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Work sharing as a metric and productivity indicator for administrative workflows

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SESSION 1. Statistical Physics

1. Abstract

A mathematical method was developed to generate an indicator on the productivity of administrative complex workflows in a sample of public educational sector in Brazil with more than 2500 administrative units. The indicator can roughly and steadily reveal the definition of productivity as a state of endosectoral (among internal sector agents) and exosectoral (among external sector agents) administrative services sharing. The indicator can be used by public and private managers to measure human resource efficiency in proportion to work requests/inputs of all administrative services occurring in a given workflow. Defining administrative workflow events as a nonlinear dynamics that assume a random ordered or disordered growth rate of information processing, a method has been proposed for large-scale administrative systems defined as structures of hybrid system variables (continuous or discrete), iterated and composed of fixed-point attracted events at which for all possible metric spaces solutions, the modeling of variables from Lyapunov exponential stability point of view allows the projection of system performance to be oriented, that is in other words, the relationship between the number of agents and the number of administrative services/units within an administrative workflow environment. This definition differs from traditional or differentiated key performance indicators (KPI), such as working hours, medical certificate, per capita productivity, among others and the proposed methodology is only suitable for large-scale administrative activities that have a wide range of activities as well as the number of agents that perform them. For system management purposes, it is possible to view the possibility of administrating system discretization, computerization and monitoring in order to be able to predict and validate the exponential function as a valid indicator of nonlinear systems where the results were defined by the amount of work sharing effect.

2. Introduction

The main importance of creating an indicator for productivity analysis in nowadays human workflows, is to be able to define the best optimization towards labor requests and human resources amount proportion within workflow environments [1]. Since new technological devices took place in modern life [2,3], information processing and organization become tools that improve the speed and precision in which administrative work share executed [4]. The main common problem found in daily administrative workflows resides when despite of new technologies existent, the input of work requests rises dramatically and overwhelming the systems and human resources available, and it can give the impression that new technologies or human resources weren't enough efficient, leading managers in the private/public sectors seeking for new systems and workflow architectures. This condition is commonly found at large public administration and private business, where massive amounts of human resources and administrative services are found. Considering discretization and computerization as the main robust approach to organize information flow and performance [2], operated by biological components and emergent phenomena [5], the precision reaching aspect of any given work can be or not possible to be fulfilled due to inherent aspects of biological cognitive dimension. Also, not only the biological aspects are natural barriers to keep 100% higher performance of workloads, but the available infrastructure of information technologies in a workplace. These conditions cause the work daily activities to present potentially an instability regarding performance aspects, leading the workflow system to an uncertain predictive production [6-10].

3. Methodology

Theorem 1. Consider that the variables a, b and t are defined within a maximum metric space δ (information processing) of the best optimized solutions for ε (work demands). Defining the interaction and iteration between the number of agents and the number of schools (as sequences of $f(x) = ab_1^{x_1}.ab_2^{x_2}.ab_3^{x_3},\dots,ab_n^{x_n}$), it must assume solutions φ (performances) lower or equal to ε fixed boundaries.

Considerations: Considering the sum of variables that compose the system as y (a) as an input of the function $f(x) = ab^x$, then, an output is expected giving a proportionality in the time b in order to achieve a less asymptotic curvature of the function [11,12]. In graph form as $f(x) = yx^e$, the relationship for each a and b represent, respectively, the value of y for each discrete variable and the value of x as time of analysis of the stream of events (continuous) in potentiation. This can be observed when $f(x) = ab_1^{x_1}.ab_2^{x_2}.ab_3^{x_3},\dots,ab_n^{x_n}$, and x at a frequency rate e (Euler number as $b_x \log_e b$ (e= 2.71828...)) present growth or reduction of numerical results. Now consider a derivative such as $x = \frac{d_{a_i}}{d_t} b^x = f_i(t, a_1, a_2, \dots, a_n)b^x$, where $i = 1,2,\dots,n$, enabling the observation of the power of each iterated event as a work sharing effect for hybrid environments. This dynamic reflects very objectively the behavior of events in interaction and continuous iteration when the discretization and computerization effects over the years are empirically true via data collection. The exponential function can be observed by the curvature of the generated and can empirically reflect in the high growth or reduction rate of overlapping effects with an initial condition defined by $a_i(t_0) = a_{i0}$. Applying R^2 as $r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2\sum(y-\bar{y})^2}}$, then it is possible to observe the ratio between the function components separately, which allows you to view the ratio of an input and output of productivity [13-16].

Proof: Having n possible initial trajectories $X(t_n)$, as input data, the solutions $\varphi(t_n)$ at $X(t_1)$ input to one of the components of the function represented by $f(x) = a_1 b^x$ need to satisfy the solution for an output of $\varphi(t_n)$ as $f(x) = a_n b^x$ (ε). Therefore, the asymptotic stability of Lyapunov defined by $X(t_n) - \varphi(t_n) < \delta$, is possible having as range of control δ. Hence, this modeling of public administration stability by work sharing can be viewed as a metric and productive indicator of collective behavior X discretization X productivity, like $X(t_n) - \varphi(t_n) < \delta$ where $|X(t_n) - \varphi(t_n)| \leq \alpha|X(t_0) - \varphi(t_0)|e^{-\beta t}$, being α and β the empirical parameters of the exponential function, hence, the final nonlinear dynamics results of the interactions. Since, $f(x) = ab_1^{x_1}.ab_2^{x_2}.ab_3^{x_3},\dots,ab_n^{x_n})$ is equal δ, then $X(t_n)$ necessarily remains $\leq \alpha|X(t_0) - \varphi(t_0)|e^{-\beta t}$, being α and β now defined by $f(x) = ab_1^{x_1}.ab_2^{x_2}.ab_3^{x_3},\dots,ab_n^{x_n})$ itself. Q.E.D. ■

4. Results

An example of a result with the use of the indicator is that as the number of work shares grows, the asymptotic effect of the exponential function curve decreases, and the coefficient of determination has its value increased. This indicates the effectiveness in producing the administrative structure and allows new demands, if properly planned, to be passed on to the administrative unit to be executed with a high level of accuracy.

Note that the curvature of the function as well as the value of the coefficient of determination R^2, indicate, respectively, how much potential there is for action by agents and collaboration in proportion to the number of establishments. In the two first samples, 1 and 2 are highly efficient at sharing work ($R^2 = 45\%$ and $R^2 = 44\%$) resulting in a ratio between input and output relatively higher than 3 ($R^2 = 33\%$).

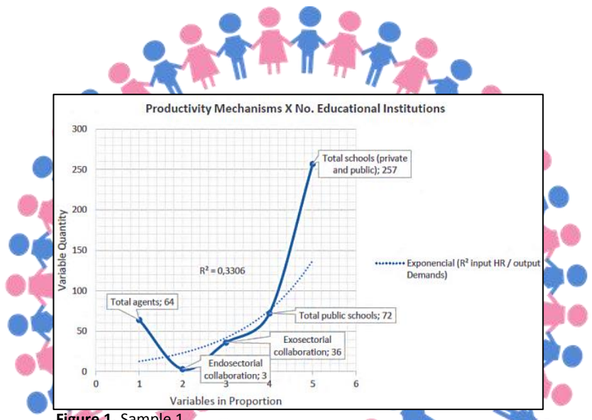

Figure 1. Sample 1.

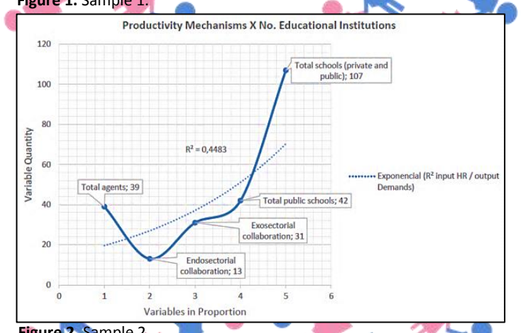

Figure 2. Sample 2.

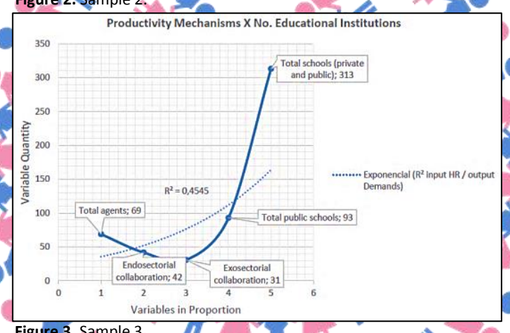

Figure 3. Sample 3.

5. Conclusion

The research presented a method to be used as an indicator of productivity in large-scale administrative works such as those found in the public federal, state or municipality administration. In a case study investigated in public educational field, it was found that work sharing effects can become effectively beneficial for productivity in concomitancy to discretization and computerization innovations within administrative workflows. Also the indicator can be used for monitoring and diagnostic purposes.

Also when using defined power exponent property (Euler Number), it maintains the impartiality of verifying human resources, workloads and work performances, keeping the work sharing effect as the main numerical approximation of the nonlinear unresolved equations existent in the cognitive and technological limitations/arrangements for information processing workflows.

6. References

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