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Improvement of public finance process efficiency: Theory and practice

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The topic of modelling and identification of fluids flowing into system processes is highly significant for public finance efficiency research. In 2017, research was conducted at the Budapest Business School, resulting in the creation of technical-mathematical models applicable to service processes (Gubán 2015). In a previous study, we introduced a possible extension of that research into practice: we were able to get an accurate picture of Hungarian public finance processes by thoroughly examining financial processes at the Secretariat of the Hungarian Academy of Sciences (Gubán et al. 2014).

This study provides a new perspective to this research topic by applying the previous results and a new mathematical model better suited for public finance. We describe status changes in the nodes of the organisation from a process and workflow aspect, thus creating non-interactive transformation systems. Our hypothesis focuses on objects flowing into public finance and a detailed examination of public finance processes. The hypothesis is the following: *'The efficiency of the public finance system is determined by the location change of the specific and examined objects in the fluid flows. The well-defined fluid flows of public finance processes ensure the efficiency improvement of the workflows.'* The first part of this study outlines the efficiency improvement tool adapted to public finance. The second part illustrates the practical application of this tool through an example.

Keywords: efficiency improvement, public finance, process, object, fluid flow.

JEL codes: C61, H83.

Introduction

With the development of the methodology presented in this study, the results of previous research could be applied to public finance processes. This is a highly unique topic within the analysis of service system efficiency due to the orgware environment of public finance systems being more strongly regulated than that of other service systems (Janssen–Estevez 2013). We shall define efficiency for public finance systems as follows: if the output status of the system is the same (or within a predefined range) as the target status expected after the process flow is over.

For this reason, we must also examine whether public finance systems can be fully integrated into the studied service systems. Analysis results have shown

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that technical and service processes can be handled together from a process improvement and process modelling aspect. However, public finance processes have extreme and unique characteristics from an efficiency improvement point of view, as general service systems can be modified relatively freely in order to achieve an operation that is close to optimum. Public finance systems are locally limited organisations, systems that have very hard limits.

Financial system processes may differ in both structure and operational characteristics depending on their location within the organisation, with highly differing process operational attributes at first sight. With a detailed examination however, we realise that they are similar in one respect: in any process, there is at least one "object" that flows through the whole process or process parts and that partly or fully utilises available resources at several "locations" (Bloch–Bugge 2013).

By analysing the financial systems of the organisations we examined, we concluded that the fluid (the aforementioned object) is a piece of data, material or resource which flows, may transform and can be measured as a piece of information at any node of the flow. We shall call a transaction every event in the financial process that has an impact on the information attribute of the fluid. The timeframe of this characteristic (that can be regarded as an axiom) is fixed, it includes at least one data value (message), and its data content and time stamp cannot be modified. The process is determined by the transactions impacting the fluid within the given timeframe and at the examined nodes, i.e. what activities must or are supposed to happen (Bányai et al. 2015).

Let us examine the following assumptions regarding the fluid:

- Can it be treated as a basic fact that an initial fluid can be found in any financial system?
- This fluid will always generate an initial transaction that is created by a deterministically or stochastically generated "causing" object, and
- This fluid can and should appear at one of the system inputs.

A fluid – and a transformation – shall indeed appear at every system input, otherwise that input would not be a part of the process system. As a transaction (event) cannot happen without an object (cause), we can consider the existence of an initial fluid to be evident. Furthermore, the initial object (signal or message) always flows through the whole system. However, due to its information attribute, it may be – and it mostly is – transformed during the process. Thus, based on the above and on Mezei–Gubán (2017), we can consider the second part of the hypothesis proven, meaning that efficiency improvement is possible in public finance systems.

When examining the hypothesis for this study, we shall start with a simple generalisation. In the processes of public finance systems, the observed flows (e.g. information, material, resource, emission, etc.) are, in general, location changes of the specific and examined objects. These location changes show alterations occurring over time in the parameters and attributes of the object, so the flow can be considered a location change of objects – we call this the aspect relative to the system. If a location change is only virtual, i.e. no spatial movement can be detected (but only changes in the characteristics of the fluid), then the processes can generally be considered changes in the object – we call this the object aspect.

The latter case can handle more changes, including those without physical movement. This is most frequently a data change where no location change happens on a physical level – when analysing things from a user perspective – because the data stays at the same location from a user standpoint, only its "value" changes. For this reason, we may use the same method to examine both aspects of object flow and the result will not change. Gautam et al. (2017) have a similar approach in their segmented models.

The object as a flow in financial systems

In our further examinations for the foundation of practical application, the fluid itself will describe its status changes over time. This is beneficial because in many cases – primarily in the case of service or public finance processes – fluid flows of material or information origin cannot be clearly found, and neither can a location change be observed. Still, it is important to create a dynamic model that can describe changes in financial systems in such a way that it can be applied to any process description – making a sector-neutral efficiency improvement possible.

The nodes in the system (e.g. elementary employee activity, defect location, checking point, etc.) and their status changes are a great starting point. This means we disregard the classical process approach where the process nodes are locations where fluids can be transformed and this is the only attribute important from a process aspect. In this study, the node itself is the "process", meaning that value changes in the components of the node (attributes, status variables) constitute the process itself. These status changes themselves constitute a process system as well, and the "changes" found there will be the fluids, for which an examination methodology has already been established (Kása–Gubán 2014). Thus, if we create a model in which status changes can be divided into simple transformations, then practical status change systems will be easily adaptable to public finance systems.

Outline of object flow model

Suppose that O is a node with a finite status characteristic set (status variable set), including all status characteristics that characterise that node in $[t_1; t_2]$ time period. If S_i status characteristic does "not characterise" the node at a specific $t \in [t_1; t_2]$ point of time, its value shall be Ø, which is not a real value but only a symbol, so that the value prevails in any comparison to it. Thus, hereinafter we expand the original A_i status set – for function-like descriptions – to $\bar{A}_i = A_i \cup \{\emptyset\}$. Furthermore, hereinafter let us suppose that S_i is a status characteristic of node O (hereinafter, in order to comply with Kása–Gubán (2014), we shall call the node the object), the value changes of which can be described in the examined time period by the function $S_i(t): [t_1; t_2] \rightarrow \bar{A}_i$. The full object change is the following:

$$S[t_1; t_2] \rightarrow \bar{A}_1 \times \bar{A}_2 \times \ldots \times \bar{A}_n \; (= \mathcal{A}). \quad (1)$$

This means we look at ongoing changes for the full status characteristic at the same time. This raises the question: what changes can be regarded as still belonging to the object, i.e. what degree of change is necessary for it to become a different object. For example, in wood processing, when does it become paper, i.e. a totally different object – holometabolism.

In our examination, suppose that our object is in O object type at t point of time $[O; T_O; S_O(t)]$; T_O is the quality of the specific object type and it is in $S_O(t)$ status system, i.e. we interpret the object as a unit with a qualitative characteristic that changes over time. The aforementioned type change may include a sudden change in status system that is a new object type (holometabolism), which in our example can be a log, a board, wood chips, paper, etc. On the other hand, the quality of object type can be interpreted in our example as high-quality white paper, recycled paper, etc.; in the examined systems, the object type characteristics are implicit and given. As our example has shown, neither the type nor the quality is straightforward, so it is advisable to create the system model in a fuzzy system.

This is because a flow system can only be monitored with discreet methods, meaning it can only be achieved with sampling. For this reason, we shall only deal with status changes that are discreet in time – this further strengthens the possibility of using fuzzy and neuro-fuzzy modelling and simulation in practice in the future.

We shall conduct the examinations for a fixed system here and we shall refrain from developing a detailed mathematical model in this article. We shall also ignore the reasons for transformations and controlled status changes working in public finance organisations (flow systems) because these should be examined on a case-by-case basis with primarily economic science tools.

Suppose that, in the examined system, fluid flow (i.e. the series of status changes flowing through the system during a period of time) is $FF(t)\colon [t_1; t_2] \rightarrow A_1 \times A_2 \times \ldots \times A_n (= \mathcal{A})$, where $[t_1, t_2]$ is the examined flow time, A_i ($i = 1; 2; \ldots n$) is the status set of a specific characteristic with both upper and lower limits.

Let us say the reason for the status change occurring at $t_0 \in [t_1; t_2]$ point of time is *T transformation*. Transformations appear in a discreet way – for reasons mentioned above – but their effect will be realised $[t_0; t_0 + \Delta t]$ ($\Delta t > 0$); it is reasonable to expect that time periods may overlap. We can interpret this model similarly to an extension of the set of traditional medical therapies (treatments), where effects and side effects may both arise. In this case, we include both the effects occurring after the therapies are completed and spontaneous changes. We call the latter spontaneous transformations, where needed.

Suppose that T is the Transformation and $[t_0; t_0 + \Delta t]$ ($\Delta t > 0$) is the effect's period of time, and system status at t_0 initial point of time is $\mathbf{a}_{t_0} \in \mathcal{A}$ and status change of S_i characteristic will be described by the following function: $f_i(t; \boldsymbol{a}_{t_0}; t_0)\colon[t_0; t_0 + \Delta t] \rightarrow \boldsymbol{a}_t$ $(\Delta t > 0)$. This will clearly ensure an ideal model only if no other Transformation effect has taken place in the system, impacting that specific characteristic. Let us suppose that in $[t_1; t_2]$ time period, a finite number of effects (and a finite number of side effects) take place in the system. Thus, at a specific $t \in [t_1; t_2]$ point of time, Transformation effects can be specified in the following general format:

$$\varphi(t)\colon[t_1; t_2] \rightarrow \mathcal{A}. \tag{2}$$

The above function cannot be continuous, of course, as a new Transformation can immediately cause a sudden change; as a consequence, we get an intermittent at least once differentiable $n + 1$ dimension surface, which is a sufficiently flat surface for examinations.

Thus, the actual status of S_i characteristic does not only depend on the current transformation but also on the effect of other transformations during that period of time. This may cause a very different effect: transformation effects may add up, strengthening or amplifying each other. On the other hand, they may also cancel each other, or only the “weaker” or “stronger” effect may take place. We shall not go into detail on these models in this paper, but they can be described with simple function operators.

Let us examine a simple case where only one Transformation has an effect. We call this Transformation *good* if it shows an asymptotic characteristic during the examined time, i.e. it moves towards one specific value over time, and this limit value is equivalent to a predefined value. Furthermore, the Transformation will remain stable, i.e. the limit value should not be changed by the effect of other effects. For example, a petition that has been sent back due to missing documents will be completed as expected sooner or later.

In practice, the speed of most Transformations (status change) is proportional to the difference between current status (measured) and ideal status (in a specific period of time). If that is the case, the function for the effect can be described with the following simple exponential form:

$$a(\tau) = (a_0 - a_{opt})e^{k\tau} + a_{opt} \tag{3}$$

For such models, the individual effect of the Transformation at a specific moment can be easily determined. Thereby we also gain the information whether the therapy applied to the financial system is moving in the “right” direction, whether the “treatment” is effective.

Of course, one Transformation may have an effect not only on one status but on several other states as well. We call these – if they are not intended – side effects. Thus, a Transformation can be generalised in the following way:

Suppose that T is the Transformation and $[t_0; t_0 + \Delta t]$ is the effect’s period of time, status change function for S_i characteristic $f_i(t)$: $[t_0; t_0 + \Delta t] \rightarrow \mathcal{A}$ $(\Delta t > 0)$, where $\Delta t = max(\Delta t_i; i = 1; 2; \ldots n)$ i.e. the time period of the effect or side effect with the longest period – the resulting effect of Transformations that have an effect at that specific point of time. Thus, in financial systems, it is possible to define the duration and scope of a transformation’s effect, so the various “consequences” of the transformation are manageable.

Multiplication of transformations: We shall define the multiplication of transformations for a general description of transformations acting together. Suppose that all transformations having an effect in $T_1; T_2; \ldots; T_k$, $k > 2$ a $[t_1; t_2]$ period are, $\varphi(t) = [a_{1t}^{T_i}; a_{2t}^{T_i}; \ldots; a_{nt}^{T_i}]; i = 1; 2; \ldots; k$ ’s influence function. Multiplication of transformations $\mathcal{T} = T_1 T_2 \cdot \ldots \cdot T_k$ at t point of time is the influence function which specifies the current status system: $\varphi_{\mathcal{T}}(t) = [a^{T_i}_{1t}; a^{T_i}_{2t}; \ldots; a^{T_i}_{nt}]; t \in [t_1; t_2]$.

Independence of transformations: Transformations that do not have an effect on each other's states and do not influence each other's effects are more easily manageable. For this reason, we introduce the concept of independence of transformations. Two Transformations T_1; T_2 are *independent* if the Transformations have a sole effect at $[t_1; t_2]$ period of time on a subset of the status set. This means their effect status sets are disjoint sets – they do not have a common element. As a consequence of this definition, the relation is symmetric. Thus, in financial systems, transformations are "dissociated" from each other on both sides.

In order to examine reflexivity, we must utilize a few conditions. On the one hand, a transformation may appear several times at different points of time during $[t_1; t_2]$ period of time, in which case its effect on the states will not be independent. (For example, in case of an asymptotic dampening effect, one impulse can change the asymptotic behaviour, or the asymptote. Independence could be reflexive in one case only: if simultaneous identical effects appear in the system as one effect – i.e. the system has a redundancy filter.) This expectation is not very realistic, so we can conclude that the relation is not reflexive. Hereinafter, we will only use transformations that are irreflexive.

It is also crucial to examine transitivity. When we think about examples in everyday life, very often they are not transitive. It is feasible that medicine A and B and medicine B and C pairs have no effect on each other during a treatment. But medicine C may have an effect on a component of medicine A, so they might not be used at the same time during a treatment. Examining the above definition, we can engineer a case where transitivity is not achieved, meaning that the independence relation is not transitive.

The above definition can be extended to the independence of any number of transformations, i.e. a transformation is independent from a transformation system if the transformation is independent from each element of the transformation system in pairs.

In case of a combined effect of Transformations (multiplication transformation), it is important to examine whether they can be decomposed to the multiplication of independent Transformations at a specific $t \in [t_1; t_2]$ moment in time. Our hypothesis is that they can, however we shall omit the reasoning in this study.

Since the above assignment can be performed for any $t \in [t_1; t_2]$, we shall define transformations $\hat{T}_i$; $i = 1; 2; \dots n$ as their effect function being: $\varphi_{T_i}(t) = \varphi_{T_i t}$; $t \in [t_1; t_2]$. These functions satisfy the definition of independence at all points in time, so the generated $\hat{T}_i$; $i = 1; 2; \dots n$ transformations will realise the effects of the original transformations and will be independent transformations.

If we accept the above hypothesis, then the transformation effect function can be described for a specific status in the following form:

$$\varphi_{T_i}(t) = \sum_{j=1}^{k} \alpha_j(t);\ t \in [t_1; t_2];\ i = 1; 2; \dots n \qquad (4)$$

Having clarified the issues above, we can build a model in order to assign a simulation model to public finance systems in the following chapter. This is because the system of processes and transformations can be mapped into the tool outlined in the previous part.

How to do this mapping for a public finance system?

The existence of public finance systems is ensured by legislation which determines the function of the financial system and provides its orgware seed as well. It is often difficult to find fluids that show location change in such processes because, in some cases, it is human behaviour that constitutes the system's processes. The "side effects" of transformations that occur in such places very often worsen the effectiveness of fluid operation flow in another process. For this reason, it is crucial to only perform modes of action (process element changes) which have the least possible side effects.

Of course, it is impossible to create a system without side effects unless it is an ideal case (according to the above model) – see redundancy filter in database theory. Let's return to actual public finance systems: the steps of the budget cycle, some of the external and internal events, and processes, all of them belong to the delegated functions. As mentioned in the introduction, public finance processes are event-controlled, and the event always includes at least one data with an information characteristic.

We have already accepted it as a fact that an initial fluid can be found in the system, and this fluid shall always be an object appearing at one of the system inputs that triggers or initiates the transaction. Furthermore, the initial fluid always flows through the system and has an information characteristic.

In the next part, we shall adapt our hypothesis based on a previously analysed financial process of a self-managed Sample budgetary institution (Gubán et al.

2014). Sample is a legal person which has an independent budget, as well as independent financial authority and responsibility. Sample performs the tasks related to management, bookkeeping and data provision with regards to the appropriations of its budget, so all functions (that are relevant for this study) of public finance management are present in the organisation.

According to the Organisational and Operational Rules endorsed by the Sample public finance organisation, the maximum lead time is 15 days. This means that it can take up to 15 days from the generation of initial fluid until the final event, in the case of an error-free process. Of course, this does not include the time period needed for an external partner to perform its tasks, or the "grace period" specified by law – e.g. the deadline for an invitation to tender in the case of public procurement.

We must highlight the 'budget implementation' step in the budget cycle of the Sample public finance organization as this step includes some very complex processes. For this study, we have chosen the investment procurement module where all processes (that may occur in the implementation of the budget step) are present. Our specific example will be the procurement of a solar collector with its related public procurement process. The table on the next page shows the events occurring in this example.

The node indicated in grey (12) is outside of the Sample budgetary institution's organisation. This is an event that the Sample budgetary institution cannot influence; the parameters of the construction contract prevail here.

Most of the fluids in the previous table are not of material nature (electronic mails or pieces of information are flowing in the process), but some material fluids can also be found, such as solar collector and paper-based documents. In the case of type transformation, the nature of the information carrier document changes, or an electronic mail becomes a paper-based document. In this process, the initial fluid is the warning sign that occurs in the controlling source node. In this example, the drain node is the finance department, and the closing fluid is the bank transfer.

Some redundancy can be found in the investment expense process (events #1-3) in the preparation phase. If this series of activities only runs once at most, the time required for the process can be reduced as cloning increases uncertainty. Reducing lead time with logistification (eliminating cloning) results in lossless operation (Mezei–Gubán 2017).

Table 1: Solar collector procurement in detail

No.	Node	Input	Output	Nature of transformation
1	Controlling	High energy consumption	Warning sign	Creation of new element
2	Engineering department	Warning sign	Informal e-mail	Type
3	Budget holder	Informal e-mail	Positive response	I/O
4	Engineering department	Positive response	Claim notice	Type
5	Budget holder	Claim notice	Request letter	Type
6	Finance department	Request letter	Draft commitment document	Type
7	Finance manager	Draft commitment document	Countersigned document, permission letter	Type, creation of new element
8	Public procurement department	Permission letter	Summary note	Type, creation of new element
9	Procurement	Summary note	Draft construction contract	Type, combining
10	Legal department	Draft construction contract	Approved construction contract	I/O
11	Procurement	Approved construction contract	Ordering, construction contract	Type
12	Supplier	Ordering, construction contract	Solar collector (a), report (a), invoice (b)	Type, creation of new element
13	Accounting	Invoice	Request for professional completion certificate	Type
14	Engineering department	Solar collector, report, invoice	Professional completion certificate	Type, combining
15	Accounting	Professional completion certificate	Booked invoice, draft transfer order	Type
16	Finance department	Draft transfer order	Record of validation	Type
17	Finance manager	Record of validation	Expense transfer order	Type
18	Finance department	Expense transfer order	Bank transfer	Type

Source: Own editing – based on laws and internal regulations of Sample

Based on Table 1, we are able to determine that the finance department and finance manager nodes of the examined process in the public finance system from our example are strategic nodes. At the same time, these two are also the bottleneck nodes, since there is no alternative route to conduct the solar collector procurement.

In a financial process system, bottleneck nodes are usually the most problematic ones. Most frequently, the fluid has to wait, slow down or be damaged in these nodes. For this reason, the focus should be on these nodes when implementing potential process improvements. Based on the above, hereinafter we only have to extend our examination to the nodes and the status changes occurring in them over an examined period of time. This period is, in most cases, determined by the starting time of a transformation defined by the appearance of an event and the time the last fluid related to the event "flows out" through the output.

When improving process efficiency, we focused on process lead time and service quality indicators (KPIs). Also, when analysing process efficiency, it is imperative to also examine cost efficiency, but due to the special operation of budgetary management (annual budget management, no profit expectation, withdrawal of remaining money as the norm), this is not relevant for this study. We should also add that when analysing efficiency, we regard it as the full process efficiency (not node efficiency) that is interpreted as one batch in the budgetary organisation.

The maximum lead time of the solar collector procurement is determined by the OOR of Sample. According to the Organisational and Operational Rules endorsed by Sample, the maximum lead time is 15 days. This means that it can take up to 15 days from the generation of initial fluid until the final event, in case of an error-free process. Of course, this does not include the time period needed for an external partner to perform its tasks, or the "grace period" specified by law – e.g. the deadline for invitation to tender in the case of public procurement.

Based on previous research data (Mezei–Gubán 2017) and some on-site sampling[3], the following benchmarks can be established for the Sample budgetary institution:

- The expected maximum lead time is reached in 75-80% of completed processes, but the lead time can reach up to 160% of the standard in an extreme case;
- The expected service quality is fulfilled in 80-85% of completed processes, but, when a new process is introduced, this can be as low as 60%.

[3] We took 5-5 samples from all the completed processes examined at the public finance organisations participating in the research.

Lead time and service quality are in a close relationship, best demonstrated by the concepts of TPM (Total Productive Maintenance). (Due to a lack of relevant public finance publications, we used literature on the lean approach.) According to this, the most important factor is the focused elimination of problems and reducing efficiency loss in crucial areas. TPM measures equipment productivity with an indicator called OEE (Overall Equipment Efficiency). The primary aim of TPM is to improve this factor. When doing a TPM activity, it is necessary to continuously measure OEE and systematically suppress losses that cause the most harm (Péczely 2012).

The value of the OEE indicator never exceeds 100% and is calculated the following way:

OEE = availability x performance x quality

The accepted world standard target is 85%, which is made up of the following values:

- availability 90%,
- performance 95%,
- quality 99%.

In this research, we adapted the OEE indicator to the processes of the Sample budgetary institution. We calculated an OPE (Overall Process Efficiency) indicator value for the Sample budgetary institution; however, the value is not related to its tools or nodes, but to the whole process. The components of OPE indicators are the following:

- Availability, in this case, is the base working hours of the employees, taking legal requirements into consideration.
- Performance shows the percentage of completed processes where the full series of activities were finished within the expected maximum period of time.
- Quality shows the percentage of completed processes that were free of errors.

In the case of the Sample budgetary institution, the OPE indicator before logistification is 53%, consisting of the values below:

- availability 89% (30 minutes lunch time and break times according to the Labour Code),
- performance 75% (lead time, calculated with a lower value),
- quality 80% (service quality, calculated with a lower value).

Since availability cannot be increased due to legal requirements, the theoretically achievable OPE target for the Sample budgetary organization is

83%. The expected minimum OPE after logistification is 70% (Muchiri–Pintelon 2008), so our target range shall be 70%-83%.

Analysing on-site samples and previous empirical data, we can determine that inadequate lead times can be corrected by the following method: eliminating redundancy (events #1-3), where we can expect a 9% performance improvement. Thus, the lower value of the performance rate is modified to 84%, resulting in an OPE value of 60%. This is a change in the right direction, but it does not yet reach the targeted efficiency range.

Process efficiency can be further increased if only electronic documents flow between the nodes, and the electronic signature and time stamp are used instead of signatures and stamps. One possible solution for this is EDI (Electronic Data Interchange). EDI aims to fully replace paper-based documents with a telecommunications channel for the flow of standardised messages. The advantages of introducing EDI are the following:

- Reducing and/or avoiding paper usage;
- Exchanging information in real time;
- Better data accuracy (by avoiding errors of manual data input);
- Data traceability and controllability;
- Accelerated system reaction time due to reliable information.

If only the electronic signature and time stamp were used in the examined process of the Sample budgetary organisation, a 4% performance increase can be expected from this therapy. If the Sample public finance organisation were to use EDI technology at all events, performance can be increased by a further 3% - that is 7% in total. Effectively, the achievable OPE value (in case of 91% performance) will be 66%, which is significantly greater than the initial value, but still it does not reach the targeted efficiency range. The OPE indicator value can be further increased if the bottlenecks at strategic nodes are solved by process scheduling and process design (e.g. flexible time window).

As for increasing human resource capacity, this might be possible at the finance department, but it is not feasible at the finance manager node, so this is not an acceptable therapy in this case. Another possible therapy would be to optimise the time schedules of public finance system processes with process design tools. The timeframe for each process is fixed, so by introducing a flexible time window, we could relieve bottleneck pressure and reduce losses over the examined time period.

According to the suggestions made during in-depth interviews (Gubán et al. 2014), the quality rate of the Sample budgetary institution could be improved by training and clear work instructions. However, such training should be interpreted as gaining deeper knowledge of the financial IT system in use, not as advanced general studies. Similarly, clear work instructions should mean a professionally sound, easy-to-understand user manual that contains precise descriptions of all activities belonging to the explored processes. According to interviewees' opinions and experts' estimates (Nallusamy–Majumdar 2017), such a therapy could result in a minimum of 7% increase in the quality indicator. If that is the case, our cumulated OPE value changes to 71% (0.89 x 0.92 x 0.87) and has reached our expected efficiency range.

Based on the above, if the finite set of transformations is known, then an independent (virtual) transformation system can be engineered for them based on the thesis proven in the first part of this study – this system will be without "side effects", i.e. influencing only and exclusively one status. This also means that any event and/or status change that is in effect at any time can be divided into such intervention methods that will only push the status change in the right direction and will have no effect on any other status. This is a very high expectation that has the potential to create a transformation system with much greater cardinality, but it has no effect on the current examinations as our sole target was to achieve efficient operation.

Summary

Having established a customised methodology in this study, it will be possible to apply the scientific results of previous research to public finance processes. This is a highly interesting and special topic in the examination of service systems. At the same time, results have shown that technical, service and public finance processes can be handled together from a process improvement perspective. If we examine the processes explored in this study from an internal status change angle instead of the traditional flow aspect, they can be managed and improved the same way as other, more flexible service process systems.

The public finance processes introduced in this study are an extreme case, with unique characteristics from an efficiency improvement point of view, since general service systems can be relatively freely modified in order to achieve an operation close to optimum. On the other hand, public finance systems are locally limited systems. However, this should not cause any surprise after the initial examinations, as we can see they can be managed with the same methods and solutions as any other finance process system upon closer inspection – although management efficiency may be lower.

The most problematic parts of a finance process system are the bottleneck nodes. Most frequently, the fluid will have to wait, slow down or be damaged in such nodes. For this reason, the focus should be on these nodes when implementing potential process improvements. In practice, this means that any process improvement should be implemented for all affected nodes and cannot be done separately. When implementing organisational changes, the independent transformation model should be used only to correct processes to go in "the right direction" and "without side effects".

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