The basic principle of Dimensional Analysis was known to Isaac Newton (1686), who referred to it as the "Great Principle of Similitude". Important contributions were made by the 19th century French mathematician Joseph Fourier, based on the idea that the physical laws (like $F = ma$) should be independent of the units employed to measure the physical variables.

- This led to the conclusion that meaningful laws must be formulated as homogeneous equations in their various systems of units of measurement.
- In Physics, D. A. refers to the operations with dimensional equations and with units, describing the nature of physical quantities. In other sciences D. A. operates with other specific quantities.

- Because physical quantities may be connected, in many ways, there is necessary to select a set of physical quantities to be considered a fundamental (basic, primitive or primary) set, from which all others physical quantities, the derived (secondary) quantities, could be defined.
- The choice of the basic set of dimensions is, thus, partly a convention, but cannot be arbitrary, because the dimensions must form a basis: they must span in a multi-dimensional space and be linearly independent.

- All the commonly used systems of units in physical science have the property that the number representing the magnitude of any quantity (other than purely numerical ratios) varies inversely with the size of the unit chosen.
- This universal property of unit systems, often known as the ‘’absolute significance of relative magnitude’’, determines the structure of all dimensional formulas.
- Because physical quantities may be connected, in many ways, there is necessary to select a set of physical quantities to be considered fundamental (basic, primitive or primary), from which all others, the derived (secondary) quantities, could be defined.

- The choice of the base set of dimensions is, thus, partly a convention, but cannot be arbitrary, because the dimensions must form a basis: they must span in a multi-dimensional space and be linearly independent.
- Basic units are defined for fundamental quantities, possibly in different ways, in different historic periods, in different fields.
- The fundamental quantities (and their symbols) and their units (and symbols), currently agreed in Physics, established by international convention, form the International System of units (SI) and are:

- *length*, **L** (m, meter); *time*, **T** (s, second); *mass*, **M** (kg, kilogram); *electric current*, **I** (A, ampere); *thermodynamic temperature*, □□□□□□□□kelvin); □*amount of substance*,□**μ** □□(□□mol, mol); *luminous intensity*, □**J** (cd, candela)**.** They form a set of fundamental dimensions and may be seen as a vector space over rational numbers.
- In other fields one may define other fundamental dimensions.

- The units of chosen fundamental quantities in a system of units are chosen by convention but the units for the derived quantities are to be established as to be able to eliminate parasite factors of conversion between the units for the same quantity and to preserve simultaneously valid the equations for quantities and units.
- Such a system of units is called a coherent system of units.
- The coherence of a system of units is the result of recognizing the existence of essential relationships among physical quantities.

- *Strictly, when like dimensioned quantities are added or subtracted or compared, these dimensioned quantities must be expressed in coherent units so that the numerical values of these quantities may be directly added or subtracted, the equations connecting the magnitudes only, being exactly like the physical equations.*
- Therefore, all conversion factors have to be equal to 1 and could be disregarded in practical work..

- It can be proved that every secondary quantity which satisfies the condition of the absolute significance of relative magnitude is expressible as a product of powers of the fundamental quantities

- For example, the physical quantity, speed, may be measured in units of meters per second, miles per hour etc; but regardless of the units used, speed is always a length divided a time, so we say that the dimensions of speed are length divided by time, or simply **[v] = L/T**.

- Thus, dimensional analysis may be used as a sanity check of physical equations: any equation must be ‘’dimensionally homogeneous’’, for all fundamental dimensions.
- Scalar arguments to transcendental functions such as exponential, trigonometric and logarithmic functions, or to inhomogeneous polynomials, must be dimensionless quantities.
- The dimensionless constants could not be computed by D. A.

- The choice of the dimensions or even the number of dimensions to be used in different fields of physics (and not only) is to some extent arbitrary, but consistency in use and ease of communications are very important.
- *The most basic consequence of dimensional analysis is that only commensurable quantities (quantities with the same dimensions) may be compared, equated, added, or subtracted.*

Units

- Dimension is a more abstract concept than scale unit: mass is a dimension, while kilogram is a scale unit (choice of standard) in the mass dimension.

- **Operations with dimensional equations; observing dimensional homogeneity**
- A necessary condition for the correctness of any equation is that the two sides have the same dimensions, are measured in the same units, whitin the same system of units.
- The condition of dimensional homogeneity has to be observed for each equation and for each term.

- *There is allways compulsory to observe in each case (products, powers), the equalities of the exponents (dimensions) of each basic physical quantity which enters in any term and in each member of a dimensional equation as any relationship among dimensional expressions be homogenous relatively to all fundamental physical quantities.*
- Any physical equation:
- **X1 = X2**

- may be true when and only when the corresponding dimensional expressions of the members of the equation are identical:
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- **[X1] = [X2]**

- that meaning that the equation may be true only when there is observed the propriety of homogeneity of the equation with respect to all fundamental physical quantities. This homogeneity check my be easily done by expressing each of the quantities in the last equation in the fundamental units in which the solution is required, too.
- For social modelling there may be necessary to introduce specific dimensions for specific fields.

Applications of Dimensional Analysis

- Dimensional analysis is most often used in Physics, Chemistry, Engineering - and in the Mathematics thereof - but finds applications largely outside of these fields as well.
- D. A. analysis is a tool to understand the properties of physical (or other specific) quantities, independently of the units used to measure them.

- D. A. may be always used to check the dimensional homogeneity of physical equations and not only. It is a help in the check of complicated analytic expressions. It affords a convenient means of checking equations used in other sciences.
- D. A. may be approached as a primary tool for obtaining information about physical (and other) systems, too complicated for full mathematical solutions be feasible.

In Law, D. A. is essential to understand principles and to design legal or norms.

In Finance, Economics, and Accounting, Dimensional Analysis, as a part of Econophysics, is most commonly used in interpreting various financial, economics and accounting ratios.

Some examples of applying Dimensional Analysis

- D. A. applied in Sociology, by sociophysicists, leads to solutions of problems that have not been solved before in regard to decisions, intentions, emotion, cognition.
- Of course, the help of D. A. could not replace human decision-makers. A manager's domain expertise and tacit knowledge can not be replaced by an automated algorithm. However, a sorrow analysis can support and augment decision-makers' instincts and reasoning abilities.

The authors suggest to to be introduced for the analysis of the Draft Law of th Revision of Romania's Constitution:

- The "procreation" fundamental dimension, when defining the family;
- **Reproduction** (or **procreation**) is the biological process by which new "offspring" individual organisms are produced from their "parents". Reproduction is a fundamental feature of all known life; each individual organism exists as the result of reproduction.
- Sexual reproduction is a biological process by which organisms create descendants that have a combination of genetic material contributed from two different members of the species. Each of two parent organisms contributes half of the offspring's genetic makeup by creating haploid gametes. The two sexes are referred to as male (producing sperm or microspores) and female (producing ova or megaspores).

- The sexual reproduction has a bigger advantage by itself, since it allows gene shuffling (hybrid or recombination between multiple loci) among different members of the species, that permits natural selection of the fit over these new hybrids or recombinants that are haploid forms.
- From the dimensional point of view, due to "procreation" dimension, the families are of two heterosexuals.
- He homosexual couples represent the human society in its biologic terminal stage, not being able to ensure the next generation.

- The “hierarchic competence level” when analyzing the relationships between the legislative, executive, judicial and financial powers.
- The “time horizon”, to, be able to compare the effect in time of different constitutional provisions, f. e. for the “reasonable time”.

Equilibrium

An object is in **equilibrium** if the linear momentum of its center of mass is constant and if its angular momentum about its center of mass is constant:

- P = constant If a body is in **translational equilibrium** then dP/dt = 0
- L = constant If a body is in **rotational equilibrium** then dL/dt = 0
- To ensure the equilibrium of a body, there is necessary that it has a support enough large that the center of mass‘ vertical rests inside it during the considered process.

- Therefore, by analogy, there are necessary three powers – legislative, executive and judicial, in a relative equilibrium among them to insure the stability of the center of mass – the presidency, representing the state.
- The introduction in the new Constitution of a new autonomous financial power, represented by the National Bank of Romania is to change many things in the power relations among the powers of the state.

Processing of errors

- Other Physics tools in modelling the socio-economic life are Physics common procedures in processing the errors on experimental data.
- Such procedures, might be used in improving the control of public expenditures, f. e., when selecting a winner of a public auction for services or goods (highways, mines, army goods a. s. o.) or for public-private partnership investments, by changing the current regulations, such as to observe common procedures in processing the errors on physical experimental data.
- The authors have used D. A. in developing models to compute the propagation of errors in economic forecasts.

- The D.A. permits, f. e., to quantitatively evaluate the responsibility of the members of the Parliament, to demonstrate that Taxation of financial activities is dimensionally correct and at level to be regulated a.s.o.
- Following there is displayed the June 19, 2013 Law of Revision of Romania 2003 Constitution, with the comments and suggestions of the authors, using Classical Physics models.