Logistics Reengineering of Service Processes Through the Implementation of Software and Hardware of the Telephone Exchange in the Company

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Abstract **– In-house logistics is primarily about coordinating activities; quality planning; management, implementation, control of external and internal material flow, and synchronization of information and processes. Each process is closely related to the operator, who ensures optimal conditions for its operation. Implementing software and hardware for the telephone exchange and supporting corporate information management significantly increased customer satisfaction with the solution to their specific requirements. The impact of information technology, monitoring, data collection and processing in the company aims to make these processes more intelligent, emphasising obtaining certain strategic information important for further decision-making. A powerful and reliable communication platform is used in various industries, which is presented in the submitted manuscript. The advantage of a suitably chosen communication platform is that it offers a range of functions like traditional telephones combined with intelligent solutions for uniform communication.**

By applying service processes through implementing a software and hardware telephone exchange in the company, we focus on adapting solutions for each customer according to requirements. In the future, the research will focus on the digitization of the company and the use of smart technologies in the prediction of service processes in the company.

Keywords **– Logistics of service processes, telephone switchboard, process efficiency, information technology.**

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1. Introduction

Each process is closely related to the operator, who ensures optimal conditions for its operation. Service processes, individual service processes, their organization and management and mutual coordination, are handled by the logistics of service processes, which ensures the smooth, trouble-free operation of all processes [1]. When evaluating service processes, time, labour, and cost several indicators are often used, among which we can include labour productivity, service efficiency, number of service workers, etc. Since these indicators are rather means to achieve the goal and not a sufficient expression of the service processes' goals, it is necessary to look for new unconventional criteria. Suppose the basic function of the service process is to ensure reliability and the economic operation of primary production. In this case, the performance of this function should be designated as the primary criterion according to which the level of the service process will be assessed [1], [2], [3].

This criterion – the performance can be evaluated and then assessed ed the various variants of the organization. Based on the analysis, the variant that enables the best performance of the primary function is chosen.

The absolutisation of the primary service function could also lead to an extreme, that is, to ensure the direct operation of the service process at any cost, regardless of whether the number of people is equivalent or the costs incurred to achieve a given degree of fault-free primary production. It is necessary to establish a secondary criterion - the costs spent on the service process itself. Thus, the second criterion is here in the function of limiting conditions, so it does not have the role of a criterion function. The subordination of this criterion specifically means that any cost savings for the service process without ensuring its primary function is economically unjustified. From this, the losses of production failures exceed these savings. [3], [4]
Choosing the optimal organizational solution presupposes having, in addition to the criteria, methods with which a suitable variant of the organization of service processes can be selected. Currently, these methods represent a wide range - from empirical methods to experimental verification to exact optimization calculations, where mathematical methods from mass service theory and network analysis have the greatest application [1], [3], [4].

Considering the current times and Industry 4.0, which brings with it two basic pillars [5]:

- digitization - of products, processes, equipment, services ...
- application of exponential technologies, the most effective way to optimize the logistics of service processes is the implementation of the already mentioned Industry 4.0 elements.

One of the effective tools for the vertical connection of intelligent systems, intelligent logistics, production, marketing and intelligent services with a strong orientation to the needs and unique and specific possibilities of the customer is the application of new technology, namely the telephone switchboard [5], [6], [7]. To increase the efficiency of the logistics of production service processes, the most important decision-making process is to assess the service requirements themselves, evaluate the possible variants to satisfy them, and finally decide which organizational solution is optimal in specific conditions. If we talk about communication and obtaining information, then the telephone switchboard is one of the effective solutions. A telephone switchboard is a device through which the company ensures the connection of telephone calls and other functions, including the billing of telecommunications services. It is possible and especially effective to introduce a professional telephone switchboard in the company, with which the number of received calls is increased thanks to the hold-on line.

Also, lost calls are recorded, which can, for example, be contacted back by the operator at the reception so that the company retains potential customers who expressed interest in the company and got it by phone [8], [9]. With the telephone exchange, it is possible to make detailed statistics on incoming and outgoing calls, including the number, average call length, distribution by the worker, utilization by hours, etc. It is important information for the company's management to make operational and strategic decisions based on the statistics and goals [8], [9].

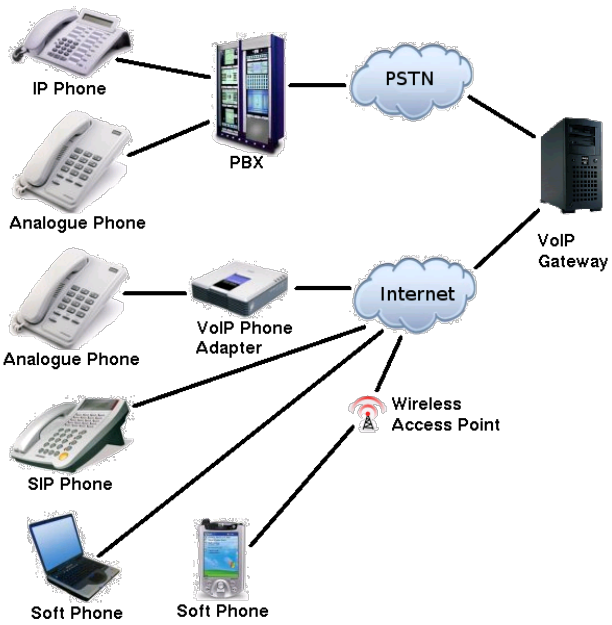

Figure 1. System configuration of the telephone exchange [10]

In July 2020, a significant step in building the technical infrastructure was the introduction of the HW and SW of the telephone exchange. This HiPath 3500 V9 communication system is also implemented with the OpenScape Office superstructure.

2. Methodology

HiPath 3000/5000 is an innovative communication solution for small and medium-sized businesses. HiPath 3000 is a powerful and reliable communication platform for all industries, which offers the same range of functions as classic telephones in conjunction with the most modern unified communication solutions in one flexible and cost-effective configuration. As a modular communication platform, HiPath 3000 meets the demanding requirements of individual companies. Depending on the selected system variant, the HiPath 3000 can be used with construction for up to 384 conventional voice and 50 data terminals.

When connected to a local network based on the TCP/IP protocol, it is possible to implement up to 500 VoIP solutions with IP phones or software clients. Interactive operation using the display and dialogue buttons enables simple and quick activation of functions on digital system telephones and IP telephones with the CorNet IP-TS protocol. This service also applies to comfortable DECT telephones connected to HiPath Cordless Office. Thanks to the flexible concept of the adapters, combining several additional terminal devices directly into the system telephones is possible. It enables individual workplaces to be easily adapted to changing requirements. For several locations, networking with other systems is realized through the CorNet N and QSig protocols or a LAN-LAN connection based on the TCP/IP protocol. Individual user solutions are integrated into the system as a module or connected via open interfaces. HiPath 3000 enables a flexible transition from a conventional communication system to a multimedia platform based on the IP protocol [11], [12], [13].

The HiPath 3000 system has a wide range of functions [13], [14], [15]:

- List of unanswered incoming calls - for system phones with a display, unanswered incoming calls are recorded, provided that the caller's phone number is displayed for external calls (i.e. a call from ISDN) and the name or number is displayed for internal calls. The records include the date, time and number of call attempts. It is possible to select any form from this list and directly establish a connection to the participant who did not call;
- "Do not disturb" / "Silent ringing" - the subscriber can protect himself from incoming calls. The caller will hear a busy tone. Authorized participants (e.g. operators) can overcome the barring of calls. With system phones, the acoustic signalling is turned off, so that incoming calls are displayed only on display (cannot be used on Optiset Eentry and optiPoint 500 entry phones);
- Call pick up - a call coming to another phone or for a certain subscriber can be picked up on the own telephone within a defined group of subscribers;
- Connection - authorized participants can directly connect to another participant's ongoing call;
- Authorization classes - the telephone authorization can be set individually for each subscriber within the branch exchange. In doing so, a distinction is made, for example, between:
  - unlimited access to the public network,
  - limited access to the public network,
  - no access to the public network (only internal calls),
- Loud addressing - information intended for several recipients can be announced to the loudspeakers of the system telephones or another loudspeaker (e.g. in the waiting room),
- record of call charges – each end device or internal distribution is recorded in a summary counter. The length of the call is displayed on lines without receiving tariff pulses,
- group ringing - for a total of 150 groups with max. 20 participants. Individual participants can temporarily disconnect from the group,
- line buttons (MULAP) - the following settings can be controlled using the line button:
  - group functions,
  - chief-secretary functions,
  - convenient transmission part (Gigaset) parallel to the system telephone under one telephone number (only in connection with HiPath cordless Office),
- internal phone book - all branches with their associated names are stored in the system's internal phone book. Their numbers can be searched and dialled directly from system telephones with a display,
- abbreviated selection individual/shared - for each phone, it is possible to enter up to 10 destinations individually and for shared use max. 1000 targets,
- alternating between two existing connections,
- text messages - on the display of internal participants, you can send pre-programmed texts ((e.g. "Visiting is waiting") or short readers that you write yourself and create),
- internal texts sent to a mobile phone - when using HiPath cordless EM, internal text messages can also be sent to a comfortable mobile phone,
- text responses in absence - you can activate some of the predefined notifications (e.g. Return:.) on your phone during your absence,
- project numbers - by entering the project number (max. 11 digits), even during a call, incoming call charges can be assigned to a specific order or project,
- suppressing the display of the number - in the case of an ISDN connection, the caller can prevent the transfer of his telephone number to the called party either for one specific call or in the entire system,
- ring signalling - for acoustic signalling of various types of incoming calls, i. e. different ringtones are used for internal, external, and return calls,
- ring assignment - an incoming call to the extension is simultaneously signalled on other phones in the group,
- switches (sensors - not included with HiPath 3700/3750) - up to four free relays can be connected through the control relay module, which can be controlled using codes (optional),

- an electric gatekeeper - is a communication device at the door with the function of opening the door. In addition, it is possible to link the ringing of the doorbell by activating the redirection function to an external destination,
- redial (extended) - for the three most recently dialled external phone numbers.

In addition to the functions mentioned above, the HiPath 3000 system also has standard functions such as Missed calls/switchboard, Second call notification, Incoming call forwarding, Display text language (can be set individually for each phone), Conference call (internal/external), Line occupation (automatic), Music on hold, Music from an external source (optional), Night/day mode, Call Parking, Call back (automatic) if the subscriber is busy or does not answer, Transfer ringing to another line after a certain time - if the subscriber does not answer, Serial connection (linear/cyclical offering of an incoming call to group members when the call is accepted), Locking the phone (using a personal code), Central phone book, Call transfer (internal/external), Redial.

The HiPath 3500 V9 communication system includes additional cards for (4) incoming calls via the IP SIP Trunk protocol with 30 call options - incoming and outgoing calls are mediated by an additional IP SIP gateway (card) HG1500, which is connected through a secure tunnel with an Internet connection to the telecommunications exchange SWAN provider. Also, the analogue flap card will be expanded by eight flaps with the SLAD8R card (with CLIP transmission) for 12 flaps. [11], [12]:

The overall construction of the UNIFY HiPath 3500 switchboard includes [11], [12]:

- Incoming IP SIP Trunk with 20 channels - provided by the HG1500 card (IP SIP gateway),
- Total number of digital participants (doors) up to 8,
- The total number of analogue subscribers (doorsteps) is 12, of which 8 with CLIP functionality;
- OpenScape Office software add-on - OSO contact centre (works on Linux OS on a separate PC):
- The OpenScape Office system is connected to a common subnet of the LAN network with the UNIFY HiPath 3500 V9 control panel, with which it forms a single unit,
- All incoming calls are evaluated by the OSO (OpenScape Office) system, which assigns calls to registered agents in the contact centre according to the created scheme,
- Suppose no agent is free or logged in. In this case, the call is evaluated cyclically, and the caller is notified of the location of the call. All operators (contact centre agents) are busy and subsequently inform the caller, who is waiting for his call to be arranged. The caller should arrange accordingly (wait or hang up and call again),
- All outstanding calls are logged and sent to all agents for handling (call back) in order, with the indicated date and time of call arrival,
- The OSO system has set times for calling in and accepts lunch breaks as well as the calendar of national holidays,
- Suppose a public holiday for the company operating the OSO Contact Center is a working day. In this case, these days will be excluded from the holiday calendar, and the system will consider their normal working days.

3. Results and Discussion

With the help of the plied telephone switchboard, the number of phone calls handled increased by 30 - 50%, which for the company represents a high increase in the number of agreed dates for outpatient treatments and consultations, ultimately increasing customer satisfaction. In Figure 2, we can see the current configuration of the HiPath 3500 switchboard.

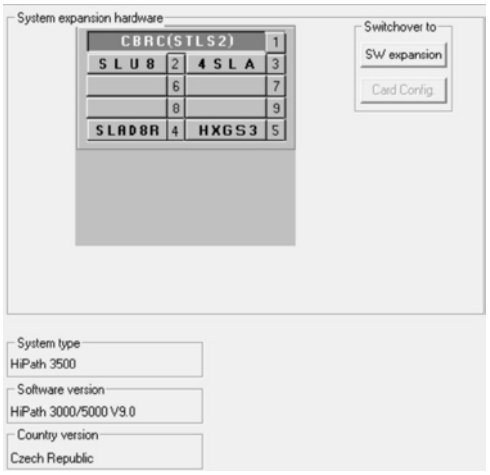

Figure 2. Configuration of the HiPath 3500 control panel [authors' own processing]

Its firmware version and MAC address, to which IP SIP Trunk licenses apply, can be seen in Fig. 3.

Figure 3. Software version and MAC address [authors´ own processing]

As part of the analysis of the number of calls in the monitored period 09/2020 - 02/2022, a high impact of innovative technologies and a new marketing strategy on the number of calls and the number of "handled" calls was demonstrated. Thanks to the HW and SW of the telephone exchange and online reservation system, the company could arrange simultaneously (within the working day). 30 – 50 % more customers than before introducing innovative technologies. In Table 1, we can see the increase in the number of calls during individual months of the analyzed period and the average number of calls per day, which was recalculated based on the number of working days during individual calendar months.

Table 1. Number of calls in the period 09/2020 – 02/2022 [authors' own proceesing]

Year	Month	Numbers of calls	Average number of calls per day
2020	September	912	46
	October	1,727	79
	November	1,496	71
	December	948	53
2021	January	1,999	91
	February	1,784	89
	March	2,072	99
	April	1,735	87
	May	1,991	95
	June	1,916	96
	July	1,799	82
	August	1,778	85
	September	2,111	101
	October	2,228	97
	November	1,951	98
	December	1,288	68
2022	January	2,313	110
	February	1,827	107

Based on the recorded number of calls, we can conclude that the sum of calls for the year 2020 (September to December) was lower compared to the year 2021, which shows the sum of calls for the first three months (January to March), which compared to the four months of 2020 up to 772 more calls. When comparing the same periods of 2020 and 2021, specifically September to December, they had up to 2,495 more calls than the previous year, representing an increase of up to 49 %. Comparing the months of January to February 2021 and 2022, we see that the sum of calls for 2021 was 3,783 and the sum of calls for 2022 was up to 4,140, which means an increase of up to 357, i.e. 9.44 %.

From the graphical processing of the call analysis, we can also conclude that the number of calls has an increasing tendency, shown by the linear line in Figure 4. Ultimately, the rising number of calls is closely related to the growing trend of satisfied customers calls, which is a performance measure for the company.

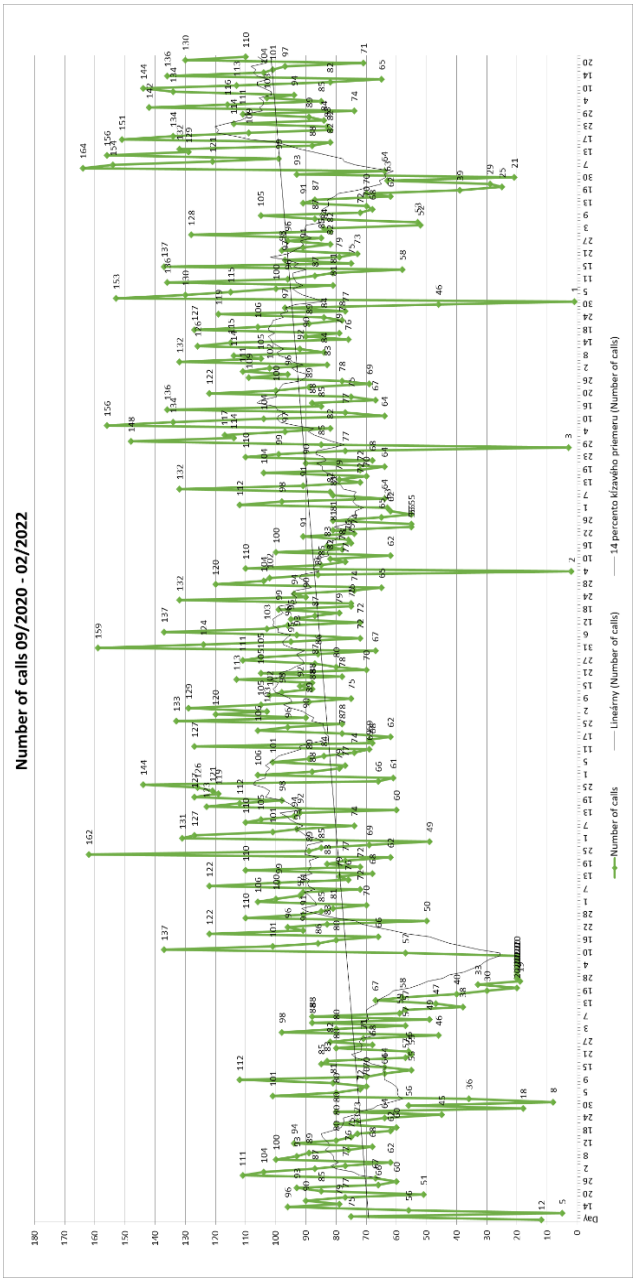

Figure 4. Analysis of the number of calls [authors' own processing]

The proposed solution's advantage is the switchboard's basic and advanced functions, which include call recording, automatic dialer, call connection and forwarding, conference calls, mailbox, answering machines, time conditions, comprehensive reports, virtual fax, and many more. By applying service processes through the implementation of SW and HW of the telephone switchboard in the company, we focus on customizing solutions for each customer according to the requirements.

An important condition is that all company system updates are a matter of course so that the company always has the latest updates. The data is backed up daily, so the company will never lose its settings.

4. Conclusion

For the logistics of service processes through the implementation of SW and HW of the telephone exchange in the company, the most important decision-making process is to assess service requirements. The impact of the environment, evaluate possible variants to satisfy the customer's needs and decide which organizational solution is optimal under which conditions. It is known from the submitted contribution that the basis of today's successful company is the ability to work with large volumes of data, process them, derive relevant conclusions from them and make decisions based on them. In this activity, they are helped by logistic service processes, supported by other information and communication technologies, which fundamentally affect how they work with data and information and the methods of decision-making and communication. A powerful and reliable communication platform is in use in various industries. The advantage is that it offers the same range of functions as classic phones in connection with intelligent solutions for unified communication. In the future, research will focus on the digitization of society and the use of smart technologies in predicting service processes in the company.

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References:

[1]. Tarabová, Z., & Chudada, M. (n.d.) *Logistika obslužných procesov.* Logistický monitor. Retrieved from: https://www.logistickymonitor.sk/images/prispevky/logistika-obsluznych-procesov.pdf [accessed: 19 February 2023].

[2]. Spišák J. (2005) *Podniková logistika - učebné texty*, Košice.

[3]. Spišák, J. (2005). *Logistika obslužných procesov*. Technická univerzita. Košice.

[4]. Malindžák, D., Marková, Z., & Drábik, L. (2007). *Teória logistiky/definície, paradigmy, princípy, štruktúry*. Košice: Karnat.

[5]. *Základné prvky Industry 4.0*. (2023). Industry. Retrieved from: https://industry4.sk/o-industry-4-0/principy/ [accessed: 22 February 2023].

[6]. Molokáč, M., Alexandrová, G., Kobylanska, M., Hlavňová, B., Hronček, P., & Tometzova, D. (2017, October). Virtual Mine—Educational model for wider society. In *2017 15th International Conference on Emerging eLearning Technologies and Applications (ICETA)*, 1-5. IEEE.

[7]. Wittenberger, G., Cambal, J., Skvarekova, E., Senova, A., & Kanuchova, I. (2021). Understanding Slovakian Gas Well Performance and Capability through ArcGIS System Mapping. *Processes*, *9*(10), 1850. Doi: 10.3390/pr9101850.

[8]. *Telefónna ústredňa*. (2015). Wikipedia. Retrieved from:https://sk.wikipedia.org/wiki/Telef%C3%B3nna_%C3%BAstred%C5%88a [accessed: 05 May 2023].

[9]. *3CX Telefónna ústredňa*. (n.d.) Nettrade. Retrieved from: https://old.net-trade.sk/clanky-detail/3cx-telefonni-ustredna/ [accessed: 19 January 2023].

[10]. *VoIP, telefóny, ústredne*. (n.d.). Advanced Information Systems. Retrieved from: https://www.ais.sk/sk/voip-telefony-ustredne-vratniky [accessed: 01 March 2023].

[11]. *HiPath 3000, HiPath 3700/3750, HiPath 3500/3550, HiPath 3300/3350.* (2003). Microel. Retrieved from: http://microel.eu.sk/files/HiPath_3000.pdf [accessed: 17 February 2023].

[12]. Čtvrtníčková, P. (2021) *Hardvérová vs. virtuálna telefónna ústredňa – ktorá ponúka viac benefitov?* VIP tel. Retrieved from: https://www.viptel.sk/blog/hardverova-vs-virtualna-telefonna-ustredna-ktora-ponuka-viac-benefitov [accessed: 20 January 2023].

[13]. Dupláková, D., Duplák, J., Simkulet, V., & Kojic, D. (2022). Implementation of digital ergonomic tools during the flexible screening of lighting in the working environment. *TEM Journal*, *11*(3), 995-1001. DOI: 10.18421/TEM113-01.

[14]. Markulik, Š., Petrík, J., Šolc, M., Blaško, P., Palfy, P., & Girmanová, L. (2022). The Relationship between Process Capability and Quality of Measurement System. *Applied Sciences*, *12*(12). Doi: 10.3390/app12125825.

[15]. Turisová, R., Pačaiová, H., Kotianová, Z., Nagyová, A., Hovanec, M., & Korba, P. (2021). Evaluation of eMaintenance Application Based on the New Version of the EFQM Model. *Sustainability*, *13*, 3682. Doi: 10.3390/su13073682.