System Growth Modelling – An Insight into the Linguistic Theory of Growth

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Abstract

Growth is the factor, which underlies any movement and change, because every movement and change can be characterised by the process of an increase and/or decrease in the value of its parameters, and this process we understand as a process of growth or briefly growth. This trait of growth leads to the conclusion that growth is a very basic function of any element and system in nature and therefore it has very wide generality.

This paper, based on our development of the linguistic approach to a qualitative and quantitative modelling of systems and processes, outlines the basic aspects of system's growth in the form of mathematical trajectories. Our work uncovers more complex aspects of growth and its association with currently used methods of modelling and reveals more effective ways to analyse and steer behaviour of different kinds of systems and processes.

Keywords: linguistic theory of growth, trajectories

1 Introduction

Regardless of the aim and the circumstances of the use of language, its primary function is always the identification of certain reality, which can consist of real and/or abstract elements of our surroundings. It can be qualitative and/or quantitative identification of static and/or dynamic traits of the studied reality. The common language is the basic tool for general qualitative identification and assessment, whereas logic is a special development of formal qualitative identification.

The universal phenomenon of repeatability of various elements in nature is the main reason behind the quantitative aspect of the function of systems. In addition, it also has a fundamental influence on the organisational order of every system. The static order of a system is determined by the repeatable geometry of its elements and the dynamic order by the repeatable changes or processes. The most repeatable process is growth, which can be represented in the form of $x=x_0\pm\Delta x$, where 'x' is the quantity of a parameter of an element expressed by a number, 'x_0' is the initial quantity and 'Δx' is the quantity of the rate of growth. This rate (Δx) is the quantitative and elementary model of activity of growth or briefly the model of activity. When the rate equals zero ($\Delta x=0$), then the parameter 'x' is constant or does not manifest its activity.

The natural response of language to the phenomenon of repeatability has been the creation of numbers and four operations: addition, subtraction, multiplication and division. These elements were the basis of the development of a complicated scientific language, which describes quantitative issues in the form of mathematics. The universality of repeatability is responsible for the great role of mathematics, as a language developing quantitative identification, in the processes of cognition and utilisation of various phenomena. Moreover, repeatability also causes that in the processes of identification and modelling exists a great need and scope for the creation of synthetic and abstract models and ideas. In this context, the most important synthetic and qualitative idea in the function of systems is the structure of the complex sentence and its basic element subject-object relation. This idea reflects the fundamental functions of systems that are being observed and experienced by human beings.

In addition, the naturally formed and organically connected qualitative and quantitative methods of identification of processes and systems are the firm basis to the conclusion that the processes of system modelling should not omit their qualitative or quantitative aspects. Exclusion of one of these aspects represents an extreme solution and leads to serious methodological errors, because extreme phenomena are relatively rare in nature in comparison to stabilised and balanced phenomena, which are changeable in a gradual manner.

2 General Analysis of Growth in Relation to the Subject-Object Relation

Our research indicates that the subject-object relation represents an elementary system or a field of force of the system [Turkiewicz K. and Turkiewicz D.B., 2004]. Hence, analysing the quantitative aspects of the function of the processes of growth, we assume that the two elements 'x' and 'y' form the subject-object relation $R_s(x,y)$, where the elements are able to change according to the structures $x=x_0\pm\Delta x$ and $y=y_0\pm\Delta y$ within the range $r>0$ or $r_x>0$ and $r_y>0$. The parameter 'r' represents a limited and shared factor of growth determining the possible magnitude of these elements. However, the parameters r_x and r_y represent limited and independent factors of growth. Any substance, space and information can be these factors and their magnitude is a real number, which determines for example its quantity of units of mass, length or any other units. The fundamental structure ($x=x_0\pm\Delta x$) of growth underlaying any changes shows that every change of an element in nature occurs with participation of its surroundings. This means that every positive rate of growth ($+\Delta x$) of the element 'x' is accompanied by negative rate of growth ($-\Delta x$) of its surroundings and vice versa.

The naturally formed operations of addition, subtraction, division and multiplication are also the concepts of the following quantitative characteristics of the activity of growth of the system $R_s(x,y)$:

1. Addition and substruction of the rates of the elements ($\Delta A_S=\Delta S=\beta_x\Delta x+\beta_y\Delta y$ and $\Delta A_D=\Delta S=\beta_x\Delta x-\beta_y\Delta y$) appropriately determine the activity of growth of the magnitude of the system and the quantitative diversity of its elements, where 'S' is the magnitude of the system, 'x' and 'y' are the magnitudes of the elements, 'D' is the magnitude of their diversity and β_y,β_x are the constant coefficients determining the influence of the elements on the system.
2. Multiplication of the rates $\Delta A_{xy}=\gamma_{xy}\Delta x\Delta y$ determines the interdependent activity of growth formed by the elements 'x' and 'y'.

3. Division characterises the rigidity (intensity of growth or resistance to growth) of one parameter with respect to another. This is denoted as $IR_{p1/p2}=\Delta p1/\Delta p2$ and means that rigidity 'IR' of growth of parameter 'p1' in relation to growth of parameter 'p2' is a quotient or ratio of rates 'Δ', where p1,p2 belong to the set {x,y,S,D,A,r and other parameters} [Turkiewicz K. and Turkiewicz D.B., 2004].

Because every elementary existence of systems is always continuous, therefore continuous functions of growth are the basic or initial elements of any theory of growth. Hence, we denote the mentioned rates as $dA_S=\beta_x dx-\beta_y dy$, $dA_D=\beta_x dx-\beta_y dy$, $dA_{xy}=\gamma_{xy}dxdy$ and $IR_{p1/p2}=dp1/dp2$. If we assume that 'x' and 'y' are independent variables, the elementary intensities of activities adopt the following forms $dA_S/dx=\pm\beta_x$, $dA_D/dx=\pm\beta_x$, $dA_S/dy=\pm\beta_y$, $dA_D/dy=\pm\beta_y$, $dA_{xy}/dx=\gamma_{xy}y$ and $dA_{xy}/dy=\gamma_{xy}x$.

3 Trajectories of Growth

The derived continuous intensities of growth activity $dA_S/dx=\pm\beta_x$ and $dA_S/dy=\pm\beta_y$ are constant and individual rigidities of the elements 'x' and 'y', whereas $dA_{xy}/dx=\gamma_{xy}y$ and $dA_{xy}/dy=\gamma_{xy}x$ are variable and interdependent rigidities. In order to complete the derived set of intensities of a system we have to include the variable and individual rigidities $dA_x/dx=\pm\alpha_x x$ and $dA_y/dy=\pm\alpha_y y$. However, we exclude the following two types of rigidities: 1) constant and interdependent because they are the same as the constant and individual rigidities and 2) rigidities, which are greater than $dA_x/dx=|\alpha_x x|$ and $dA_y/dy=|\alpha_y y|$ because such intensive activities rapidly lead to local chaos and destroy the system and/or its surroundings.

Because the expressions denoting the intensities of activities are differential equations, their solutions are functions reflecting the following types of activities:

1. $Ax=\pm\beta_x x+C$ and $Ay=\pm\beta_y y+C$ of non-progressive growth of individual elements characterised with constant intensity, where the constant coefficients β_x, β_y also incorporate the intensities of interdependent and quantitative diversity of the elements of systems. The structure of these activities is identical to the structure of the physical models of activity of resistance.
2. $A_{xp}=\pm\alpha_x x^2/2+C$ and $A_{yp}=\pm\alpha_y y^2/2+C$ of progressive growth of individual elements characterised with variable intensities with the structure that is identical to the model of kinetic energy $E=E_0+mv^2/2$ and to the model of distance in linear motion $s=s_0+at^2/2$.
3. $A_{xy}=\gamma_{xy}xy+C$ of progressive and interdependent growth of elements.

These functions are only representative functions of the three above-mentioned types of activities, and therefore they can be substituted with other theoretical or experimental functions depending on the analysed system.

Assuming that the elements 'x' and 'y' of the subject-object relation $R_s(x,y)$ can realise these three types of activities, then the total activity of growth of the relation (system) is expressed in the form of the following equation:

$$A(x,y) = \alpha_x x^2/2 + \gamma_{xy}xy + \alpha_y y^2/2 + \beta_x x + \beta_y y + C.$$

The constant coefficients $\alpha_x,\alpha_y,\beta_x,\beta_y,\gamma_{xy}$, and the constant 'C' are real numbers reflecting the influence of the elementary activities. Equalling these expressions to zero $A_{tr}(x,y)=A(x,y)=0$ we obtain the function $A_{tr}(x,y)$, which is the trajectory of growth of the relation in the form of curves of the second degree in the Cartesian coordinate system of 'x0y'. These trajectories can be of the following types:

- Hyperbolical (hyperbole, pair of crossing straight lines) for $\alpha_x\alpha_y-(\gamma_{xy})^2<0$,
- Parabolical (parabola, pair of parallel straight lines) for $\alpha_x\alpha_y-(\gamma_{xy})^2=0$,
- Elliptical (ellipse, circle) for $\alpha_x\alpha_y-(\gamma_{xy})^2>0$.

Such an approach to the issue of activity is in agreement with the physical notion of 'force' modelled with a vector. Assuming that the elements of the relation $R_s(x,y)$ are vectors **'X'** and **'Y'**, which act upon each other, then this can be denoted as the sum of vectors **X+Y=Z**, where vector **'Z'** is the result of this activity [Sussman G.J., Wisdom J. and Mayer M.E., 2001]. According to the rules of addition of vectors, we can transform this sum to the following trajectory $T_r(x,y)=x^2+y^2+2xy\cos\varphi+C=0$. This trajectory is a special case of trajectories of growth activity of the subject-object relation $A_{tr}(x,y)$, because physics also makes an assumption that forces cause changes to occur, and therefore force is a specific model of activity. Depending on the value of '$\cos\varphi$', the trajectory $T_r(x,y)$ can be of a hyperbolical or circular type. However, when we assume that x=C or y=C (constant), then the trajectory can be of a parabolical type.

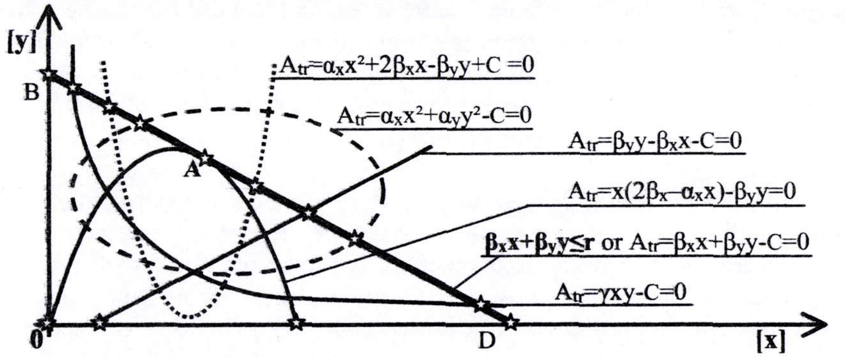

Figure 3.1 Illustration of the most important types of trajectories of growth

For example, Figure 3.1 shows the most important trajectories of growth of a system depending on the magnitude of its elements 'x' and 'y'. The conditions $x,y\geq 0$, $\beta_x x+\beta_y y\leq r$ form the growth space 'BOD'. On this figure, we can see that all trajectories intersect the limiting conditions of the growth space at the points marked with stars. These points indicate destruction of the system, because for real systems, the factors of growth are limited and the magnitude of any element must be greater than zero. The higher system activity at these points, the more violent is the destruction, and the lower the activity, the more gradual is the destruction.

From the above analysis, it can be concluded that existence of a system depends on the following three factors: 1) the magnitude of factors of growth, 2) the ability to change the limited factors of growth and 3) the ability to curve the trajectories of growth. The smaller the magnitudes of factors of growth and the lower the ability to change the factors and curve the trajectories of growth, the more common is the occurrence of violent processes in the function of systems, and vice versa. For stable magnitudes of these factors and lesser ability to change them, violent processes can also develop when systems have a lower ability to curve the trajectories. The elliptical, derived and compound form elliptical trajectories have the highest potential of curving. In addition, this potential also increases with a decrease in the diagonals and axes of such trajectories. In reality, such trajectories are also observed as repeatable processes characterised with appropriately more or less regular changes. More generally, trajectories whose course is based on the idea of closed line, for example circle, ellipse or other closed figure can be called revolving trajectories of growth. On the other hand, simply open trajectories can be called monotonic ones.

One of the most important traits of any system is interaction of its elements in the same and/or opposite directions, which for many systems can be also called co-operation and competition respectively. For trajectories of growth, a process of co-operation is formed by the types of elementary activities of growth marked with the same sign, plus (+) or minus (−). If the types are marked with opposite signs then the activities form competition. For example, for the elliptical trajectories, the progressive activities co-operate or complement one another, because $x^2/[2(x_{max}-x_{min})]+y^2/[2(y_{max}-y_{min})]=1/2$ and for the hyperbolical trajectories, they oppose (compete) with each other, because $y^2/2Y-x^2/2X=1/2$ (constant coefficient $X,Y>0$). Therefore, co-operation between progressive growths causes that at the level of appropriately great disproportions between the elements of a system and/or when approaching the limits of factors of growth, there occurs curving of the trajectory of growth of that system. On the other hand, competition between these growths together with an increase in the disproportions decreases this curving and the system does not react appropriately to the limiting of the factors of growth. In the first case, the system decreases its growth, but it also increases the flexibility in its function, and therefore it improves its ability to adapt to changes. In the second case, the system increases its growth, but it decreases its flexibility of function and hence it looses its ability to adapt and risks its destruction. Non-progressive growths are the activities of resistance and they can oppose or support other types of growth. As the result, when non-progressive growths are appropriately powerful in relation to progressive growths, then they have appropriately strong influence on the formation of trajectories of growth through increasing or decreasing of their curves.

The above presented ways of realisation of system growth in the form of trajectories of growth show that generally we can distinguish two opposite functions in the behaviour of systems: co-operation and competition. However, the detailed analysis of these functions in relation to the trajectories of growth, leads to the conclusion that they are organically associated, and therefore it is impossible to organise social, economic or any other systems that are totally deprived from co-operation or competition. As the result, the exaggerated development of competition or co-operation also leads to destabilisation and destruction of a system. Hence, in order to stabilise system function, there is a need to achieve an optimal proportion between co-operative and competitive processes.

As an example, in order to illustrate the above statement it is worthwhile to consider discrimination, one of the social phenomena, which has a strong influence on the quality of function of a society and an individual person in general. Discrimination is a phenomenon strictly associated with any processes of limitation of every element of systems in the form of deprivation of their possibility to realise certain growths (activities), because any system is a finite and limited object and any growth always encounters various barriers and constraints. Hence, both competition as well as co-operation always form appropriate processes of discrimination that can have a negative and/or positive influence on system function. Because competition relies on the elimination of its weaker participants by stronger ones, therefore in social context more intense competition eliminates more people from social processes of growth, of which economy is the basic process determining also biological survival. Therefore, the times of intensification of only internal economical processes are associated with the rise in unemployment. However, a great number of unemployed people also become justification for further redundancies using a variety of pretexts. As the result, people begin to feel discriminated on the basis of their qualifications, age, image, sex, race, religion, nationality or others. In contrast to competition, co-operation allows employment of people in social processes of growth, who under the conditions of competition would be a subject of elimination. As the result, these processes tend to be less effective because the conditions of co-operation discriminate against very competitive people and do not allow the achievement of their full development.

Hence it is clearly evident from the above that excessive dominance of either competition or co-operation is always associated with increasing discrimination. If social discrimination, regardless of its type, reaches a certain level of intensity and degree of spread, the society becomes destabilised and this can lead to its destruction. The optimal solution involves identification of the types of processes and to what extent they should function on the principle of competition and co-operation. A separate paper is required to cover a more detailed analysis of the influence of co-operation and competition on the function of systems.

4 Revolving Organisation of Growth

As we have already mentioned, the derived representative functions of growth activity can be substituted for other types of functions such as, for example, trigonometric functions, which facilitate the modelling of revolving processes (circular, elliptical and cyclically repeatable). Application of these functions requires the use of the polar coordinate system '$r0\varphi$' to denote the subject-object relation $R_s(x,y)$, where 'r' represents the factor of growth and the angle $\varphi=\omega t$ determines the disproportion between elements 'x' and 'y', depending on the velocity of changes $\omega=d\varphi/dt$ and the time of their duration 't'. In this context, the expressions $A_x=x=\beta_x r\cos\varphi=\beta_x r\cos\omega t$, $A_y=y=\beta_y r\cos\varphi=\beta_y r\cos\omega t$ form a parametric equation of an ellipse when $\beta_x\neq\beta_y$ or circle when $\beta_x=\beta_y$. This form of notation emphasises the existence of the extensive growth of a system described with the parameter 'r' and the intensive growth described with 'ω'. The extensive growth is limited by 'r_{max}' and the intensive growth is limited by the disproportions between the elements at the points $\varphi=\omega t=0,\pi/2,\pi,3\pi/2,2\pi\ldots$, in which functions $\sin 2\omega t=0$, $tg\omega t=y/x=0$ or $tg\omega t=y/x\rightarrow\infty$.

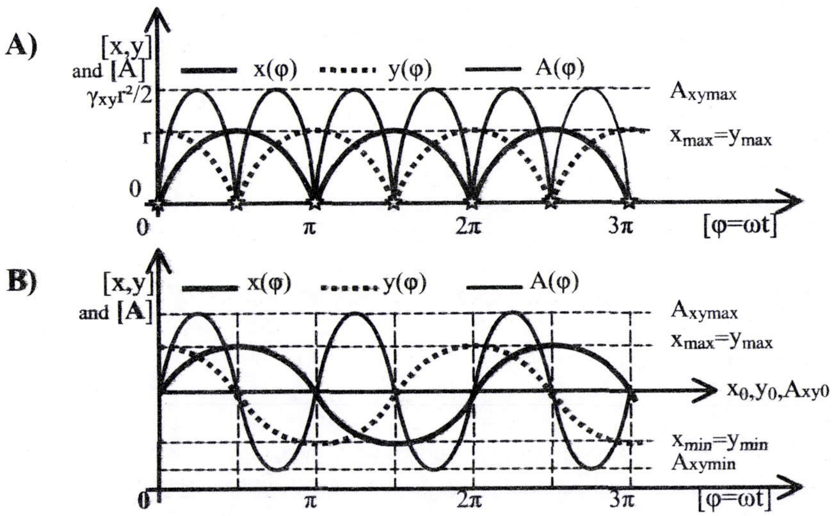

Figure 4.1 Illustration of two ways of realisation of growth activity following the representative circum-revolving trajectory.

Figure 4.1 presents two fundamental ways of organisation of growth following the circum-revolving trajectory ($\beta_x=\beta_y=1$). In the first way (Figure 4.1A), growth accomplishes only half turn and has characteristic points $0,\pi/2,\pi,\ldots,3\pi$, in which the magnitude of one element and interdependent activity decrease to zero causing the destruction of the system. But at these points the renewal of the system also begins through an increase in the magnitude of a new element and new interdependent activity. Because changes are the fundamental trait of nature, therefore this half-turn type of growth reflects the most basic function realised probably by all elements in nature. Hence, this trajectory can be named as a trajectory of life of a system, because it is particularly developed in living nature, where individual species are born, grow, age and die forming a complex process of element exchange in a group of species. The analysed functions are curved at their top due to the limitations $x_{max}=y_{max}=r$ and $A_{xymax}=\gamma_{xy}r^2/2$. But they are not curved at their bottom, and therefore the elements of the system are destroyed at the points $\pi/2$, π, $3\pi/2,\ldots3\pi$. For example, growth of cells in organisms is limited by their division, growth of any organism is limited by the DNA of their genetic code, and the quantity of any species is limited by their surroundings. According to this, the death of an organism is a consequence of strong limitations at its top growth and very limited abilities to curve its growth trajectories from the bottom.

The second way of fulfilment of conditions $x(\varphi)\geq0$, $y(\varphi)\geq0$, $r\geq0$, $\omega\geq0$ and $A(\varphi)\geq0$ can be achieved through an appropriate shift of growth process to a higher level of activity so that its trajectory can curve from the bottom at certain minimal values $x_{min}>0$, $y_{min}>0$ and $A_{min}>0$ and accomplish a full revolution. In this situation, the functions of growth can be expressed with $x(\varphi)=x_0+r\cos\omega t$, $y(\varphi)=y_0+r\sin\omega t$ and $A(\varphi)=A_0+\gamma_{xy}(r^2\sin2\omega t)/2$ (Figure 4.1B). Because nature contains numerous systems characterised by stable function during appropriately long periods of time, therefore there exist many mechanisms ensuring that their parameters and/or elements do not decrease below a critical minimal value. One of such popular mechanisms is formation of safety barrier of progressive activity when a certain parameter decreases closely to its critical minimal value. For example, for people and animals it appears in the form of maternal instinct or increased activity when their life is in danger. Another special case of increasing activity is increasing temperature when a body is injured or infected. A similar role is played by the potential barrier in the function of subatomic particles. In the function of societies and organisations, the safety barrier of progressive activity is created through an increase in their activity such as for example in the form of social, national and religious revolutions.

5 Extensive and Intensive Growth

Even though existence of every system is always associated with both extensive and intensive growth characterised by the parameters 'r' and 'ω' respectively, we do not fully understand growth, especially intensive one, in relation to the socio-economic processes. For example, economics and social sciences are very limited in their efforts to elucidate in more detail the influence of the intensity of socio-economic processes on the societies and people. After all, intensity is one the most important dynamic parameters of all systems. As the result of this deficiency, we are unable to fully solve the negative problems that plague our contemporary societies, such as for example the problem of terrorism, which strongly decreases the quality of our life.

In order to analyse intensive and extensive growth the following basic characteristics of intensity of any activity must be considered. When a system increases the intensity of its activity (where 'ω' represents the angular velocity of changes), this results in a corresponding increase in the intensity of activity of its elements as well as the elements of its surroundings. This increase is accompanied by more rapid changes in the parameters of the system. At appropriately great intensities, the magnitude of these parameters and the regularity of changes can no longer be observed even with the use of extremely advanced methods of observation. Such a system, which does not have any constant, even the smallest or short-lived, elements and where there are only continuous entirely irregular and non-observable changes is called ideal or theoretical chaos. In reality, we can only talk about local chaos, because in the ordered cosmos and subatomic world there is no place for ideal chaos [Sussman G.J., Wisdom J. and Mayer M.E., 2001]. In this context, local chaos is characterised by the existence of non-repeatable and irregular objects, their motions and changes as well as by the elements aiming towards its new ordering. The less repeatable elements and their motions and changes in the system, the less ordered or organised is this system and its surroundings. At the same time, the processes of such a less ordered system are also characterised with greater randomness and their deterministic traits are more limited and vice versa.

This analysis indicates that systems aim towards chaos through exaggerated increases in the intensity of activity of their elements and the elements of the surroundings. This trend is manifested by increasing irregular and random processes of destruction. A particularly common example of this occurrence is gradual warming of various materials and substances (increase in thermal activity). These properties of system function are the reason that all appropriately non-limited or organised progressive growths characterised with activity $A(x) \geq |\alpha_x x|$ are relatively short lasting processes leading to local chaos. This is the reason why we have omitted this type of activities in the formulation of the trajectories of system growth. In cases, when systems are characterised by appropriately rigid structures, increases in their activity lead to chaos through explosions. On the other hand, constant decrease in activity of a system also leads to the destruction of the system but in a gradual way.

In this context, terrorism is neither a social object nor a social force, but it is a way of function of social forces. Its most important trait is formation of excessively great disproportions between people, organisations and societies, which we appropriately refer to as terrorists and victims. This fundamental characteristic leads to the conclusion that the most advantageous conditions for the development of terrorism are created by intensive socio-economic processes based on exaggerated socio-economic disproportions. Hence, the effective prevention against terrorism can be done through appropriate decreases in intensity of socio-economic processes and/or increases in isolation between strongly diverse elements, but not through violence and wars, which escalate the intensity of processes and terrorism.

It is also important to consider extensive and intensive growth from the perspective of the trajectories of growth. In doing this, we have assumed that the subject-object relation $R_S(r,\omega)$ exists between the extensive 'r' and intensive 'ω' parameters of growth [Turkiewicz K. and Turkiewicz D.B., 2004]. According to Sections 2 and 3, the trajectory of growth has the following form of the curve of the second degree:

$$A_{tr}(r,\omega) = \alpha_r r^2/2 + \gamma_{r\omega} r\omega + \alpha_\omega \omega^2/2 + \beta_r r + \beta_\omega \omega + C.$$

The most important conclusion of the analysis of these trajectories of growth is that the type of trajectories, which stabilises the function of systems the most, is limited elliptical as well as its derived and compound forms. According to this, in order for a system to have a stable function it has to respect the upper and bottom limits of the parameters 'r' and 'ω', which are denoted as r_{max}, r_{min}, ω_{max} and ω_{min}.

For example, Figure 5.1 illustrates elliptical synchronisation of extensive and intensive growth. A particular trait of this synchronisation is that for relatively long-lasting systems, the achievement of each value of parameters 'r' and 'ω' is not its aim, but its temporary state. The achievement of these temporary conditions occurs gradually if changes of the parameters 'r' and 'ω' do not extend beyond the ellipse. Whereas exceeding of the limits r_{min}, r_{max}, ω_{min} and ω_{max} leads to destruction of the system, the fields ABC, CDE, EFG and GHA represent growth traps, because they are entered into gradually but their exit triggers violent processes [Hiwaki K., 2003].

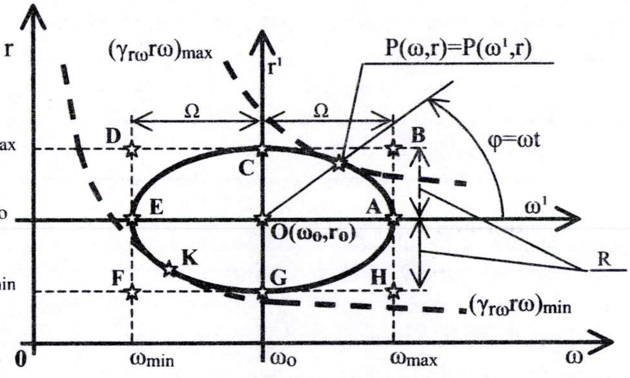

Figure 5.1 Idea of elliptical synchronisation of extensive and intensive growth of a system [subject-object relation $R_s(r,\omega)$ or $R_s(x,y)$]

With respect to globalisation and integration processes, it can be concluded that any level of achieved integration or disintegration is not a final state of this process, but only an indirect state in a complex process of growth. In addition, the pathway of the ellipse according to the accepted direction of the turn '$\varphi=\omega t$' determines the sequences 'AC', 'CE', 'EG' and 'GA' of the logical rules for changes in extensive and intensive growth (Figure 5.1). These logical rules are a prerequisite for the realisation of the achievement of gradual processes of growth. For socio-economic processes, the limitations of extensive and intensive growth may be determined via adaptive control by observation of negative occurrences, which occur during changes in growths.

The validity of the presented interpretation of the elliptical synchronisation of extensive and intensive growth is illustrated by the theory of relativity, which uses this synchronisation to determine the relativistic parameters such as time, length and mass in relation to the intensive parameter of velocity. For example, according to this theory, the relativistic mass of a particle moving with velocity nearing the velocity of light in vacuum is denoted with the expression $m=m_0/\sqrt{(1-v^2/c^2)}$, which is a transformation of the equation of the ellipse $m_0^2/m^2+v^2/c^2=1$. Because the limit of velocity 'c' is absolute, the centre of ellipses is the point (0,0) [Liboff R.L. 2003].

Conclusion

The above-presented analysis of the trajectories of growth of systems leads to some very important and universal conclusions regarding the fundamental behaviours of systems. These conclusions apply to all types of systems and processes, because growth is the most elementary function of all elements of nature and the presented model of system growth can be easily developed for a system with multiple elements.

The principal conclusion is that revolving growth is the most essential factor stabilising the function of every system and in contrast to this monotonic growth is the most destabilising factor. Hence, revolving growth underlies the function of all long lasting systems and processes and this strictly corresponds to the repeatable organisation of changes and processes. This characteristic determines that the future of a system can be almost fully anticipated for the system whose processes together with the processes of its surroundings are realised in a revolving fashion. In contrast, the long-term future of a system cannot be anticipated if its processes and those of its surroundings are realised monotonically. As such, these processes are driven by the motivation to increase in size and intensity and this leads to the creation of local chaos.

In this context, much of the technological progress has occurred as the result of discovery and/or creation of conditions and mechanisms of realisation of revolving growth, which for some types of systems can be called revolving movement. However, it is significant that socio-economic sciences and their applications prefer monotonic growth. This is the reason for the societies to experience repeated violent conflicts in the form of social crisis, wars, revolutions and terrorism. Currently, we are continuing to experience more and more negative socio-economic occurrences. As the result of the incorrectly realised globalisation, we have now destroyed cultures of many ethnic minorities [Hiwaki K., 2003], we have created very aggressive social, religious and political movements and have devastated vast expanses of natural surroundings especially in the underdeveloped countries. Hence, it is imperative and urgent to discover and establish conditions and mechanisms of realisation of revolving growth for socio-economic systems. This task should be regarded as a search for and/or creation of a new more effective factor of growth that may lead to the breakthrough in the function of societies.

Our work demonstrates that the global society as the whole must urgently turn the trajectory of its growth through the decrease in the population and/or in intensity of its activities directed towards the natural environment and other people. Our inability to accomplish this turn would signify that the modern human civilisation has entered the trap of growth whose exits are only through violent processes. It remains to be seen whether or not we are not already in this trap.

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