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Theoretical and practical features of data processing centers evaluation (DPCs)

In this Article the author considers the features observed in the course of valuation of special purpose real estate, i.e., the data processing centers (DPCs) and the data processing and storage centers (DPSCs) in accordance with experience accumulated by the international community and based on the recommendations contained in the International Valuation Standards as well as the RICS methodological guidelines (The Royal Institution of Chartered Surveyors (Great Britain)).

The present article is justified as currently Russia lacks a separate and uniform for all valuers or forensic experts standard or methodological recommendations in the sphere of valuation of the data processing centers and courseware is scarce. At the same time Russia, similar to other countries of the world, is witnessing a considerable growth of construction of the DPCs later involved in the stream of commerce as transacted, subject to mortgage or disputed properties.

The present article analyzes the modern approach internationally applied to value the DPCs, summarizes the author's personal professional experience in this sphere. At the same time the author determines and provides a deep insight into the specifics of the target group or real estate, identifies and classifies its key merits which exert effect on the properties' value. The author provides a deep insight into applying the valuation approaches and methods, together with practical recommendations as to how measure market value within the frameworks of the cost, market or income approaches. The author gives special focus to the key (income) approach, describes the details of the types of the services which are capable of forming income from DPC operating activities, examines the items of DPC operating costs and provides practical guidelines to be applied to measure the cap rate of this type of real estate.

Keywords: *real estate valuation, valuation approaches and methods, market value, commercial real estate, specialized assets, data storage and processing center (DSPC), DPC, or the data center, cloud services, ICT (information and communications technologies), forensic examination*

INTRODUCTION

Currently Russia lacks a uniform for all valuers or legal experts standard or methodological recommendations pertaining to valuation of the data storage and processing centers (DPCs/DSPCs, data centers), while the academic literature is scarce.

Both in Russia and in all other countries of the world a considerable growth of construction of the above properties is observed which later are involved in the stream of commerce as transacted, subject to mortgage or disputed properties.

The unprecedented increase of global Internet traffic and data volumes during the COVID-19 pandemic and 2020 lockdown triggered a growth in the communications and technologies infrastructure (CTI) which resulted in the increased demand for the data centers as well as the cloud services.

In accordance with the Synergy Research Group, international agency, the volume of the global market of the data processing centers colocation in 2021 equaled 50,335.72 mln dollars. It is expected to grow up to 159,852.82 mln dollars by 2039, which means 13.7 % increase during the forecast period in average (2022 — 30) [1].

In the present Article the author has presented the results of the analysis of international experience [2] and methodological peculiarities of valuation of the data centers, generalized the practical experience accumulated in the course of valuation

of DPC by Professional Group of Appraisal, as well as identified the key characteristics which have effect on value and also recommended how market value of DPC is to be valued.

DPC: CLASSIFICATION, CERTIFICATION AND TYPES OF OPERATING ACTIVITIES

The data (storage and) processing center (DPC/DSPC, the data center) is the complex technology and capital consuming infrastructural property intended for colocation of computer equipment (servers), storage, processing and transfer data systems for the corporate, commercial and government sponsored users of the services.

The DPC key functions include as follows:

- storage and analysis of different volumes of the data;
- ensuring security of hardware, stored, transmitted and received data;
- ensuring the maximum data availability for the users;
- failure free equipment operated in the uninterrupted mode;
- integration of distributed databases;
- ensuring conference communication, etc.

The above functions are mainly framed within those services demanded by the users, which may be delivered by DPC.

DPCs classification is based on determination of their reliability (security, fault tolerance, availability).

The reliability tiers are currently determined based on the criteria introduced by Uptime Institute¹.

- There are 4 reliability tiers [3]:
1. TIER I is the lowest level with reliability of 99.71 %, to which installations in the office premises correspond. The weak protection scheme² N, basic safety, downtime up to 30 hours annually required for maintenance — all appropriate for the internal corporate services, but not for IT business. Here basic conditioning and additional power source are mandatory.
2. TIER II. In order to be certified for TIER II, the backup capacities are to be added in accordance with N + 1 scheme. This allows to decrease idle time to 22 hours a year and reach fault tolerance of 99.749 %. For this the data center must have:
- computer so-called raised floor with embedded in networks used for switching equipment on;
 - improved conditioning system;
 - additional power sources.
- The above proves to be sufficient where failures are insignificant, however operation is to be suspended in case of technical maintenance.
3. TIER III. The key advantage of DPC certified TIER III is that in case of maintenance the servers are not to be switched off. Value is increased up to 99.982 %, and idle time is decreased to reach merely 1.6 hours a year. To this end:
- all system components are backup;
 - one more independent power source is added;
 - additional cooling system is installed.
- TIER III is the level at which most major data centers are operated in Russia.
4. TIER IV is the higher level of reliability known today. At this level the best backup schemes which duplicate each component are used. In case of a failure in any network component it will be automatically switched to a parallel one which ensures uninterrupted operation of DPC. The maximum idle time is decreased to be the record of 0.8 hour a year.

Table 1 below reports the key differences in the level of fall-over protection.

Table 1. Key differences in the reliability level (fall-over protection)

Description	Tier I	Tier II	Tier III	Tier IV
Equipment protection	No	N + 1	N + 1	2(N + 1)
Possible maintenance without interruption	No	No	Yes	Yes
Annual idle time	28.8 h	22 h	1.6 h	26 min
Reliability level (fall-over protection rate), %	99.671	99.749	99.982	99.995

1 Uptime Institute is an independent entity headquartered in New York which certifies DPCs all over the world.

2 In the protection scheme the "N" symbol is used to mean a structural element. The basic level (N) corresponds to no protection. (N + 1) means that the basic element is added by a backup which is switched on where any problem is identified in the system thus allowing to avoid any failures however in such situation it will be necessary to suspend operation for the maintenance period. 2N means using of the parallel duplicate components. The protection scheme 2(N + 1) means that the 2N scheme is added by one more element which allows for simultaneously performed operations with two systems. In 2(N + 1) scheme both the basic and additional components. The protection scheme 3/2N provides for three parallel components to distribute the capacities which allows raising efficiency (infrequently-accessed).

3 PUE (Power Utilization Efficiency) indicates power efficiency of a data processing center and is calculated as the result of electric power consumed by the data center divided to electric power consumed by the equipment of DPC.

DPC characteristics and parameters which have effect on its value

- Generally, pricing variables in the real estate market (both the land plots and the buildings and/or premises) are reported in different sources [4–6].
- However, assuming that DPC is a specialized asset, its value is under effect caused by different variables determined by a specialized nature, destination, construction, configuration, composition, and other qualities of such unique asset:
1. certification level of protection (fall-over level) — Tier I, II, III, IV;
 2. available technical switching on to the networks and commercial dedicated power supply, in MW;
 3. number and characteristics of the racks or rack spaces (nominal capacity in terms of kW/rack, number of units);
 4. calculated annual median PUE³;
 5. availability of IT equipment;
 6. Total space and allocation of spaces for:
 - administrative area;
 - computer rooms;
 - technical, warerooms and utility rooms.

Selecting the DPC valuation approaches and methods

In accordance with Clause 2 of Federal Valuation Standard V [7], in the processes of valuation the valuer must give consideration to possibility of using all the valuation approaches, including for substantiation of the conclusions obtained when other approaches were used. In selecting valuation approaches and methods the valuer should consider the nature of the asset, valuation goals, type of value, availability of reliable source information, valuation assumptions and limitations. No one valuation approach and method is suitable in every possible valuation situation. The valuer may use one valuation approach and method when the valuer has a high degree of confidence in the accuracy and reliability of a single method given available information, assumptions and limitations of the valuation engagement.

The author describes possible use of each of the approaches to valuation of DPCs below.

Market approach

DPCs in the global market, as well as other real estate sectors, are considered as an investee, however, not the real estate properties but rather the DPCs owners, specifically, their stock and shares, operate in the market.

As to the number and volume of M&As in the DPCs market their record was observed in the year 2021. In accordance with Synergy Research, in 2021, 216 M&As with DPCs were registered to the total amount of over 49 bln dollars. This exceeds the 2020 result which was 34 bln dollars, which set a record for the year 2020, by 41 %.

In 2021 and 2022 the following major M&As deals were performed in the global DPCs market (transaction costs are reported

below based on the open publications with references to reports of Synergy Research) [8]:

- CoreSite (»10 bln dollars);
- QTS (»10 bln dollars);
- CyrusOne (15 bln dollars);
- Switch (11 bln dollars).

The above four companies are in top 15 colocation providers of the world⁴, and they are rated from the third to the sixth places in the US market rating, being inferior in scales to only Equinix and Digital Realty Trust.

It is possible to calculate the price multiples used in the course of the deals (Table 2) considering as the price target the below merits and using the financial statements of the companies for the period preceding the deals.

Values of the multiples related to the deals with large DPCs correlate with the data reported by Damodaran on line for REIT (Real estate investment trusts) for the US market. In accordance with the portal, multiple EV/Sales equals 14.23.

Shares of the investors in DPCs as below are listed in exchanges:

- Equinix, Inc. (USA);
- Digital Realty Trust, Inc (USA).

The key multiples in accordance with the trades data for December 2022 [9, 10] are reported by Tables 3 and 4.

Thus, the market multiples for the US market range as follows:

- EV/EBITDA — 11.7–28.1;

Table 2. Deals' multiples for the deals attributed to large DPCs

Name of the indicator	CoreSite	QTS REIT	CyrusOne Inc (CONE)	Switch Inc (SWCH)
Enterprise Value (EV), In terms of US\$, mln	10,000	10,000	15,000	11,000
Revenue, In terms of US\$, mln	639	585	1,206	665
Book Value, In terms of US\$, mln	2,167	4,335	7,452	3,301
EV/BV	4.61	2.31	2.01	3.33
EV/Revenue	15.66	17.08	12.44	16.53

Table 3. Market multiples for Equinix, Inc.

Indicator	2019	2020	2021	2022
Capitalization (MC), US\$ mln	49,777	63,635	76,160	60,615
Enterprise Value (EV), US\$ mln	59,723	74,490	88,365	60,615
P/E ratio	97.4	171	153	85.4
MC/Revenue	8.95	10.6	11.5	8.35
EV/Revenue	10.7	12.4	13.3	8.35
EV/EBITDA	22.2	26.1	28.1	22.8

Table 4. Market multiples for Digital Realty Trust, Inc.

Indicator	2019	2020	2021	2022
Capitalization (MC), US\$ mln	24,992	39,086	50,193	28,830
Enterprise Value (EV), US\$ mln	35,025	52,282	63,499	28,830
P/E ratio	51.0	140	29.8	88.7
MC/Revenue	7.79	10.0	11.3	6.14
EV/Revenue	10.9	13.4	14.3	6.14
EV/EBITDA	18.6	23.9	26.3	11.7

- EV/Revenue — 6.14–14.3;
- P/E ratio — 51–171.

The Russian DPCs market also reports large deals however, in most cases it is impossible to acquire detailed information about such deals performed.

For example, in accordance with information published by information and analytical portal Mergers and Acquisitions in Russia, IXcellerate (LLC EXELERATE), a leading Russian operator of the commercial data centers raised investments of about 190 mln dollars from both the active shareholders and new investors, including Mubadala Investment Company, SberInvest, and Russian Private Equity Fund. However, information about the cost of the company was not disclosed neither before the investment round nor after the exit therefrom.

The similar situation is observed with another large market operator — Selectel (LLC Network of Data-centers "SELECTEL"), which held two issues of bonds to the total of 3 bln rubles each, earnings yield to maturity is⁵ 9.9 % [11]. Unfortunately, there is no information available about this company's cost, even expert's information.

In 2020 and 2021, PAO "Rostelecom" performed the largest deals of acquisition of the DPCs operators in the Russian market [12]:

- in January 2020 LLC "CENTER FOR DATA STORAGE", which is a subsidiary of PAO "Rostelecom", acquired the 100 percent share of LLC "DataLine" with the total of the deal of 17.5 bln rubles.

At the moment of the deal LLC "DataLine" had 4,811 server racks, and its proceeds for 2019 (the recent reporting period before the deal) were 5.6 bln rubles;

- in December 2020, the 44 percent stock of LLC "DATA PROCESSING CENTER" was sold to PAO "VTB", which acted in the capacity of a strategic partner. The above deal totaled 35 bln rubles, which means that at the end of 2020 the company was valued at RUB 79.5 bln rubles. At the moment of the deal the total capacity of the company's DPC network was 12.2 thousand racks.

Open information sources report the data about the acquisition deal completed by the company which owns DPC:

- PAO "MTS" acquired for 5.2 bln rubles, with account for net debt, the 100 percent share of LLC "GDC Energy Group", which is the owner of GreenBushDC, the data processing center located in Zelenograd данных GreenBushDC [13]. In accordance with the financial statements of LLC "GDC Energy Group", at the moment of sale the company's fixed assets were 3.4 bln rubles, which accounted for 94 % of all

4 Colocation means use of the data processing center technical resources by the client, colocation of the own telecommunications equipment, servers, data storage systems, etc.
5 At the application date.

company's assets. At the moment of sale, the number of the racks put into operation was 600 and there were plans to additionally equip two thirds of full capacity in 2021 [14].

Thus, currently the market offers scarce price information about the DPCs segment which could be used for the purposes of the market approach, meanwhile this approach may be used for reference, and the result may be presented in the form of the range of process.

Cost approach

As the target asset, the DPC is a property complex comprising the real estate and movable assets (specialized engineering systems, IT hardware), in the course of valuation of which and within the frameworks of the cost approach the summation method that calculates the value of the asset by the addition of the separate values of its component parts could be used.

Table 5 reports the data from open sources [15–18] concerning the analysis of the structure of DPC construction costs.

Lack of price information about DPCs construction in Russia in the market hampers the use of the cost approach for the purposes of valuation. Information available in the open sources [16, 19–21], may be presented only as a reference range (Table 6).

Many factors, including the level of DPC fall-over protection, have effect on construction costs. In accordance with the global market data, rise in construction costs of DPC for Tier IV compared with

Table 5. Structure of construction costs of DPC

Indicator	Indicator's merit (range), %		Mean value (calculated value), %
Construction of the building	10	20	15.0
Drop wire	20	25	22.5
Structured wiring system	0	5	2.5
Engineering systems of DPC	60	70	65.0
Additional costs	Pre-planning, design and commissioning of DPC may add 20 to 25 % to construction costs		

Table 6. Public market data about DPCs construction costs

Indicator	Indicator's value, In terms of US\$ (range)		Mean value (calculated value)
DPC construction costs (for Tier II), per 1 sq. m of the total space	14,000	15,000	14,500
DPC construction costs (for Tier III), per 1 sq. m of the total space (including auxiliary rooms (for Tier III) per 1 sq. m of the computer room	30,000		30,000
Construction costs per 1 rack (for Tier III)	72,000	85,500	78,750
Construction costs per 1 MW (for Tier III)	7,000,000	8,000,000	7,500,000

construction costs of DPC for Tier III reaches about 30 percent [22]. As to the Russian market such public data are unavailable.

Search of information about prices of equipment which is a component of DPC present additional difficulty for implementing the cost approach. Most producers of such equipment are from the countries which announced about the economic sanctions (e.g., France, Germany), which raises difficulties for acquiring and supply of such equipment to the territory of the Russian Federation. Where replacement cost is calculated, additional costs out of logistics and delivery terms, as well as adjustments for differences in technical characteristics when the analog equipment produced in other countries (e.g., Turkey, China) are to be accounted for.

Thus, currently the cost approach may be used for reference, the result may be presented as a cost range or otherwise used to examine the budget of the valued asset construction if it is submitted by the client to valuation.

Income approach

The income approach is applied in the valuation of real estate assets that generate or are capable of generating income flows. Here the valuers should follow the requirements of Clause 23, Federal Valuation Standard 7, and if the real estates which are leasable rents should be considered as income source and where real estate assets are intended for a certain type business, the valuation may be performed based on information about the operating activities of such business by way of selection out of its cost of its components which do not relate to the valued real estates.

DPC operating activities mean deriving of income based on the following commercial services, which may be classified into the standard and complex ones [23].

Standard shall be the services as follows:

- colocation of equipment, i.e., use by the client of the data processing center technical resources: colocation of own telecommunication equipment, servers, data storage facilities, and etc.;
- dedicated server, i.e., leasing the data center's servers out to the client;
- telehousing, i.e., colocation and switching on to the power and cooling systems of the telecommunication equipment and different components of the client's IT infrastructure in DPC;
- shared, i.e., lease by the client of the disc space of the DPC equipment.

Complex shall be understood as the services as follows:

- outsourcing of the information systems is a service which has it that the provider obtains part or the total IT infrastructure of the client in control or ownership;
- hosting of software maintenance and administration is a service which suggests centralized control of the replicated software assuming that the client has a remote or hands-off access to the software and the applications are hosted by the provider's information center;
- hosting of the infrastructure services is a service which provides standard parts of the IT infrastructure into the remote access for a definite term.

Clouds computing shall be considered as a service provided by the data centers. Actually, cloud technologies are a means of IT applications distribution between the physical servers and physical data processing centers.

Generally, three key services based on the cloud technologies are indicated as follows [24, 25]:

- infrastructure as a service (IaaS);
- platform as a service (PaaS);
- software as a service (SaaS).

The target of the widespread models of the cloud computing services (SaaS, PaaS и IaaS) is definite business models. The X (anything) as a service (XaaS) is that anything capable of being delivered by Internet may be sold. This includes as follows:

- backend as a Service (BaaS);
- storage as a Service (SaaS);
- communications as a Service (CaaS);
- network as a Service (NaaS);
- monitoring as a Service (MaaS) and etc.

Today open price information about the DPCs services is available in the market. Table 7 reports examples of the colocation services.

Table above proves that average prices of the colocation services in Moscow range from 126 thousand rubles to 200 thousand rubles per month (VAT included) per 1 rack space with load of 5 kW. Table 8 above mainly reports process for the DPCs which are certified for TIER-3; meanwhile if DPC is not certified, the rack place price is lower (refer to, e.g., to considerably lower value before 85 thousand rubles per month for asset No. 5).

Also, there are industrial researches, e.g., the research performed by iKS-Consulting agency or 3data company. In accordance with the data presented by the above companies, average prices of the colocation services in Moscow agglomeration (includes Moscow and the Moscow Region) and St. Petersburg (includes St. Petersburg and the Leningradskaya Oblast), performed in the 1st Quarter of 2023 ranged from 104.8 thousand rubles to 74.6 thousand rubles per rack (without VAT) [26].

The income approach makes it possible to apply different methods based on direct capitalization or future cash flows (income) discounting. Irrespective of the method to be selected by the valuer the following moments call for special attention where the income approach is applied to valuation of DPC.

1. *Underload*. In accordance with the market participants [27], the existing data services load reaches 80 to 85 % with the restricted number of free places in the highly fall-free segment (Tier III) and the load striving to be 100 percent.

2. *Operating expenses*. Totally expenses to maintain DPC significantly depend on the level of security and quality of the applied technological decisions, however, the expenses structure is capable of being valued. Operating expenses from DPC maintenance may be divided into five main groups [16]:

- 1) *Payment for electric power consumed* (~ 30–35 %). Electric power costs are the heaviest item in DPC expenses' structure. Where the above indicator is calculated it is necessary to account for not only the quantity of kW consumed by the racks but also for the power consumption structure as well as the annual average level of power usage effectiveness, or PUE;
- 2) *Lease* (~ 15–20 %). This indicator mainly depends on the geographical location of DPC and is time-dependent;
- 3) *Payroll* (~ 25–30 %). Where the above indicator is calculated the open financial data about the DPC services provider may be used. Table 8 reports the respective example;
- 4) *Maintenance* (~ 10–15 %). Maintenance expenses are determined by the operated systems structure;
- 5) *Other costs* (~ 10–15 %). Other expenses may include taxes, depreciation, insurance of the data processing center, etc. Where taxes are computed tax benefits are to be accounted for if DPC is located in an Export Processing Zone, or EPZ. If, for example, the would-be built DPC will be located in the Dubna EPZ and enjoy benefits and preferences for the residents, the income tax rate payable to the regional budget in the first 8 years will be 0 percent, the next 6 years, 5 percent, and thereafter, 13.5 percent; income tax rate payable to the federal budget will be 2 percent, property tax holiday will be 10 years and land tax holiday will be 5 years.

Table 7. Examples of prices of the colocation services in Moscow

Description of the leased asset	Load, kW	Price, RUB/month, (VAT included)	Information source
Lease of rack (47 Unit 600 × 1000 mm with 6 xPDU16A) In certified DPC TIER-3	5	110,000	https://datahouse.ru/price/
Lease of 1/2 rack (22 Unit 600 × 1000 mm with 3 xPDU16A) In certified DPC TIER-3	3	61,000	https://datahouse.ru/price/
Lease of 1/3 rack (15 Unit 600 × 1000 mm with 2 xPDU16A) in certified DPC TIER-3	2	44,000	https://datahouse.ru/price/
Lease of server rack in certified DPC TIER-3 42U, up to 5 kVA	5	150,000	https://www.reg.ru/colocation/stand_rental/
Lease of server rack in DPC of level TIER-3 42U, up to 5 kVA, not certified	5	85,000	https://www.reg.ru/colocation/stand_rental/
Collocation of equipment in the certified DPC certified in accordance with the standard of the Uptime Institute TIER III (Detailed Design, Constructed Facility)	5	126,000	https://greendc.ru/services/colocation/rack-space-rental/
Closed server rack 47U in certified DPC TIER-3	5	129,000	https://itsoft.ru/data-center/rack/
Server cabinet 47RU, up to 5 kVA, Berzarina (Moscow) in certified DPC TIER-3	5	200,000	https://selectel.ru/services/colocation/server-rack/
Server cabinet 47RU, up to 5 kVA, Dubrovka (LO) in certified DPC TIER-3	5	190,000	https://selectel.ru/services/colocation/server-rack/
Lease of rack 42-48U in certified DPC TIER-3	5	115,000	https://netrack.ru/server-rack

Table 8. Payroll expenses. The data are reported as at the end of 2021

Name of the entity	Payroll expenses, thousand RUB	Proceeds, thousand RUB	Share in proceeds, %
LLC "SVYAZ VSD"	223,814	1,281,612	17.5
LLC "Excelerate"	508,340	2,689,030	18.90
LLC "NETWORK OF SELECTEL DATA CENTERS"	1,479,611	4,847,983	30.5
LLC "STEK TELECOM"	228,564	715,111	32.0
Average value			25

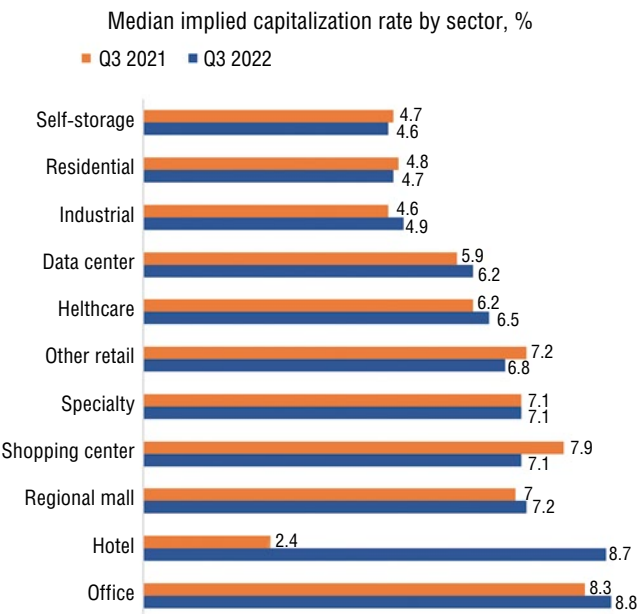
Cap rate and discount rate

In accordance with Clause 22, Federal Valuation Standard 5, cap rate and discount rate must indicate the risks as assessed by the market participants, of obtaining the expected cash flow as well as a specific transaction or user (in accordance with the type of determined value).

To derive the discount rate value weighted average cost of capital (WACC) model may be recommended while the capitalization rate may be derived with certain difficulties. There are difficulties in implementing the market extraction method as the market lacks the data about the deals (sale offers) of the comparable subjects and the build-up method may yield ever greater error in part of risks analysis and consideration.

Today Russia is witnessing recurring research works [28, 29] analyzing capitalization rates for the wide spread sectors of commercial real estate market: office, trade, warehouse; however, there are no such research works in DPCs.

Meanwhile, Western analytical research works, e.g., S&P Global Markets [30], consider the capitalization rates in many market sectors of the US commercial real estate (Fig.).



Cap rates observed in different sectors of the US real estate market [30]

The Figure shows [30], that average cap rate for DPC (data center) in the USA is 6.2 %. The data about the cap rate for DPCs in the USA as well as the data about the risk-free rate in the USA and Russia allows for computing cap rate for DPCs in the Russian market.

Final calculation

As the income approach yields the market value of the DPC operating business it will be required to leave aside the components of the resulting value which do not relate to the target real estate assets.

CONCLUSION

Valuation of the specialized assets requires from the valuer or expert rich experience, high qualification and knowledge of the market specifics. Valuation of the data centers is a labor consuming process as all valuation approaches are applied. The result obtained within the frameworks of the individual approaches may be presented not as a definite figure but also by a range of values. The key provisions of this paper may be useful and applied by the practicing valuers or forensic examiners.

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Теоретические и практические особенности оценки центров обработки данных (ЦОД)

В настоящей статье автор разбирает особенности оценки объектов недвижимости специального назначения: дата-центров или центров обработки (и хранения) данных (ЦОД/ЦХОД), опираясь на международный опыт, рекомендации международных стандартов оценки и методического руководства RICS (The Royal Institution of Chartered Surveyors/Королевское общество сертифицированных экспертов в области недвижимости (Великобритания)).

Актуальность статьи обусловлена тем, что в настоящий момент в России нет отдельного единого для всех оценщиков или судебных экспертов стандарта или методических рекомендаций по оценке центров обработки данных, а учебно-научной литературы крайне мало. При этом в России, как и в целом в мире, отмечается значительный рост строительства ЦОД, которые впоследствии вовлекаются в коммерческий оборот в качестве объектов сделки, залога или имущественного спора.

В статье проанализирован современный международный подход к оценке ЦОД, а также обобщен личный профессиональный практический опыт автора. Отдельно в статье дано определение и проанализированы особенности этой группы недвижимости, приведена классификация и выявлены основные характеристики, которые оказывают влияние на стоимость. Автором исследованы особенности применения подходов и методов оценки и даны практические рекомендации по определению рыночной стоимости в рамках затратного, сравнительного и доходного подходов. Особое внимание автор уделит основному (доходному) подходу, подробно описаны виды услуг, которые могут формировать доход от операционной деятельности ЦОД, постатейно рассмотрены расходы на эксплуатацию ЦОД, даны практические рекомендации по определению ставки капитализации.

Ключевые слова: оценка недвижимости, подходы и методы оценки, рыночная стоимость, коммерческая недвижимость, специализированные активы, центр хранения и обработки данных (ЦХОД), центр обработки данных (ЦОД), дата-центр, облачные сервисы, инфраструктура коммуникаций и технологий, ИКТ, судебная экспертиза

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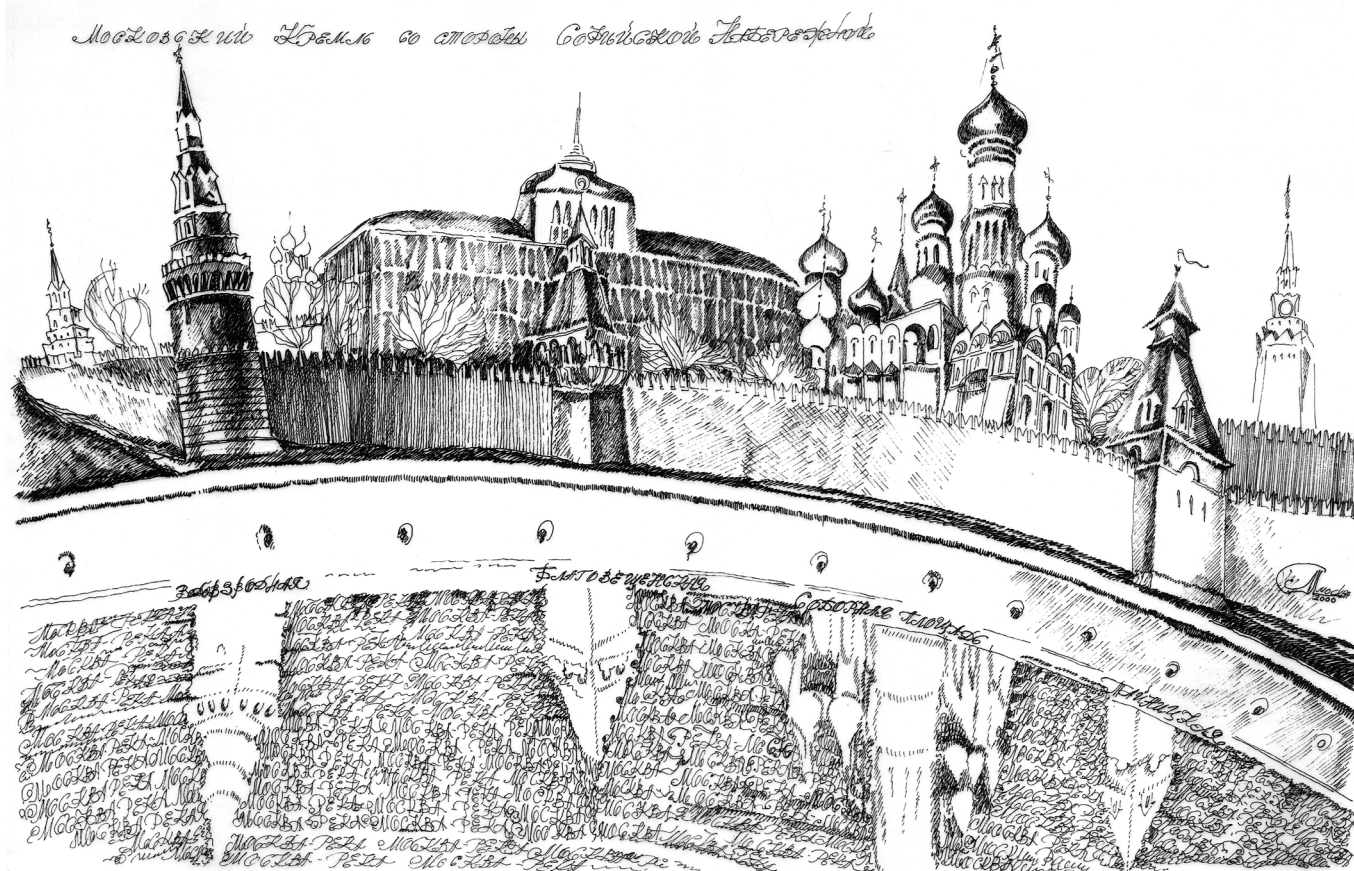
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Л.И. Павлова. Московский Кремль со стороны Софийской набережной. Рисунок, тушь перо



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