Acta Periodica

A MESTERSÉGES INTELLIGENCIA KORA

EDUTUS EGYETEM

XXVII. KÖTET

Edutus Egyetem
2800 Tatabánya, Stúdium tér 1.

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ACTA PERIODICA 27. KÖTET

EDUTUS EGYETEM KIADÁSA

www.edutus.hu

ISSN 2063-501X

2023. május

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HERAUSFORDERUNGEN DER UNGARISCHEN BERUFSBILDUNG

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DOI 10.47273/AP.2023.1.4-13

"Berufliche Bildung muss dazu beitragen, die Herausforderungen der Gegenwart und der Zukunft zu bewältigen. Dazu gehören vor allem die Digitalisierung von Wirtschaft und Gesellschaft, der demografische Wandel und das veränderte Bildungswahlverhalten wie auch der Klimawandel, die Energiewende und die Umgestaltung zu einer nachhaltigen Wirtschaft und die Internationalisierung[1].“

ABSZTAKT

A magyar szakképzés újratervezése már az 1990-es évektől égetően szükséges lett volna, de a 2019-es szakképzési törvény megjelenéséig a szakképzési környezetben a folyamatos korrekciók dacára lényegi változások nem történtek mégsem. Mindazonáltal aligha érdemes a szakképzésben az ezredforduló körül és azt követően történt állandó változások értelméről vagy hiábavalóságáról beszélni, mert a korabeli reformok legtöbb eleme úgy tűnt el nyomtalanul, hogy csak a leginkább elszánt szakértők vitatkoznak róluk olykor a tábortűz körül.

Cikkünkben a magyar szakképzés jelen helyzetének félig szubjektív SWOT-elemzését igyekszünk elvégezni, hogy számot vethessünk a 2019 óta többször módosított szakképzési törvény hatálybalépését követő első három évről. Ha az erősségekről, gyengeségekről, akadályokról és lehetőségekről van szó, akkor a látható oktatáspolitikai jelenségekből indulunk ki, hogy aztán az intézmények, a pedagógusok és a tanulók álláspontjáról is számot vethessünk.

***Kulcsszavak**: szakképzés, 2019-es szakképzési törvény, SWOT-elemzés, mérleg, oktatáspolitika*

[1] 1. Arbeitsgruppe 9 + 1 (2022): Zukunftsfähig bleiben! 9+1 Thesen für eine bessere Berufsbildung. Wissenschaftliche Diskussionspapiere. Bundesinstitut für Berufsbildung, Friedrich-Alexander-Universität, Erlangen-Nürnberg. S. 73.

ABSTAKT

Die Neugestaltung der ungarischen Berufsbildung hätte ab den 90-er Jahren brennend nötig gewesen sein müssen, aber bis zum Berufsbildungsgesetz von 2019 gab es konstante, aber keine essenziellen Veränderungen in der Berufsbildungslandschaft. Es lohnt sich kaum, über die Sinnhaftigkeit oder Sinnlosigkeit der ständigen Veränderungen in der Berufsbildung um die Jahrtausendwende und danach zu diskutieren, denn die meisten damaligen Elemente der Reformen verschwanden so spurlos, dass über die welche nur Hartgesottene am Lagerfeuer diskutieren.

In unserem Beitrag versuchen wir eine halbwegs subjektive SWOT-Analyse der ungarischen Berufsbildungslandschaft zu machen aufzuzeigen, um nach den ersten drei Jahren nach der in Krafttretens des Berufsbildungsgesetzes, das seit 2019 mehrmals modifiziert wurde, eine Bilanz zu ziehen. Bei den Stärken, Schwächen, Hindernissen und Möglichkeiten gehen wir von den sichtbaren bildungspolitischen Erscheinungen aus, dann sehen wir uns die Positionen der Institutionen, der Unterrichtenden und der Lernenden an.

***Schlüsselwörter**: Berufsbildung, Berufsbildungsgesetz von 2019, SWOT-Analyse, Bilanz, Bildungspolitik*

ABSTRACT

The redesign of Hungarian VET was a burning necessity since the 1990s, but until the Vocational Education Act of 2019 there were constant but non-essential changes in the VET landscape. It is hardly worth discussing the sense or futility of the constant changes in vocational training around the turn of the millennium and afterwards, because most of the elements of the reforms of the time disappeared so completely that only hardened people discuss them around the campfire.

In our article we try to do a somewhat subjective SWOT analysis of the Hungarian VET landscape in order to take stock after the first three years after the VET Act came into force, which has been modified several times since 2019. When it comes to strengths, weaknesses, obstacles and opportunities, we start from the visible educational policy phenomena, then we look at the positions of the institutions, the teachers and the learners.

***Keywords**: VET, VET-Act 2019, SWOT-analysis, balance sheet, education policy*

I. Begründung der Swot-Analyse aus fachlicher Perspektive

Die SWOT-Alayse entstammt grundsätzlich der Betriebswirtschaftslehre (BWL) und wird sehr häufig im strategischen Management verwendet, um sowohl die inneren als auch die äußeren Stärken und Schwächen zum Ziele einer summierenden Übersicht aufzuzeigen[2].

Da die Betriebswirtschaftslehre als Teil der Sozialwissenschaften interpretiert und die SWOT-Analyse in weiteren sozialwissenschaftlichen Feldern effektiv durchgeführt wird, ist es begründet, das äußerst wichtige Segment der Berufsbildung im bildungspolitischen Sinne mit dieser Methode zu beleuchten, insbesondere, da es auch Auswirkungen auf die Wirtschaft und auf die Gesellschaft ausübt.

Nach ihrer Beschaffenheit ist die Analyse dazu bestens geeignet, mit fachlicher Kompetenz und Erfahrung zum Teil subjektiv, zum Teil aber mit fachkundiger Objektivität die Situation des Untersuchungsgegenstandes zu beurteilen, um aufgrund dessen mögliche Strategien oder Prognosen zu präsentieren:

> „Die SWOT-Analyse gehört zu den verbal-argumentativen Methoden. Diese bewerten ausschließlich durch Argumentation, nicht durch arithmetische oder logische Aggregation. Daher ist kein ausformuliertes Zielsystem notwendig (Fürst und Scholles 2008). Solche Methoden erlauben eine einfache, schnelle und allgemein verständliche Erfassung spezifischer Faktoren und sind damit zeitund kostengünstig in der Durchführung. Ihre Schwäche liegt in der fehlenden oder geringen Formalisierung. So besteht die Gefahr einer willkürlichen und/oder unvollständigen Festlegung von Bewertungskriterien. Dies kann einen negativen Einfluss auf die Relevanz und Akzeptanz der Ergebnisse ausüben (Diller et al. o.J.). Weiterhin können Wissenslücken und Interpretationsschwierigkeiten mangels Formalisierung verdeckt werden; die Ergebnisse sind mehr oder weniger verfälscht (Weiland 1994). Die SWOT-Analyse ist im Kern ein Instrument, das in hohem Maße mit subjektiven Einschätzungen arbeitet; diverse Bewertungen können zwar skaliert werden, die Bewertungen basieren aber wieder auf subjektiven Einschätzungen. Die Anwendung der SWOT-Analyse erfordert ein umfangreiches und detailliertes Wissen über den jeweiligen Gegenstand, um Daten und Fakten zu sammeln, sinnvoll zu aggregieren und Prioritäten zu setzen. Deshalb wird eine SWOT-Analyse üblicherweise von Experten durchgeführt."[3]

[2] Wollny, Volrad; Paul, Herbert (2015): Methoden der Experten- und Stakeholdereinbindung in der sozialwissenschaftlichen Forschung. Springer Verlag.
[3] Wollny, Volrad; Paul, Herbert (2015): Methoden der Experten- und Stakeholdereinbindung in der sozialwissenschaftlichen Forschung. Springer Verlag, S. 190.

Die Autorinnen sind beide im Beufsbildungswesen tätig. Die Expertise von Anna Majorosi erstreckt sich in einer Zeitspanne von mehr als 30 Jahren auf reichhaltige und verschiedenartige Tätigkeiten und Positionen in diesem Bereich, im Moment leitet sie die unabhängige Prüfungszentrale Budapesti-Független-Vizsgaközpont, wo Anna Peres ebenfalls als Fachrefentin angestellt ist.

Die Ergebnisse einer sorgfältig durchgeführter SWOT-Analyse schaffen Ordnung in den Denkprozessen und fördern die Beibehaltung der Klarsicht, gegebenenfalls den roten Faden zu finden. Die Abwägungen differenter, parallel möglicher Drehbücher bei der Entwicklung einer Strategie helfen dabei, den gegebenen Untersuchungsgegenstand aus unterschiedlichen Perspektiven zu beurteilen:

> „Die Hauptaufgabe der Drehbücher oder Szenarien bei der Planung besteht darin, zum einen durch die Erwägung verschiedener Wege und Möglichkeiten, bzw. durch ihre Auswirkung die Beurteilung komplexer zu machen, zum anderen den Denkvorgang flexibler und offener zu gestalten, welche bei der Schaffung einer integrativen und lebendigen Strategie unabdingbar sind, darüber hinaus bereiten sie auf die Reaktionen auf unerwartete Situationen ebenfalls vor. Bei dem Aufzeigen der Drehbücher verfügen diese genannten Nebeneffekte über eine beinahe so wichtige Bedeutung, wie das ursprüngliche Ziel selbst: d.h. das Drehbuch zu finden, das am meisten realisiert werden kann und bezüglich des Allgemeinwohls am meisten optimal ist4.“

II. Frische Luft in der Berufsbildung

Durch das neue Berufsbildungsgesetz kann es der ungarischen Berufsbildung gelingen, von den 80-er Jahren in die 2020-er zu kommen, denn dieses entspricht sowohl den europäischen Empfehlungen als auch dem konstruktivistischen Lernkonzept. Die folgenden Elemente des Berufsbildungsgesetzes tragen wesentlich zur Erneuerung der Berufsbildung bei:

- die komplexe Sichtweise des Gesetzes, in dem die Rollen und Möglichkeiten der schulischen Bildung, der Erwachsenenbildung und der Hochschulbildung definiert sind;
- die Erneuerung der Berufsbilder, die in Kooperation mit der Wirtschaft entstand;
- die Aufteilung der Berufe in sog. Grundberufe, die ausschließlich an Schulen unterrichtet werden können und in berufliche Qualifikationen, die von allen Beteiligten der Berufsbildung angeboten werden können;
- die Orientierung an dem Europäischen Qualifikationsrahmen trägt zur Vergleichbarkeit und Überschaubarkeit der Abschlüsse bei;

[4] Dr. Köpeczi-Bócz, Tamás (2011): Humánszolgálati stratégiaoktatás. Budapesti Corvinus Egyetem, Budapest.S. 67-68. Vom Ungarischen ins Deutsch übersetzt von Anna Peres.

- der Fokus auf die Lernergebnisse (learning outcomes) statt Lerninhalte, was sowohl den Institutionen als auch den Unterrichtenden mehr Freiraum zulässt;
- die Schaffung unabhängiger und akkreditierter Berufsprüfungszentren, die für die Gleichwertigkeit der Abschlüsse sorgen;
- die Förderung der dualen Berufsbildung, die die beruflichen Wünsche und 333Vorstellungen der Lernenden mit der Berufswelt verbindet;
- die Vergabe von Stipendien für alle Lernenden in der Berufsbildung;
- die methodisch-didaktische Erneuerung, die auf der Grundlage des konstruktivistischen Lernkonzeptes beruht und sich nicht davor rückt, Instrumente, die gewisse, wenig zweitgemäße Lerntraditionen brechen, beim Namen zu nennen;
- es gibt Bestrebungen, ein neues Lehrpersonenweiterbildungssystem zu schaffen;
- die Förderung der Kooperation zwischen Schulen, Firmen, Erwachsenenbildungsinstitutionen und der Hochschullandschaft im Interesse aller Beteiligten zu stärken;
- das Gesetz hat geschafft, die Berufsbildung von der öffentlichen Schulbildung, die wenig zukunftsorientiert ist, zu trennen, ihren Status, die Bedingungen an den Schulen und die Lohnverhältnisse zu verändern;
- die Einführung der Qualitätssicherung und Qualitätsstandards, die das Verständnis zwischen Schulen, Hochschulinstitutionen, Firmen und Prüfungszentren fördert.

III. Swot-Analyse: Berufsbildung

III.1. Stärken

Die Rahmenbedingungen (Gesetz, Verordnungen, Finanzierung) sind für die Erneuerung der Berufsbildung geschaffen.

Die Selbstständigkeit der Schulen ist auf einem von der Schulleitung akzeptierbarem Niveau gesichert (die meisten Berufsbildungszentren überlassen den Schulen nicht nur fachliche, sondern bis zu einer gewissen Summe auch finanzielle Entscheidungen).

Die Lohnerhöhung der Unterrichtenden im Jahre 2020 zog qualifizierte Fachkräfte in die Berufsbildung, so dass der Lehrpersonenmangel an den berufsbildenden Schulen weniger spürbar ~~ist~~ als im öffentlichen Bildungswesen ist.

Die Transparenz des neuen Berufsbildungssystems ist hoch.

III.2. Schwächen

Die Berufsbildungszentren verfügen über kein Qualitätssicherungssystem und funktionieren in ihrem Alltag sehr unterschiedlich.

Das Nationale Amt für die Berufsbildung nimmt ihre Aufgaben als Steuerungsinstanz nur teilweise wahr. Nach außen scheint sie als Datenverwalter zwischen Institutionen der Berufsbildung und dem zuständigen Ministerium.

Die Kommunikation über die Veränderungen und über die Logik der Verordnungen ist leider mangelhaft sowohl auf der Ebene der Schulen als auch die für die Gesellschaft.

Die KMU-s werden kaum kontrolliert, wie sie ihren praktischen Teil gestalten, so kann ein wenig herausfordernder Umgang mit den Lernenden zu Motivationsverlust führen.

Die Veränderungen und Resultate werden zu wenig kommuniziert.

III.3. Möglichkeiten

Die Rahmenbedingungen sind für die methodischen Innovationen günstig.

Kommt der Lehrerweiterbildung mit der Erhöhung des professionellen und kontinuierlichen Angebots eine bedeutendere Rolle zu, kann sie die Veränderungsprozesse unterstützen.

Es gibt noch in der Kooperation zwischen den verschiedenen Beteiligten (Schulen, Universitäten, Firmen, Erwachsenenbildungsinstitutionen) wesentliche Potentiale.

Die Anerkennung der erbrachten Leistungen der Erwachsenen kann einen Beitrag zum lebensbegleitenden Lernen leisten.

Ein funktionierendes Qualitätssicherungssystem an den Schulen kann die Schulqualität tatsächlich verbessern.

III.4. Gefahren / Hindernisse

Die wirtschaftliche Krise betrifft die Unternehmen, die als duale Partner fungieren könnten, dadurch verliert die Berufsbildung an Attraktivität

Die Unruhe, die Demonstrationen im öffentlichen Bildungswesen lassen die Unterrichtenden in der Berufsbildung nicht kalt und es kann in dem Sektor trotz anderer Arbeitsbedingungen und anderem Umfeld auch zu Demonstrationen und Abwanderung führen.

Folgt die Lohnerhöhung der Unterrichtenden der Inflation nicht, besteht die Gefahr, dass qualifizierte Fachleute den Bildungssektor verlassen, denn in Ungarn fehlt es immer noch an Arbeitskräften in der Wirtschaft.

Die Bildungspolitik wird ungeduldig und es wird auf die konsequente und geduldige Verwirklichung der Strategie verzichtet.

Der Stellenwert des Sprachunterrichts verliert an berufsbildenden Schulen auch an Wichtigkeit, denn die Anforderungen der Hochschulinstitutionen bezüglich Sprachkenntnisse werden immer niedriger.

Ein Teil der Unterrichtenden, wenn sie wenig kollegiale Unterstützung bekommen, schafft es kaum, lernergebnisorientiert zu unterrichten und fordert eine Rückkehr zu stark inhaltsorientierten Lehrplänen.

Die wichtigste Wirkung der permanenten Reformen ist die Resistenz der Unterrichtenden, die schwerwiegende Konsequenzen für die Umsetzung des neuen Berufsbildungsgesetzes bedeutet, d.h. ein Teil der Unterrichtenden nimmt nur am Rande Kenntnis von den Veränderungen und arbeitet nach den gewohnten Mustern.

Die Akzeptanz der von den unabhängigen Prüfungszentren organisierten Prüfungen kann von den Schulen und Erwachsenenbildungsinstitutionen unterschiedlich realisiert werden, was zu Legitimationsproblemen führen kann.

Die Wege der verschiedenen Sektoren der ungarischen Bildungslandschaft gehen so auseinander, dass es immer schwieriger wird, eine kohärente Bildungspolitik für Ungarn zu realisieren.

IV. Fazit

Sollte man die Erwartungen an die Berufsbildung abwägen, soll man vor allem in Anbetracht ziehen, dass sich in unserer Bildungsgesellschaft alles sehr rasch verändert. Bildung im weitesten Sinne soll den sozialen-gesellschaftlichen Prozessen angepasst werden:

> „Bei der Gestaltung von Bildungsreformen muss der Blick über die vielen zu lösenden Alltagsprobleme hinweg 15, 20 Jahre nach vorne gerichtet werden, um strategische Perspektiven für Bildungsreformen zu schaffen. Die Welt hat sich grundlegend verändert, was insbesondere in einer völlig veränderten Arbeitswelt sichtbar wird: Noch vor einem halben Jahrhundert waren Märkte stabil, der Wettbewerb national ausgerichtet und Organisationsformen hierarchisch. Heute sind Märkte dynamisch, der Wettbewerb global und Organisationsformen vernetzt. Früher

> basierten Wachstumsimpulse auf Mechanisierung und Wettbewerbsvorteile auf „economies of scale“. Heute kommen Wachstumsimpulse aus Digitalisierung und Miniaturisierung und Wettbewerbsvorteile beruhen auf Innovation und Zeitnähe. Früher war das erfolgreiche Firmenmodell der Einzelbetrieb, heute sind es flexible Allianzen von Mitbewerbern. Früher war Vollbeschäftigung das politische Ziel, heute ist es „employability“, Menschen dazu zu befähigen, ihren eigenen Horizont in einer sich ständig verändernden Arbeitswelt ständig zu erweitern. Früher hatten Berufsprofile eine klare Identität und formale Qualifikationen waren der Schlüssel zum Erfolg. Heute sind Konvergenz, Transformation und lebensbegleitendes Lernen die Schlüssel.5“

In diesem Sinne ist in Bezug auf die Ebene der Lernenden vor allem der Zugang zum individellen Lernen erforderlich:

> „Richtig verstanden bezieht sich individuelles Lernen nicht auf die Bildungsziele für die Schüler, sondern darauf, wie unterschiedliche Lernwege und Lernmethoden eingesetzt werden können, um jeden Schüler im Rahmen objektivierbarer universeller Standards bestmöglich zu fördern6.”

Um dieser Zielsetzung gerecht zu werden, braucht man öffentlich festgelegte Standards und transparente Bildungsziele, aufgrund welcher sich die Lernenden ihre Leistung (Stärken und Schwächen) abmessen können.

Auf der Ebene der Lehrenden bedarf es dazu Tools:

> „Es geht auch darum, Lehrern ein Referenzsystem für professionelles Handeln zu bieten, um mit Heterogenität von Lernprozessen und Lernergebnissen konstruktiv umzugehen und um Lernpfade individuell aber objektivierbar zu begleiten (…) In Schweden z. B. bekommt der Schüler am Ende des Schuljahres nicht einfach eine Zeugnisnote, sondern der Lehrer setzt sich mit dem Schüler und dessen Eltern zusammen, um anhand objektiver Leistungsergebnisse zu überlegen, wie weitere Verbesserungen individuell erzielt werden können. Dabei gilt eine Grundregel: Es beklagt sich bei diesen Gesprächen niemand über die Arbeit des anderen, sondern Schüler, Eltern und Lehrer sind gefordert, ihren eigenen Beitrag zur Verbesserung der Bildungsleistungen darzulegen.[7]“

Die Förderung der autonomen Leistung, die Betonung der Eigenverantwortung für den Lernerfolg sollten mehr in den Vordergrund einer Dienstleistungsperspektive gerückt werden.

[5] Schleicher, Andreas (2008): Anforderungen an ein zukunftsfähiges Bildungssystem aus internationaler Sicht. Die deutsche Schule, 100, 1, S. 43.
[6] ebenda: S. 44.
[7] ebenda: S. 44-45.

Damit im Zusammenhang wäre es angebracht, im Gegensatz zum lexikalen Wissen viel mehr auf eine lernstrategische Sicht zu setzen, im Zeichen des intelligenten, individuellen, lebenslangen und motivierenden Lernens auf die Lern- und Lehrmethoden zu fokussieren:

> „PISA zeigt uns dabei, dass Schüler und Schulen, die in einem Umfeld positiver Leistungserwartung arbeiten und deren Schulklima von Lernfreude und Anstrengungsbereitschaft gekennzeichnet ist, bessere Leistungen erreichen. PISA zeigt sogar, dass der Erwartungshorizont für die Schüler stärker mit den Bildungsleistungen korreliert als der soziale Kontext, aus dem die Schüler kommen. Anspruchsvolle Ziele sind damit auch ein entscheidendes Instrument, um soziale Mobilität und Chancengleichheit zu fördern.[8]“

Die Unterstützung durch neue (digitale) Technologien wäre dabei wünschenswert, um den Herausforderungen des Zeitalters gerecht zu werden:

> „Ebenso muss man sich fragen, ob eine Deutschklasse immer genauso groß sein muss wie eine Mathematikklasse oder ob neue Technologien nicht intelligenter in das Unterrichtsgeschehen integriert werden können, und zwar indem sie nicht nur für die Durchführung des normalen Unterrichts genutzt werden, sondern als Instrument, um das pädagogische Repertoire zu erweitern und individualisierte Lernformen zu fördern. Neue Technologien können dabei völlig neue Perspektiven eröffnen […].[9]“

Was die ungarische Berufsbildung zurzeit braucht, ist vor allem Geduld. Da die Bestrebungen nach Kontinuität aber kaum charakteristisch für den Bildungsbereich sind, kann man dafauf nur hoffen. Wie erfahrene Lehrpersonen zu sagen pflegen: in der ungarischen Berufsbildung ist die ständige Veränderung der einzig sichere Punkt. Endlich sollte man abwarten, ob es dem neuen Berufsbildungsgesetz gelingt, die Menschen auf ihren Wunschberuf so vorzubereiten, dass sie ein harmonisches Leben führen können.

[8] ebenda: S. 45.
[9] ebenda: S. 45-46.

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CLOUD COMPUTING SOLUTIONS FOR SPEEDING-UP THE SMALL-AND MEDIUM SIZED ENTERPRISE (SME'S) BUSINESSES IN CHINA

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DOI 10.47273/AP.2023.1.14-33

ABSTRACT

China has experienced rapid digitalization in the last decade. Cloud computing makes possible for different users to access data resources from any geographical location through the Internet. This new paradigm has the ability to benefit businesses by offering low-cost, flexible, and customizable solutions that provide companies significant competitive advantages in the strongly competitive business environment on long-term timescale. It can be essential for all business, but it is especially indispensable for small and medium-sized enterprises (SME's) to make prosperity in today's accelerating social, economic and technological changes. In recent years, the SME's have allocated more budget to invest in implementing digitization and data-based decision making processes as they have become more aware of the importance of technological development and managing information on boosting their competitiveness in values creation activities. However, they are restricted by the size of the business. Transformation of information construction and digitization process is still in its infant stage as a consequence of a shortage in experts and available resources. This situation has gradually changed with the advent of cloud computing technology. By leveraging cloud computing technology, SME's could completely support the digital transformation process in an efficient and effective manner. Nevertheless, for those business organisations who make efforts for application of any cloud computing solution in their business processes, they have to face with some serious emerging questions. Whether the business deployed on the cloud provided by service providers has sufficient system robustness, and whether the data stored in the cloud has sufficient security. This review paper is aiming to provide comprehensive, relevant landscape about the different cloud computing solutions (Infrastructre as a Service -IaaS) Platform as a Service -PaaS; Software as a Service -SaaS) and services models (public, private and hybrid cloud). Besides that this study focuses on which cloud service model should SME's choose and how Chinese SME businesses should take into account their own informational structure in the age of digital transformation improving businesses performance while minimizing operational expenses and risks at the same time.

Keywords: *Cloud Computing, IaaS, PaaS; SaaS, SWOT, Cyber Security, Chinese SME sector*

1. Introduction

Currently, China's overall digitalization is in the middle of the range globally. The size of China's digital economy at 6 percent of GDP, compared to 8-10 percent in South Korea and Japan, where the IT sector is more developed and stronger in the economy. China ranks 50th out of 131 countries based on the World Bank digital adoption index, 59th out of 139 countries in the World Economic Forum index, and 36th out of 62 in the Fletcher School digital evolution index. Nevertheless, you can see diversity across sectors and regions in China, some of which are much more digitalized, such as e-commerce, fintech, IoT and cloud computing. The venture capital (VC) industry in China has grown rapidly, and increasingly focused on the digital sector. Based on experts estimatations, VC in China has surged from US$12 bn in 2011-2013 (6 percent of global total) to $77 billion in 2014-2016 (19 percent of global total), with $38 billion invested overseas. The main sectors that attract VC investment include big data, artificial intelligence, and Fintech. The cloud computing linked closely to these digital technologies (Zhang and Chen 2019).

The general idea of cloud computing lies in its online expansion to share, process and synchronize data from a perspective of advantages in terms of installation, configuration, updating, maintenance, costs and others. Cloud computing is perhaps the most interesting and disruptive new technology generated by the IT industry in the last 20 years, much more so than the transfer of mainframes to client or server architectures. As a consequence of the introduction of cloud computing, both the mode and the types of IT services used by businesses have changed, and SME businesses are also quickly adapting to the changes resulting from the new architecture.

Definition, approaches

There are several definition for cloud computing. "Cloud computing as a form of computing that allows flexible, scalable IT functionality to be delivered to external users as a 'service' over the Internet." (Gartner's 2022). Shared services that may be provided include Computing, Networking, Storage, Platforms and Applications. Cloud computing is a new type of application architecture adopted by enterprises in order to reduce infrastructure costs, improve efficiency, and solve capacity and scalability issues (Sharma 2022). The phrase "cloud computing" refers to the online storage and access of data. It doesn't save any information to local computer's hard drive. Data from a distant server may be accessed using cloud computing. Third-party service providers utilize the internet to provide computer resources and software tools under the cloud computing model. The consumer simply has to pay for the time they spend using the computer as well as any storage or bandwidth they use under this service model. With the aid of the internet or an interactive IT environment, many firms employ cloud computing frameworks to provide various IT services. Cloud computing may be defined simply as the process of storing and retrieving data for commercial purposes through the internet rather than a computer's hard disk (S. N. Ahmed 2013). The word "cloud" only refers to the internet as a metaphor, but it also focuses on a vast array of operational resources, such as software and hardware, which may be accessible over the internet (Mladen 2008). Cloud computing provides a variety of computer services in a commoditized form, and these services are utilized similarly to fundamental utilities like water, gas, and electricity. Accordingly, several research studies considered cloud computing to be a fundamental service that businesses employ every day to meet their fundamental computing needs (Rajkumar et al. 2009). Since this idea has evolved with the development of the internet throughout time, there is no one definition for cloud computing. No uniformly accepted definition of cloud computing exists in literature, and it is typically thought of as third parties providing computer services through the internet (Azam et al. 2013). However, cloud computing is determined by concentrating on its main benefits from both a

commercial and technological point of view. (M. Sean, et al. 2011) According to their definition, cloud computing is an IT service model that offers its clients on-demand access to both software and hardware computing services. The self-service network technology utilized in cloud computing isportable device and location independent. Without the use of personal computers or local servers, remote servers are used to store, process, and manage data that is accommodated on the internet (William 2007). The firms may access computer resources whenever they are needed without having to physically build and keep any infrastructure.

Since cloud computing is a rapidly developing concept, SMEs need have a thorough understanding of it in order to use better strategies when utilizing cloud computing services (V. Anthony et al. 2011). In essence, the notion of cloud computing is based on earlier ideas like grid computing, distributed computing, and virtualization. Although this subject of research is not very new, it may be distinguished from others based on how innovative the concept of providing computer services to the general public as a utility (William 2007). A widely accepted definition of cloud computing is provided by the National Institute of Standards and Technology (NIST) of the United States as "a model for empowering expedient, on-demand system access to a shared pool of configurable computing resources, such as servers, network, application, storage, that can be quickly provisioned and discharged with little effort of administration or interaction of service provider. This cloud model is made up of five key features, four deployment types, and three service models" (BI-Insider 2022).

Because cloud computing is a new technology, companies gradually realized the benefits of this technology. IT professionals anticipate that cloud computing will continue to rise over the next several years. Mid-sized and big businesses benefit greatly from cloud computing, but smaller businesses are already adopting it and leveraging its advantages to grow their enterprises. As businesses use these services, they receive benefits from cloud computing, which will lead to the development of IT across all SMEs, sectors, and institutions (Christof et al. 2009; Osman and Alhassan 2015).

Main benefits for different businesses applicantions

Cloud computing plays a significant role in resolving the effectiveness and efficiency issues that businesses face. Additionally, it supports the development and core competitiveness of businesses. Following the introduction of cloud computing, businesses will be able to more efficiently use up-to-date technology while paying less (Tiago and Maria 2010; Michael et. al. 2010). The below Table 1. briefly summarizes the future potential benefits and yields, if any company deceided to integrate cloud comptuting solution in its running business process.

Table 1. Reasons for keep in mind the cloud computing technologies

Expected benefit	Description	References
Cost saving	Cloud computing helps to minimize operating and capital expenditures. Additionally, it helps save a significant amount of money by eliminating the need for internal server storage and meeting application requirements. Companies' operational costs, such as air conditioning, labor cost, and electricity expenditure, are also lower as there are no in-house servers or storage devices need to maintain. Hundreds or thousands of customers are clustered in the cloud, which allows cloud providers to achieve greater economies of scale and thus offer lower pay-as-you-go prices. Instead of investing heavily in data centers and servers before companies know how to use	(Qi, Lu, and Raouf 2010; Seetharaman A., and Rudolph 2013)

	them, they can pay for computing resources when they use, and only pay for what firms actually use.	
Scalability	Companies can use capacity as needed, and it only takes a few minutes to grow or shrink capacity as needed. The cloud has completely transformed how firms handle their technological resources. Firms benefit from swift resource allocation where overloading and lacking of capacity are not issues since the system is appropriately maintained by service providers.	(Gerard et al.2014)
Support innovations	Using the cloud as the backbone for innovation may enhance performance, save costs, and boost agility. Companies, for example, are driving innovation in Internet of Things (IoT) product development at a velocity that can only be done with cloud computing. Cloud computing helps the IoT sector to develop, produce, and launch new world-changing goods - and this applies to the whole IT ecosystem. Companies have access to business prospects that can help them create innovations and real-time interactions that will help their firms succeed.	(Yazn, Savvas, and Feng 2013)
Maintenance	Cloud computing may be accessed from several locations and doesn't require installation on every machine, it is simple to maintain. Platforms for cloud computing provide features that assist service providers in hosting, developing, and testing cloud-based applications. Instead of building up the system and infrastructure themselves, developers can alter and run various applications in this way.	(Christof et al. 2009)
Flexibility	Firms can easily deploy applications in multiple regions around the world. The efficacy of shared resources may be increased with the aid of cloud computing. These resources are allocated by many users, and they are also distributed dynamically based on demand. Additionally, it is credible useful to have the ability for several users and allow them to access their data from a single server and update data without purchasing a license	AWS 2022, Qi, Lu, and Raouf 2010)

Source: Own edition based on the cited references in the third column.

Based on the above facts, adoption of cloud computing can contribute to environmental conservation, meaning less servers and other resources utilized. Green data center helps to achieve energy saving and emission reduction.

2. Research methods and data

As a review paper, the authors mainly focused on the methodology based on secondary research analysing scientfic publications, studies, online literature sourcesFortune and relevant, Chinese and international documents (e.g. AWS, Business Insider, State Council, Ministry of Industry and Information Technology, EU), up-to date data bases (e.g. Fortune Business Insider, IMF Working Paper, Statista) as well. This study deal with the different cloud service and cloud deployment solutions, the market size of the cloud computing in China, cloud computing cyber security issues. After than, it discussed the main challanges and opportunities of the cloud comptuing solutions from the Chinese SME's aspects. The through SWOT analysis provide signifcant contribution to help SME's to make their choice which cloud comptunig model should be the best for them. Finally, some recommendation concluded for the SME sector to

overcome the difficulties and the hidden unknown pitfall linked to apply cloud comptung based technologies in their everyday's business running operations.

The conclusions and recommendations based on this „desk research" finding reflects the authors' own professional views and hopefully can contribute to understanding the specific situation of the Chinese SME sector and their attitudes toward cloud computing.

3. Main types of cloud computing models and their characteristics

Understanding how cloud computing functions, it is crucial to clarify the fundamental paradigm before explaining the kind of cloud computing (BI-Insider 2022). Cloud computing refers to a change in the way IT services are utilized and provided, allowing for more effective management of technological progress by the enterprise. The market for IT-supported services was industrialized by the development of cloud computing models because they offer flexible and affordable access to technology. These services are shared among different business organizations and retrieved by service users. Cloud computing service users can be customers, remote workers, members of organizations working locally, or the general public. Any of them can use cloud computing services with the lowest service cost (Rajkumar, James, and Gościński. 2011). In order to effectively decide on technological structure, SMEs should categorize their IT requirements into several cloud computing categories. (Subasish et al. 2017). These services cover all IT requirements for businesses that the telecommunications and IT sectors continue to assist. According to several classifications, cloud computing may be separated into two categories: a) cloud service models and b) cloud deployment models.

Cloud service models can be classified into three main catergories as you can see in the below Table 2.

Table 2. Cloud service models and their features

Type	Essence of the model	Examples
Infrastructre as a Service (IaaS)	While offering customers virtualized computing resources, the cloud provider hosts the infrastructure, network, storage, servers, and virtualization capabilities. Computational resources that are quickly available; reduces the expense and trouble of purchasing and maintaining hardware for businesses; elimination of hardware's single point of failure.	Amazon Web Services (AWS); IBM Cloud; Google Compute Engine (GCE); Microsoft Azure
Platform as a Service (PaaS)	In addition to offering customers development tools, the cloud provider provides the infrastructure, storage, servers, virtualization, operating systems, and development environments. Offers resources for testing, creating, and hosting apps.; cloud provider oversees multiple things including backups, server updates, operating systems, and server software; promotes the expansion of joint development projects; reduces reliance on infrastructure management.	AWS Lambda; AWS RedShift; Google App Engine; Windows Azure; Red Hat OpenShift; Force.com
Software as a Service (SaaS)	The cloud provider provides the infrastructure, storage, servers, virtualization, operating systems,	Google Apps; Dropbox;

	development environments, data management, and applications while giving customers access to application functionality and/or development tools. Use a subscription model to provide consumers applications; applications are accessible on any device and from any location; applications benefit greatly from economies of scale; software upgrades and installation are handled by the cloud provider; adapting the use of resources to the demands of the service.	Cisco WebEx; Office 365; GoToMeeting; Salesforce.com

Own edition based on BI Insider (2022)

A cloud deployment model is established based on who controls the infrastructure needed for the deployment and where it is located. Public clouds, private clouds, hybrid clouds, and community clouds as you can see in the Table 3.

Table 3. Implementation alternatives of cloud services deployment

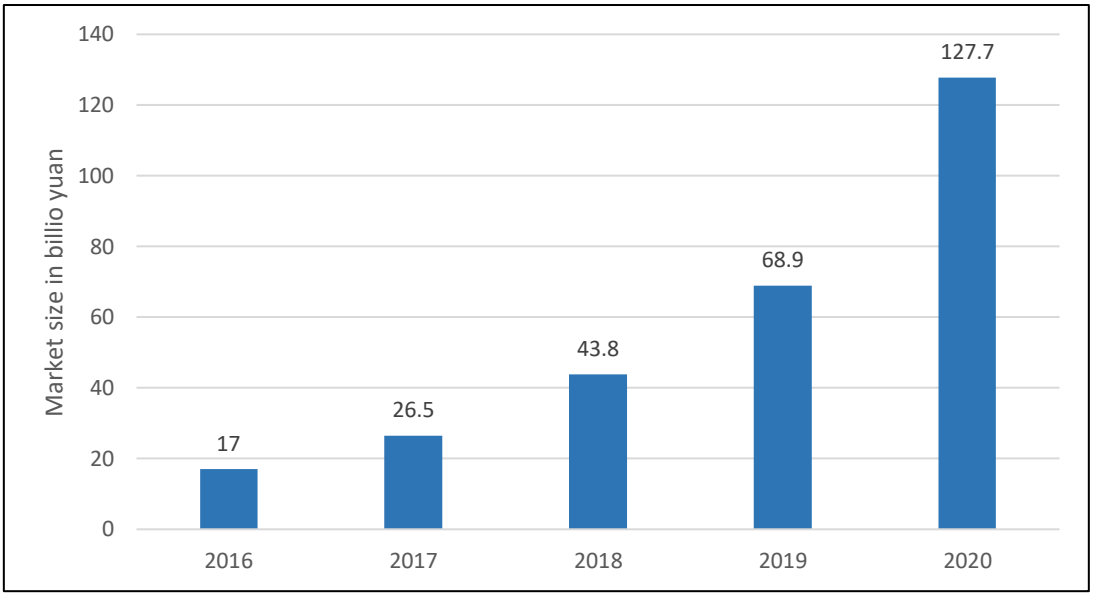
Type	Essence of the model	Examples for cloud service providers
Public cloud	The utilization of hardware, storage, and network devices is shared across a number of client companies, and computing resources, hardware, software, and network devices are owned and maintained by outside suppliers. Following that, people can access computing resources over the open Internet. Consumers may be able to use public cloud services for free or at various subscriptions or on-demand prices, including a pay-per-use model. The public cloud gives consumers access to safe data storage, dependable network connections, and information support services. The public cloud brings possibilities for the business transformation of SME sector, provides almost endless space for enterprise business data storage, and provides almost endless computing power for enterprise business data processing, increasing the efficiency and effectiveness of the project management activities.	Alibaba Cloud, Amazon, Microsoft Azure, IBM, Google
Private cloud	There is no resource sharing between organizations; all computing resources, hardware, software, and network devices are used only by one entity. Users have access to computing resources via a private network. The private cloud is established for specific users and institutions and is only used by the construction enterprise itself. It can realize the optimization of internal resources of the enterprise, and only provide "support and technical services for the internal operation of the enterprise. Enterprises that build private clouds do not cooperate with other enterprise.	IBM; HP, Huawei, Inspur, Microsoft, EMC2
Hybrid cloud	Organizations can mix elements of each form of data center deployment by combining on-premises data centers and/or private clouds with public clouds. The use of programming technology for managing the	

	connections and interactions between workloads on public and private clouds is known as cloud orchestration. With hybrid clouds, businesses may set up a private cloud to house sensitive or vital apps while using a public cloud to house less important ones.	

Own edition based on Amazon AWS (2022); BI Insider (2022); Priya (2020)

To meet the unique demands of a certain industry or business sector, combine the computational resources of many clouds. The management of shared infrastructure across many businesses may either be done in-house or by a third-party service company. Public clouds, private clouds, and hybrid clouds are all present in a community cloud. Community clouds are also frequently set up over several administrative areas. Community clouds are available for the following industries: media, healthcare, energy, the public sector, and scientific research (BI-Insider 2022). Different cloud has different features, and benefits could provide to their users. In order to getting best cloud services and maximizing profits, companies need to evaluate their current situation, future plan, budget of IT construction to make a good decision on which type of cloud service is suitable for them to implement. The below Figure 1. indicates raising trend of the public cloud market size between 2016 and 2020.

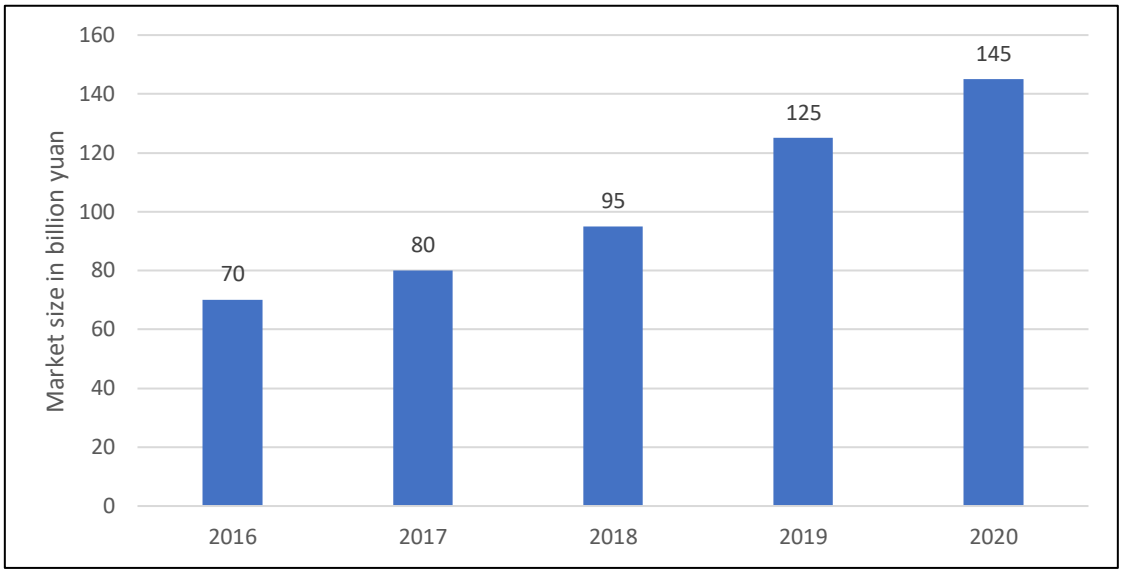
Figure 1: Size of the public cloud computing market in China in billion yuan (2016-2020)



Source: Own edition based on Statista (2022a)

The Figure 2. reveals shaping the private cloud market trend between 2017 and 2020 timeperiod

Figure 2: Size of the private cloud computing market in China in billion yuan (2016-2020)



Source: Own edition based on Statista (2022b)

4. Cloud computing and the Chinese SME sector

SME's play dominant role, making contribution to employment and producing significant part of GDP in every country around the globe. In this context, digitization means that companies choose to acquire new technological services including cloud computing solutions as a competitive advantage over their peers, which allows SMEs to reach a market segment in digital environments.

As of the end of 2021, the number of SMEs in China has reached 48 million, an increase of 2.7 times compared with the end of 2012; the number of enterprises per 1,000 people in my country is 34.28, which is 3.4 times that at the end of 2012; 3.6 times that of 2012. According to the fourth national economic census, legal person of Chinese SMEs accounts for 99.8% of all corporate legal persons. And the employment accounts for 79.4% of all enterprise employment. It owns 77.1% of assets, and accounts for 68.2% of operating income. SME sector provides more than 82% of urban employment, and provides products and services account for more than 61% of GDP, and over 50% of national profits and taxes are paid. In China, SME's independently completed more than 64% of invention patents, more than 74% of enterprise technological innovation and more than 81% of new product development (Xinhua News Agency 2019; Fortune Business Insider 2022)

4.1. *IT infrastructure of SME's*

The features and degrees of information technology of small and medium-sized organizations in various industries were summarized generally by Lu, Zishuai, and Yulong (2018) after conducting a comprehensive categorization of these businesses. Some small and medium-sized data centers can only execute a minimal amount of maintenance on desktop office terminals due to poor operating and maintenance capabilities. For such businesses, direct cloud service provider purchases are more appealing since they may significantly reduce personnel expenses.

Mei (2017) provided a summary of the rate of accounting information technology development in small and medium-sized businesses as well as the direction of future development. At the same time, he carried out a thorough study of the needs, benefits, and drawbacks of adopting

cloud accounting models for organizations. He used a corporation as an example to thoroughly evaluate the accounting scene of an enterprise. According to the report, the largest barriers to the growth of accounting informatization are SMEs' lack of interest in digitization and a shortage of professional skills. Finally, it is recommended that SMEs aggressively use cloud computing in the development of digitization.

Network security has been a crucial issue ever since the Internet's inception and cannot be avoided. Data center building has transitioned to the cloud computing age with the advancement of science and technology. Guangyu (2018) examined the cloud computing sector from the angle of data security. Small and medium-sized businesses need to concentrate on prevention in the process of cloud computing, he concluded after considering the weak links in information security that small and medium-sized businesses confront in the model of cloud computing risks that are concealed. Also examines the direction of information security in the future. Besides, in western countries, there are some similar research conducted. According to European Union (2016), SMEs are a significant force for innovation and expansion in the EU. IT constructions, like cloud computing, will also be most advantageous to small and medium-sized organizations because it would be difficult and expensive for them to set up in the conventional manner. SMBs usually lack a deep understanding of the potential risks of security. Additionally, SMBs sometimes lack IT and security specialists. They are unable to negotiate customized features or price or items in the contract with service providers. EU has created a guide to help SME’s in comprehending the risks and opportunities they might take into account when purchasing cloud services.

Besides, before SMEs use cloud computing to implement cloud business intelligence, capabilities and key success factors of SMEs should also be considered. These will help define the important resources and skills that form strategic advantage and lead to successful cloud BI projects (Fatemeh et al. 2021).

Chun-Liang (2020) analyzed the impact of cloud computing applications on the management innovation of SMEs, including the necessity of management innovation for SMEs, the demand analysis and development status of SME’s using cloud computing, and the impact of cloud computing applications on management innovation in SME’s, including management concept innovation, organizational structure innovation, information technology innovation, operation management innovation and cultural innovation. The market is changing rapidly, and enterprises need to use modern IT construction to drive business in order to expand revenue, seize new business opportunities, and focus on taking larger market shares. In some very successful companies, the IT department has gone from a cost center to a core department that can deliver tangible value and differentiated capabilities. Some extremely prosperous businesses have transformed their IT departments from cost centers to a core department that can deliver tangible value and differentiated capabilities. Cloud computing plays a critical part in this transformation of IT value by enabling businesses to decrease their one-time investment and dynamically adjust resources in response to changing business demands.

Construction of enterprise-level data centers nowadays has to be service-centric, directly business-oriented, and flexible enough to fulfill "software-defined" needs. Consequently, the technological prerequisites for data center, specialized in virtualization, automation, elasticity, and metering, have also been reached to harder level to fulfill. It is necessary to implement technologies, such as network virtualization, storage virtualization, security virtualization, and have a unified management, including scheduling and metering platform in order to fully achieve virtualization technology, which is not just computing virtualization (virtual machine technology), cloud data center that is "software-defined" (Prashant et al. 2013).

Enterprises apply cloud computing technology to gradually upgrade from virtual machines using virtualized operating systems to software-defined data centers centered on cloud operating systems. In the cloud operating system, all IT resources will be pooled, and all software and hardware resources in the data center can be managed through the API interface. In a software-defined data center utilizing cloud computing technology, infrastructure resource capabilities can be flexibly expanded and changed at any time according to user needs like Lego blocks. In the cloud data center that has been implemented, users have realized the ability to maximize the use of physical servers, storage, and networks, and to ensure that IT services are at peak times. While reducing resource requirements, the actual purchase cost is minimized.

4.2. SWOT analysis of cloud computing from SME sector perspectives

Cloud computing technology has developed rapidly in recent years, especially in many large enterprises, which have been well applied and practiced. Large enterprises have reduced the total cost of IT construction through cloud computing technology and realized the optimal allocation of resources. In the strong market competition, cloud computing increases the profitability of enterprises. But for enterprises of different scales and development stages, especially for SME's, it is worth discussing whether to adopt cloud computing technology and what cloud computing service capabilities and deployment methods to adopt. SME's can use the construction experience of many large enterprises or combine the case analysis of the three enterprises mentioned in this chapter to sort out which the IT construction plan is suitable for their own development.

The following is an analysis to discuss whether SME's with stable operation adopt cloud computing technology (Andrew 2019; Roopha 2020; Franklin 2022; Sharma 2022a)

4.2.1. Strengths

Among SME's, different types of clouds are used to run their business. As observed in interviews, most organizations are currently using public clouds or private clouds that they operate and own. In the case of cloud operating systems, the commonly used by SME's is SaaS, which helps them manage business operations efficiently. It provides different services such as network capacity, storage, communication facilities. For companies who have insufficient IT resources or weak maintenance capabilities, they can rent public cloud services. This is usually a common problem for most SME's in China. If SME's adopt the public cloud service model, they will gain the following advantages:

The model of public cloud services is on-demand subscription and payment. SME's can plan and select public cloud service types according to their own needs, which can greatly reduce the operating costs of enterprises.

The use of public cloud services is relatively flexible and has strong business elasticity. When the business expands rapidly, Chinese SME's can apply for additional resources from the cloud service provider to improve business processing capabilities at any time, and can be activated and stopped at any time, allowing enterprises to take the lead in the competition.

Renting public cloud services can allow enterprises to focus more on their own business development. On the public cloud platform where all their business is hosted, a professional team will carry out operation and maintenance. Companies are no longer required to spend energy on things they are not good at. SMEs do not need to employ many IT talents. It helps to reduce the cost of labor force and training.

*Using public cloud services can enjoy 7*24 hours of services and technical support*.

Improving the efficiency of daily work in SME's. Since the data of the business system is stored in the cloud, employees can access the system at any time and place through the Internet.

Having disaster recovery backup plan. Disaster recovery is one of the classic cases of infrastructure as a service. Smaller organizations may not have another disaster recovery site, in which the cloud provider can save the company a lot of money against a catastrophic event.

Providing value-added social effects. The cloud computing center shares IT resources for many users, which can reduce the waste of overall social resources and maximize the energy saving and greener in environment protection.

4.2.2. Weaknesses

Cloud computing technology is not an exception. SME's need to fully recognize these advantages and disadvantages before making decisions. After extensive literature research and case analysis, the use of cloud computing technology has the following weaknesses:

Data security: From the perspective of data security, the most popular cloud computing vendors such as Alibaba Cloud, Amazon, Microsoft, 21Vianet, Lenovo, GDS have not completely solved this drawback. Acording to their own business characteristics and compliance requirements, many enterprises will still build their own data centers to monitor these sensitive data and never expose these potential risks to the public cloud platform. It is a factor that many enterprises are still under consideration in the current wave of cloud computing. Once the core data of the companies is leaked or lost, it will cause a catastrophic blow to the enterprise, including SMEs as they are vulnerable to any changes.

Cloud service providers charge by consumption, which will greatly increase the cost of use. Although cloud service providers vigorously states that resources is available anytime and anywhere and pay based on usage, when promoting public cloud products. It is flexible and convenient to expand. However, the price of use will be relatively high, which will increase total costs for these enterprises. If all data are stored on the platform of public cloud service providers, it will incur expensive internet charges, which even exceed the cost of purchasing the storage itself.

The control over business systems and data has declined. Enterprise managers hope that companies have full control and management rights over business system and data. In the process of traditional IT system construction, companies can build their own systems with their own data centers, and all applications and infrastructure are comprehensive managed and controlled. After migrating to the public cloud platform, the enterprise only needs to deploy and use the application system, which simplifies the management, but also allows the firms lose control of the entire data center and rely only on cloud service providers.

It is difficult for firms that have already carried out large-scale IT construction to expand. Many large enterprises have made huge investment in their own data center infrastructure, built a data center and a system, and purchased a large amount of software, hardware and services. For such companies, there are no need to migrate its business to the cloud data center immediately. It should comprehensively consider the actual situation of the enterprise itself, and gradually follow the plan. Thus, enterprise can complete the digital transformation under the established track and can maximize the protection of the current investments or business assets.

Cloud computing technology is not very mature yet. Although many cloud service providers stated the value brought by computing, and the products and services launched by each cloud service provider are also endless, there is no unified standard currently. When enterprises consider their own IT development plans, they cannot put all their efforts into the most popular technologies. Instead, it is necessary to comprehensively consider whether it is suitable for the enterprise development in combination with the actual situation of the enterprise. Functions provided by cloud computing also need to take into account. The future of cloud computing

still has a long way to go, and the government and industry associations need to regulate and manage this industry.

For tech startups that lack capital, IaaS is the only option. Conversely, for traditional financial systems or highly regulated and sensitive data, the disadvantages of IaaS outweigh the advantages. These kinds of workloads are best handled by in-house data center infrastructure. These applications are closely tied to legacy business systems and processes. Migrating to IaaS can be extremely disruptive. The risks of changing a stable workload environment and migrating it to the cloud far outweigh the benefits. Some organizations also want to keep sensitive data, especially user and financial information, in controlled data centers. Extending the appropriate server and network security controls to the cloud is possible but can be quite complex.

4.2.3. Opportunities

The State Council (2015b) put specific goals for cloud computing. It supports green energy and environmental preservation, encourages the adoption of the cloud computing paradigm to connect existing business and governmental IT systems, and reduces the size and number of self-built data centers. A bright spot of this paper is also how the government's role is described. The government frequently played the role of oversight in earlier schemes for economic growth. The crucial role that the government is playing in the cloud computing business is also amply highlighted in this document, along with opinions on taxation and finance. It increases the government's position as the industry's primary driver in cloud computing.

After that, policy documents related to the cloud computing have been issued one after another. The State Council (2015a) issued the document " Guiding Opinions of the State Council on Vigorously Advancing the 'Internet Plus' Action. The Ministry of Industry and Information Technology (2015) mentioned "operational services" corresponding to cloud services in the documents "Notice by the State Taxation Administration of Implementing the Administrative Measures for Promoting the Development of Small and Medium-Sized Enterprises through Government Procurement". The growth of our cloud computing has been successfully aided by the consecutive establishment of a number of governmental legislations. On the other hand, this shows the focus that the present government authorities have on cloud computing. The present policy environment for cloud computing in China has essentially been developed in certain key themes such as industrial growth, industry promotion, application foundation, and security management after the extensive implementation of cloud computing-related legislation in recent years.

From an international perspective, major developed countries also attach great importance to the development of cloud computing. The major western developed countries such as the United States and the European Union develop their own cloud computing industry. They use the government's public incentive policies to boost the rapid development of the cloud computing industry and establish a good business atmosphere. The cloud computing industry in the United States has started very early, and its products have the highest market popularity. It is the only country that fully applies cloud computing to government agencies currently. In addition, Europe and other Asia-Pacific countries are also actively using of e-government cloud, reaching a certain proportion of use. The cloud computing strategy of US government has achieved remarkable results. It can not only improve the operational efficiency of government agencies and save a lot of government expenses, but also bring huge market opportunities and significantly increase the rapid expansion of the US cloud computing industry. To put it simply, the US government drives the progress of the cloud computing industry in three aspects. It could provide Chinese regulators to consider in the future (Zhang and Chen 2019).

Cloud security issues need to be paid attention to. Besides, it is necessary to establish and improve security management and control at the policy level. Cloud security is the most important issue in the field of cloud computing. Therefore, the use of cloud computing services by government agencies requires strict security control mechanisms. It should establish industry standards, review systems, government and industry access certification, and real-time platform monitoring.

The government's policies will be appropriately ahead of the industrial development. US cloud computing strategy is decomposed into a number of policy measures which need to be implemented in various cities by many measures, such as encouraging the construction of cloud computing data centers, establishing and improving cloud computing standards, and forcing government departments to migrate their businesses to cloud centers. Each measure is implemented and checked by a specific department. The Chinese government's direction will enable the development of the whole cloud computing industry in the near future, along with a quick growth in investment in the country's cloud computing sector. For SMEs, it offers a unique opportunity. The cloud computing sector will develop in the future with a more ideal set of standards and rules, in a healthy and orderly manner.

4.2.4. Threats

Cloud computing is being promoted by an increasing number of businesses as an emerging technology that may significantly lower the cost of company information technology. At the same time, a number of new threats and challenges have emerged:

Reliability Threat. When a company outsources many services, it is difficult for SMEs to manage the reliability of IT operations on the cloud because of the high level of security risks in the environment. Service legal agreements and vendor lock-in are also the biggest threats for SMEs to adopt and implement cloud computing.

Security and Privacy Threat. Cloud computing services are used to manage different business processes of SMEs, such as managing sales data, creating payroll, managing financial records. It also helps SMEs manage R&D and provides data analytics solutions. However, risk arises when a single cloud system fails to implement secure services. SME businesses encounter security and privacy concerns. Therefore, a more reliable solution is a hybrid cloud, where automated services allow users to control their data on the network. In this way, some SMEs are properly managing the security and privacy issues of their organizations.

Threat of lacking relative knowledge. There are some managers who don’t obtain knowledge of cloud computing technologies (protection of critical data, the distribution of power among various departments, the billing model, return on investment). Many businesses choose a cautious approach to cloud computing, deploying their edge business systems on the cloud platform while the core company continues to use the paradigm of self-built data centers, placing enormous operational, maintenance, and management burden on the system.

Incompatibility Threat. It is challenging to combine cloud-based corporate systems with local systems. Most businesses have already implemented IT construction in varying degrees, created their own IT systems, and developed internal usage patterns. It is challenging to fully adapt this method to the unique demands of SMEs. A significant challenge is figuring out how to connect and integrate the enterprise's current systems with those on the cloud.

Migrating threat. Migrating infrastructure and applications to the cloud is a multidimensional decision. Even though it's not just about cost, cost is often the most important factor. Organizations have to be consider the complexities of migration, including disruption to existing businesses, the intensity of application modifications, and IT's willingness and ability to embrace new management portals and processes. Cloud services have a number of benefits,

such as easy, quick, and affordable scaling, decreased maintenance intensity for operating system activities like updates and patches, avoiding capital expenditures, and usage-based pricing for more accurate cost figures. Even though this is a tricky subject, the majority of firms will discover that when business moves to the cloud, the application transfer is frequently far better than the current situation.

Selecting on cloud service provider. The cloud computing market in China has begun very recently. There is no excellent or bad among the many cloud service providers. The growth of these cloud service providers also faces several obstacles or dangers at the same time. Because of this, it is crucial for SMEs to pick an appropriate cloud service provider. Among the dangers posed by domestic Chinese cloud service providers are the following: a) Balancing the functionality of the cloud platform with the associated development expenses is a challenge that cloud service providers have to overcome. b) Cloud computing data centers place a premium on the ease of managing the data center. In cloud data centers, a vast number of services require automatic scheduling, control, administration, operation, and maintenance. The equipment that makes up the cloud data center may also include items from different brands and models, thus enhancing the data center's complexity. Users will experience significant difficulties as a result of the cloud center's poor compatibility with several brands and products, which will also make operation and maintenance more complex. c) Growing scale of cloud computing poses a significant challenge to data centers. It is impossible for us to process them with a straightforward SQL database due to the constant growth of business systems and data in cloud data centers. To address the issues in the data storage industry, there is currently no ideal solution. Utilize various technologies for either transaction processing or storage, or a combination of the two, each of which can handle a variety of application scenarios. A few workable solutions are being investigated by the current major cloud service providers. Setting restrictions on plan storage space or search time is necessary to optimize query processing because, otherwise, processing large amounts of queries would take too much time and resources. d) Sharing physical storage devices in infrastructure clouds might also result in the theft of data. The original physical limits cannot be leveraged to maintain data security since physical resources are virtualized into logical storage. Therefore, cloud data security has turned into a secret threat that most businesses are concerned about. However, it also expands the market for data security with new commercial prospects. Some business cloud services with strict security requirements are struggling to figure out how to guarantee the security of cloud data. One of the biggest cloud computing vendors, AWS, has four practices to protect cloud security as you can see in the below Table 4:

Table 4. Main cloud computing security practices and their characteristics

Security practice	Description
AWS Shared Responsibility	Cloud security is entirely distinct from on-premises infrastructure. Security of the AWS cloud depends on both the business and the cloud service provider. While the cloud is in charge of information security, the business will be in charge of determining which data should be moved to the cloud. The shared responsibility paradigm is the name given to this spirit of collaboration. The data is now more secure as a result.
AWS Global Infrastructure Security	Businesses may use a range of resources in this framework. These resources, which need to be setup, include buildings, hardware, networks, software,
AWS Account Security Features	To safeguard data from intrusion, AWS has several security features like access control, the establishment of AWS IAM user accounts, data encryption, and trusted advisor security checks.

AWS Service-specific security	Every program and level of software has security mechanisms. As a result, any application may use cutting-edge security to safeguard data.

Source: Own edition based on Sharma (2022b)

SME's can use cloud computing to enhance security when they lack knowledge and capabilities. By deploying business in the cloud computing center, there are security experts and professional team specialized in security operation and maintenance for systematic security management. Public cloud service providers have creatively introduced cloud data center security solutions to aid business clients in adjusting to the changes the cloud has made to corporate systems. This will help business clients build a stable, high-performance, safe and robust cloud data center and support the steady development of enterprise cloud services. The value proposition of cloud data center network security solutions is automatic network deployment, elastic network connectivity, and sophisticated network operation and maintenance.

5. Conclusions

Cloud computing in China began later compared to other nations, but it has expanded quickly. Many information technology manufacturers have entered into this field and made concerted actions, offering SME businesses convenient circumstances and pathways to implement business cloud and digital transformation. Using cloud computing technology to build cloud data centers or rent public cloud services will bring the following advantages to enterprises.

Currently, Chinese SME's are facing many difficulties in adopting new IT construction into their business, especially in the following two aspects: Insufficient funding and limited technical knowledge.

Chinese government has set up many external financing channels for SME's, such as state financial appropriation, public issuance of stocks, issuance of corporate bonds, borrowing from banks. However, among these financing methods, policy has been changing, some SME cannot fulfill all the requirement to apply financing support from government, and the entry threshold for Chinese enterprises to issue bonds is quite high, and the approval conditions for public issuance of stock financing are more stringent than before, and SME's are basically unable to obtain financial support from the above channels. However, because private lending is not supported by China's financial supervision and legal system, and has poor ability to deal with financial risks, it has been strictly prohibited by China. Due to the limitations of funds, technology, talents and other factors, the information technology construction of SME's has not been able to have a big change.

Additional challenge can be to implement IT construction for SMEs is due to the limited technical knowledge of managers in Chinese SMEs. Since the major transformation from the mainframe computer architecture to the C/S architecture (client-server) in the 1980s, the construction of data centers has undergone rounds of evolution. However, due to the lack of knowledge in the latest scientific and technological trend/information, the majority of small and medium-sized enterprises currently have a very low degree of digitization and their construction ideas are relatively traditional. SME's are mainly facing the following challenges: Deployment of applications is extremely slow, Operation and maintenance are difficult, Traditional information construction requires large investment at the beginning,

The digitalization level of Chinese SME's is still relatively low. The large number of small and medium-sized companies are facing constraints such as shortage of funds, large daily workload, and insufficient labor force. Business owners hope to improve the operation efficiency of the

enterprise, upgrade the business model, and boom the revenue of the enterprise, through the construction of information technology. However, it is exactly because of these unsolved issues that there is a tremendous market potential and opportunity for new technology such as cloud computing.

Currently, local governments are aggressively establishing high-tech parks with distinctive local features to promote local economic growth. The government stressed throughout the park's development that it should not only invest more on physical infrastructure but also work to establish a "soft environment" that is service-focused. Faced with the current competitive environment, the high-tech industrial park combines its unique qualities and develops service model innovation via the use of cloud computing technology to give small and medium-sized businesses in the park with a choice of cloud services. This will improve the ability of the established businesses to innovate, lower their overall production and operating costs, and raise the scientific park's allure to businesses.

Cloud security is an important topic and branch in the field of cloud computing. As an important part of cloud security, anti-virus has been widely used in the construction, operation and maintenance of cloud service providers. Threats to cybersecurity are constantly changing. Gaining insight into practical security strategies is able to effectively manage risk and expand business opportunities. Learning how to arm network with integrated and pervasive security is necessary to better secure critical company assets. Current service providers are already having many solution or plan to optimize safety for their business clients.

Summary

The purpose of this paper is to make overview on the overall technical development of cloud computing and introduces different choices of cloud computing services. In addition, the benefits of cloud computing for SME's operating in China were also discussed. During the past several years, cloud computing has rapidly emerged and been adopted, especially by SME's.

Cloud computing technology can reduce the IT construction and operation costs of enterprises, and has the characteristics of high efficiency, convenience, flexibility and high elasticity. It is more suitable for the enterprise development and IT demands of SME's. Enterprises need to conduct a comprehensive evaluation on business condition and current IT level to find the most suitable solution for their development. With the popularization and application of the Internet, mobile terminals, 4G networks, Internet of Things, and big data, the informatization of SME's has also shown a trend of diversification. This makes traditional small and medium-sized enterprises face the challenge of digital transformation. Proper adoption of cloud computing technology can help SME's to complete their own digital transformation and improve their competitiveness and profitability. The adoption of cloud computing technology can greatly reduce the cost of enterprise informatization construction, and at the same time improve the reliability of business systems and the speed of new business online, so that enterprise business can respond to market changes more quickly, and greatly strengthen the competitiveness of enterprises. This is a perfect opportunity for SMEs to do digital transformation. There is no standardized formula for which cloud service model to adopt. Enterprises need to choose the appropriate method according to their own situation and capabilities.

Chinese SME sector should also take into consideration the development opportunities brought by this wave of cloud computing, complete the digital transformation for themselves, and help their business to embark on the fast lane of rapid development and enter a new world. A growing trend of cloud use is seen in China, according to certain research. Despite this, numerous SME are still unsure whether to utilize cloud computing. SME's should take advantage of the country's vigorous support and take advantage of cloud computing to promote their own informatization construction.

Modern information construction and its applications can be offered by renting cloud service providers' IT resources, data storage capacities, as well as their development environments and apps. This can significantly lower organizations' IT investment. For those SME's which lack informatization professionals, weak technical strength, and limited funds, in the informatization construction, they have to customize the overall development goals of informatization according to their own business characteristics and future development strategies and complete their IT architecture design. They should evaluate their own current circumstances, select the best cloud service model fitting their needs, and maximize business efficiency, as well as hasten business growth. To foster a favorable environment for the adoption of cloud computing, service providers can intensify their collaboration with SME's that already use cloud services. The degree of confidence in service providers, which also minimising their security problems, is a crucial component for SME's adopting cloud computing.

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IMPORTANCE OF VALUE ANALYSIS IN DOMESTIC AND INTERNATIONAL OUTLOOK

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DOI 10.47273/AP.2023.1.34-50

ABSTRACT

The value analysis is a well-known and widely used multi-criteria group decision-making procedure that not only looks for the cheapest, or not only the better, but also satisfies the desired and necessary needs at the lowest cost. Covering all important details of the project (product, service, procedure, process), the so-called multidisciplinary team of internal and/or external experts works together with the consultant. Value analysis identifies project functions and focuses on the most impactful intervention points. It then explores alternative solutions and creates optimal solutions for functions to cost-effectively satisfy and/or increase performance. Value analysis is now used by almost every large company in the world and is widespread in all industries. According to expert estimates, around 50,000 value analysis projects are carried out in Europe every year. Based on the provisions of the EN 12.973:2000 Value Management Standard in Hungary, the Public Procurement Act recommends the contracting authority require the tenderer to apply the method. This review paper reviews the process of the formation and development of value analysis, its fields of application in international comparison, the main methodological frameworks, its current challenges, and new opportunities.

Keywords: *value analysis, functions, costs, multicriteria decision, multidisciplinary team, methodology, options*

1. Introduction

Value analysis is an organized problem-solving system that maps all the functions that we perform with a process, product, system, or organization. It creates the conditions necessary to satisfy customer needs at a high quality level by creating an optimal function-cost relationship. The subject of value analysis is the analysis of all products (product, technology, service, investment, organization) that have functions and costs. Its purpose is a regular, well-founded examination of the functions and costs and the complete fulfillment of the functions at the lowest possible cost level.

By applying the value analysis method, all areas of company work can be improved quickly and efficiently. Value analysis is a system-based procedure that prompts the company to think effectively in technical and economic terms, enabling economic actors to quickly, efficiently and cost-optimally adapt to changes in a globalized, constantly changing business and economic environment containing numerous uncertainties and risk factors. Value analysis, as a systemic, strategic organizational development and management method, must definitely be integrated into the strategic decision-making and operational processes of companies. For this reason, the importance of value analysis is increasing both domestically and internationally, and it is becoming an increasingly researched field.

This review paper provides a comprehensive theoretical overview, supported by practical examples, of the development of the field of value analysis, its methodological toolkit, and its possibilities. They can be equally useful to all the actors involved in both the corporate and public sectors.

2. Methodology

The domestic and international review relies on secondary or "desk research" research methods (reviewing existing relevant documents such as publications, studies, and online websites, then organizing, selecting, and analysing the data collected in this way).

The conclusions, findings, and suggestions made during the analysis of the data presented in this article reflect the private professional opinion of the authors.

3. The theoretical background of value analysis

3.1. History and application of the value analysis

The history of value analysis dates back to the late 1940s; similar to several other economic contexts and methods, it started in America. In 1947, General Electric executives commissioned L. D. Miles, an engineer and materials procurer at General Electric's Baltimore division, to develop a generally applicable process that would result in a reduction in material costs while ensuring the performance of the function.

Over the course of four years, Miles and his team developed a new procedure based on cost reduction and other solutions successfully applied in other areas, which Miles called Value Analysis (VA). Value analysis first spread in the country of its development, the USA. The US Department of Defense (DoD) played a major role in its wide application. As early as 1954, the American Maritime Administration included a value analysis clause in its procurement contracts, according to which the two parties, the supplier and the customer, shared the savings achieved equally.

The American Department of Defense (DoD) announced a cost reduction program in 1962, and value analysis played a key role in its realization. The defense budget in the USA between 1960 and 1965 was 46–53 billion USD annually; in 1972 it was already 75 billion USD. Thus, it is understandable why the DoD clauses were so significant in the spread of value analysis in the USA. As necessary, the state provided the amount necessary for the implementation of the project in advance, but in this case it withdrew 50–70% of the savings. The rapid spread of value analysis is typical of the fact that, in 1959, there were already 120 full-time value analysts working in Miles' department at General Electric.

Value analysis is now used by almost all large companies in the world and is widespread in all industries, integrated into strategic decision-making processes and development activities (Ibusuki and Kaminski 2007; Mousakhani et al. 2017; Tang and Bittner 2014).

The method has been known for more than 60 years. Its reliability is clearly demonstrated by the fact that in the United States of America, the Federal Acquisition Regulation (FAR) obliges ministries, state offices, agencies, and municipalities to use the method when spending public funds—a specified value limit, usually over USD 2 million. An annual report is prepared for the Congress on the results achieved. According to American sources, the use of value analysis currently saves the budget about 20 billion USD/year.5 Since 1996, according to the Federal Acquisition Regulation (FAR), all executive organizations must have value analysis procedures and programs in order to use the budget more efficiently (Fodor 2010; Vickers and Mandelbaum 2009).

Of course, value analysis has not only spread to such an extent in America. In Japan, the value analysis, during the design phase, covers nearly 90% of the product, and in the later stages of the product's life curve, during further development, the value analysis is repeated, thereby extending the product's life cycle. According to American experts, one of Japan's most important weapons in ensuring its competitiveness is value analysis. The Transport for London company carries out 150–180 projects a year. A practical example from Europe is the Jubilee Line metro line in London, which was created with the help of value analysis. The interesting thing about this is that the shape of the assembly also approximates the circular section, i.e., the shape of the tunnel. This significantly reduced the amount of earthwork and thus resulted in a cost reduction, so that the function of the metro remained intact.

The Society of American Value Analysts (SAVE) was founded in 1959 and transformed into an international company (SAVE International) in 1997. Today, this company includes the national value analysis companies of several countries, including the Society of Hungarian Value Analysts; it has members from around 40 countries. According to estimates, around 50,000 value analysis projects are carried out in Europe every year. The EN 12.973:2000 Value Management standard regulates the application. The standard can be obtained from the Hungarian Standards Board (https://shva.hu/ertekelemzes-a-nagyvilagban/).

In Hungary, the Public Procurement Act recommends the contracting authority require the tenderer to apply the method. Based on successful application experiences, the Road Technical Regulations require the use of value analysis in the field of road investments as of January 1, 2004. During the revision of road construction investment plans, in the course of 85 completed value analysis works (further development of road investment plans) between 1999 and 2010, the total savings shown from the estimated gross investment cost of HUF 816 billion were close to HUF 110 billion (13%). The surplus content and the additional expenditure due to quality improvement were HUF 11 billion (1%). As a result of the proposals, the investor, the Hungarian state, is expected to be able to carry out these investments for HUF 98 billion (12%) less and with better quality.

In our country, the procedure is not yet very widespread in the company circle, but among the state-owned companies, value analysis is regularly used at the Hungarian State Railways and the Paks Nuclear Power Plant. (Balogh 2008; Fodor 2010).

At the Paks Nuclear Power Plant, the first value analysis project was implemented at the end of 2005, and an independent value analysis group (3 people) has been operating since November 2009. The total value of the projects reviewed between 2006 and 2009 is HUF 24,088 million, the savings are HUF 7,898 million, and the proposed additional expenditure is HUF 1,438 million, i.e., the net cost savings of the projects is HUF 6,461 million, i.e., 26.8%. 9 The diversity of the value analysis and the presentation of the possible areas of application are included in the study by Kardos (2009), in which the results of the implemented projects were gathered, and through the description of these, it draws attention to the advantages of the methodology and its potential.

The range of data and analyses used in measuring the usefulness of the value analysis work is relatively narrow; an exceptional area—where the application of value analysis is mandatory based on legal requirements—is road investments. During the review of 80 investment projects over the past 10 years, the teams pointed to the possibility of cost reductions of about HUF 71 billion (12%) out of HUF 604 billion in gross estimated costs, and with the aim of increasing quality, they proposed HUF 11 billion (2%) of additional spending. The net savings can thus be put at about HUF 60 billion and the total cost shift is HUF 82 billion. Approximately 100 road professionals participated in the review of road investments using the value analysis methodology.

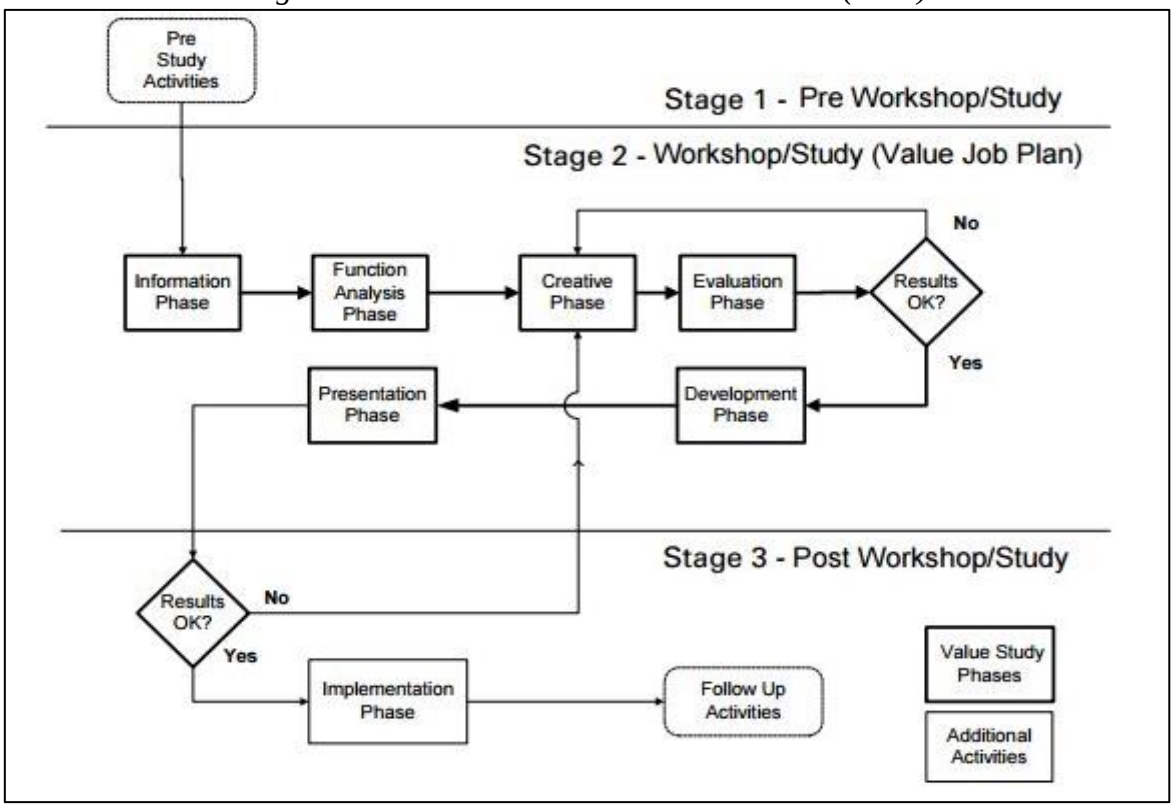
The average team size was around five people. The interventions basically took place at the level of the planning permission plan; six times the study plan was further developed, and 11 times the implementation plan (combined plan). The teams raised a total of about 3,500 ideas, and more than 700 of these proposals were developed in detail. Based on the correlation between the order of magnitude of the costs of the investments and the order of magnitude of the savings achieved, it can be concluded, that the higher-value investments are worth reviewing, since larger savings in volume are likely for these projects. When selecting the topic, the expected estimated benefit of the methodology, i.e., the cost savings, must be compared with the cost of applying the methodology. During the projects, the most frequently occurring proposal types were the following: junctions, works of art, track structure, and track modification. The type of proposal with the most results and cost savings was route modification (Balogh 2008; Fodor 2010).

3.2. Approach to Value Analysis

The value analysis is a decision-making procedure that not only looks for the cheapest, or not only the better, but also satisfies the desired and necessary needs at the lowest cost. The value analysis embodies the conscious application of the natural way of thinking and decision-making mechanism, according to which we consider the available advantage (quality) and the sacrifice made for it (cost) at a moment in time. It goes without saying why this useful technique should be applied at each stage of the normal day-to-day development to every product, process and organisation. According to the theoretical approach, everything that has a function and a cost can be the subject of value analysis.
Value analysis is a group decision-making procedure. Covering all important details of the project (product, service, procedure, process), the so-called multidisciplinary team of internal and/or external experts work together with the consultant. The methodology focuses on information and possible approaches. Value analysis means the implementation of a systematic series of development steps, during which analytical and creative sub-techniques appropriate to the nature of the problem are applied. Value analysis identifies project functions and focuses

on intervention points with the greatest impact, then explores alternative solutions and creates optimal solutions for functions to cost-effectively satisfy and/or increase performance (Ho et al., 2000; 2004; Fodor, 2010; Sharma and Belokar 2012). It can be read from Figure 1, which shows the logical sequence of steps of the value analysis method, that in his view, value is the satisfaction of the required function at a minimum cost level.

Figure 1. SAVE International Value Standard (2015)



Source: VMS (2015) and Wao (2018)

During the logical correlation system of the value analysis, the designer always starts from the expectations of the customer, consumer, user, and service user, determines the performance capacity, tasks, and functions required in terms of demand satisfaction. In this context, it has to examine what the functions are like in terms of properties, parameters, or whether they can be fulfilled at a cost, and looks for the smallest possible solution for these functions at a cost.

The expenses associated with the value are basically characterized according to the material sacrifices, so any unit of measurement in the world can be converted to a monetary value. It is important to mention, however, that the value is not unconditionally time-independent.

The value is the quotient of the function and the cost of the function, thereby defining a value independent of time and space. The cost of the expenditure must include not only the one-time point investment costs but also the aggregate lifetime cost, which corresponds to the function cost. By expectations, we must understand the change of needs over time, where the development of technology and society, changes in society's needs, and changes in the environment can and has to be taken into account. Here, the environment is not only natural but also businesslike, population-related. The environment is also understood. In practice, this defines the third-dimension axis and can sometimes be interpreted as time (Wolf, 2008).

In order to use value analysis as a decision-making method, a value analysis group is required, in which experts selected from the necessary fields of expertise take part in order to achieve the goals of the economic organization. In addition to the value analysis group, a management group is also necessary, which is a group of managers whose members ensure the conditions for carrying out the value analysis work.

3.3. The process of Value Analysis

In the process of value analysis work, each stage independently supports the knowledge and understanding necessary for the successful implementation of the next stage.

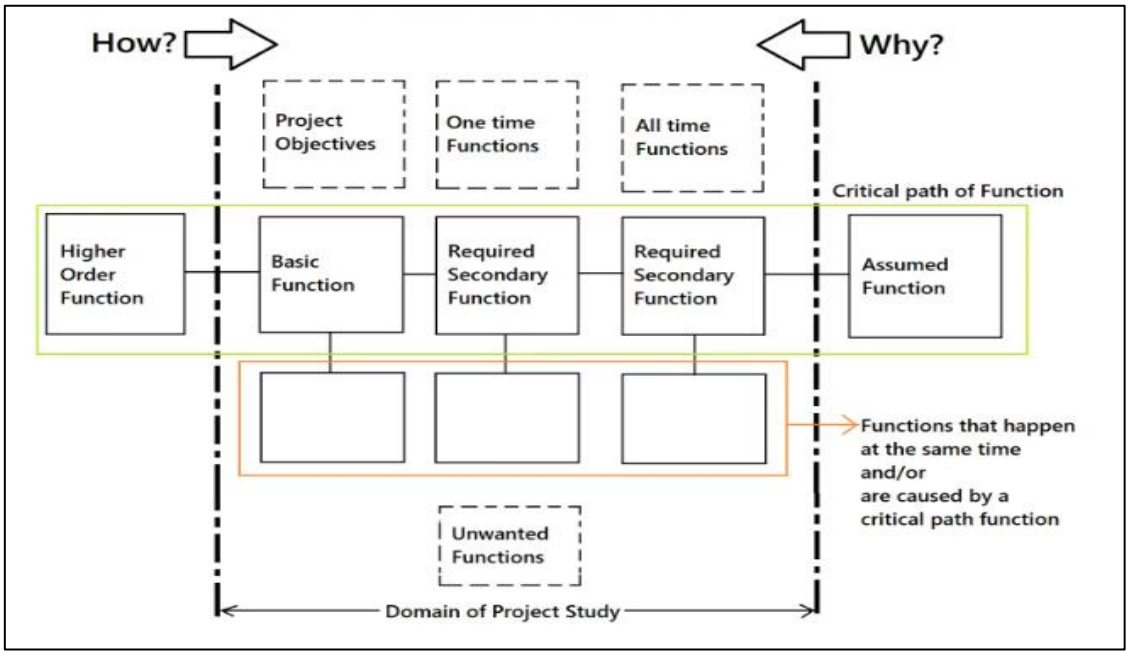
In the preparatory phase:

- to select the topic and develop the topic boundaries;
- to record the objectives by the management in a form defined by parameters;
- to appoint the members of the value analysis group by the head of the organization;
- to create a work plan containing the time schedule of the work steps.

In the information stage, the information defining the subject, limits, and external and internal requirements of the value analysis is collected. Within the information, priority should be given to the discovery of needs and the definition and arrangement of functions.

The function is the purposeful task, operation, performance, or possibly property of the object of the value analysis. Hierarchical, cause-and-effect, logical, or other relationships and interactions between functions are represented by the function scheme, which can be an ordered function list, a function family tree, or a FAST diagram. The Function Analysis and System Technique (FAST) is used to define, analyze, and understand product functions, how the functions relate to one another, and which functions require attention to increase product value. It is used to indicate different functions in a logical sequence, prioritize them, and test their dependency, as you can see in the below Figure 2.

Figure 2. Different functions in FAST



Source: Sundar (2020)

In the course of application of the FAST diagram, the first step should be to organise brainstorm to get deeper insight whether all the functions the product will serve from the aspects of the customer. A function is everything that the customer expects and requires from the product (technical functions, quality, service life, reliability, ease of maintenance, transparency, attractiveness, simplicity, other special features). The function should be defined as broadly and generically as possible. You can see the main types of functions in Table 1 below.

Table 1. Classifications of the functions

Name of the function	Description
Basic functions	They are the overall product function. For example, the basic function of a car seat belt is to restrain a person in a car seat
Secondary functions	These are essential to the performance of the basic function and they are direct cause to the basic function. Secondary functions can be categorized into 3 types: a) Required; b) Aesthetic; c) Unwanted by product
Other Functions	All Time Functions are functions that are pervasive to the product. Listed on the right of the diagram. One Time Functions are functions are listed at the centre of the diagram.

Source: Own edition based on H. R. Fartookzadeh and M. Fartookzadeh (2018); Sundar (2020)

The calculation of function costs, the determination of how much it costs to perform a given function, is represented by the function-cost matrix. Its sections are as follows (SAVE International Value Standard, 2007).

In the creative phase, ideas for weak points are collected, and all possible ideas are explored in order to eliminate weak points.

In the proposal phase, proposals for possible solutions are collected in a decision-preparation study.

During the decision process, one of the offered alternatives is selected.

The proposals will be introduced in the implementation phase. In this phase, the value analysis group cooperates only to the extent necessary.

In the control and evaluation phase, the managers recognize the implementation of the proposals and the results derived from them, according to the developed interest system and the work of the participants.

3.4. Value-based methods of Value Analysis

As value analysis spread throughout the countries of the world, so did its trends (Miles 2015).

Value analysis has remained in the United States, while value management is used in Europe. According to some opinions, there is no difference between these two trends, while according to other approaches, there is. Looking ahead, it can be said that value management places value analysis in the management toolbox and treats it as one of its tools.

In the United States of America, value analysis activities are brought together by the Society of American Value Engineers (SAVE), founded in 1957, which was transformed into an international company (SAVE International) in 1997. About 40 countries are members of this company, including Hungary.

In Europe, value analysis and value management are represented by the European Value Analysts Society (EGB; European Governing Board) (SAVE International website; European Governing Board website).

Society of American Value Engineers

International deals with the development and support of the value analysis method and is a leading advocate of function-based value-adding methods. His duties include teaching value analysis, preparing publications, and organizing conferences.

The members of the company are present from the public and private sectors and from quite diverse fields, such as the construction industry, product design and manufacturing, transportation, health care, and environmental protection. SAVE International's Value Standard and its knowledge material, published in June 2007, are both a manual and a code of conduct.

The objectives of the Standard are as follows:

- Defines the steps and components that make up a reasonable value test.
- Provides information on general methodology, terminology, and practical application to guide value analysts and managers in the effective use of value analysis.
- Provides guidance to value analysts and managers as they determine the points at which value methodology is applied to maximize the benefit of the team's innovation skills and implement alternatives that increase project value.

The value methodology can be used both in product production and in connection with service provision, business systems, and processes, as well as in the value analysis of an organization.

The standard states that value methodology is a systematic procedure that is carried out by a mixed team in order to increase the value of the project through the analysis of the project's function.

Function analysis is the basis of value methodology; it is the key activity, and this knowledge sets it apart from other problem-solving or practical development methods (SAVE International website).

European Governing Board

The European trend of value analysis, or value management (hereafter VM), is a management style committed to motivating people, promoting skills and synergies, and innovating with the aim of maximizing the performance of the organization. It is a structured, team-based, analytical, and creative process for finding innovative solutions to complex problems. Its goal is sustainable, value-based solutions that reflect the needs of the organization and key stakeholders.

VM is based on principles that define measurable value and focus on functions that promote innovation.

Developing and integrating a unified value management system into the processes of an organization is a big task. The unified system starts from customer and market expectations and covers product development, including preliminary value analysis (Kmetty and Hegedűs 2001).

The European standard, hereinafter standard, can be applied flexibly in different circumstances. The essence of a VM is to provide a framework for applications. It presents a lot of useful tools, encouraging you to choose the most suitable method to achieve the desired result. The standard can be used in the design and development of new products, equipment, and processes, as well as in the revision of existing products, equipment, and processes.

The objectives of the European standard are:

- Create a foundation for management in the implementation and application of VM.
- Help team leaders and team members apply the method.
- Provides guidance for all managers who implement and use VM and for all members who want to understand it.

The most important principle of VM is value. The complete management work is built around this. The most important management goal is to maximize the value of the various activities carried out by the company, which is compatible with satisfying the needs of consumers, management, and other stakeholders.

Managerial work requires professional preparation, leadership skills, good communication, and teamwork. The organization's environment has to take into consideration when developing management activities. An organization has an internal and external environment. The external environment includes customers, suppliers, legal regulations, and economic factors. The internal environment also includes internal politics, organizational rules, organizational culture, and employees. These must all be taken into account, and the appropriate tools must be selected for this (the European Governing Board website).

Comparison of the two trends

SAVE International and the Society of European Value Analysts operate two rating systems, but everyone in the world understands the same thing by value analysis. The focus is on value. During the value analysis, the value is derived from the needs of the consumers, and the object of the value analysis is either a new product designed in teamwork, an existing product that is value analysed, a product that is re-analysed, or, where appropriate, a product whose value is checked.

The standard published by SAVE International provides detailed guidance on this. It defines steps that can be used as a work plan. The work plan presents the individual sections comprehensively. For the stages, it assigns the goals, basic questions, main activities, the methods and tools necessary for them, and, at the end, even the expected result.

On the other hand, value management is a management style that can be particularly recommended for motivating people, developing capabilities, and promoting synergies and innovations with the aim of maximizing the performance of an organization. The Value Management Standard published by EGB not only deals with the conduct of value analysis but also creates a basis for management and the entire organization to be able to carry it out successfully. Organizational culture and organizational strategy are extremely important. Value management organizes management tasks around value. Its purpose is to maximize the value

of the activities carried out by the organization, which arise from the needs of consumers, management, and other stakeholders.

The tools and methods used for value analysis are the same for both European and American standards; there is no significant difference between them.

4. New challenges and solutions

There are many different tools, methods, and perspectives that help with the development and improvement of value analysis methodology. Information and communication technology (ICT) is present in the operation of businesses. Today's economic life and consumer society are characterized by ever shorter product life cycles, the power of community spaces, the need for continuous innovation, constant cost reduction (thereby increasing efficiency), the need for sustainable development, and complex thinking. Value analysis is also helped by using all possible techniques whose way of thinking and logic are suitable for optimizing and increasing the aforementioned value. In my opinion, these can be used regardless of industry and are even necessary**.**

4.1. Scientifically based cost reduction (Disruptive Cost Workout)

Disruptiveness means that a new product is produced with a technology or method radically different from the previous one; a constant element of this is continuous innovation. A challenge that also creates an opportunity for growth.

Disruptive cost reduction can be briefly defined as creating more with less, i.e., with a smaller budget. The question is what can be the minimum functionality of a product that suits the consumer? This procedure actually means step-by-step cost optimization. In order for this to work, a "cost-out" team has to create within the company, whose only task is this. With a value analysis methodology, they look at the product through "functional glasses" and leave only those functions that the customer really requires. (The additional value is not paid by the customer anyway, so it is smaller value product is created due to higher costs). First, they focus on which are the most value-adding functions, which are definitely necessary, and then which are the second biggest value-adding functions. The reduction of costs is approached from the perspective of the necessary functions, the task is to reduce production costs by 5%. The continuation of the method is that if this is successful, in the next step the product will be "taken out" again, and I will try to reduce its cost by another 5%. They do all this very meticulously, breaking down cost reduction opportunities into small steps along the entire length of the value chain. The team often changes its point of view during the cost optimization. First, they look at the production of the given product and its costs with an engineering eye, then they also look at it from financial and marketing points of view, and then they examine again with an engineering point of view, is it still possible to produce the product? This cost reduction should be integrated into the entire value proposition chain, i.e. it must be applied and visible in all elements of the value chain.

An important element of this project work is the necessary value analysis expertise and know-how, the employment of appropriate experts, who must know the process and the technology, but must also be aware of the cost implications. These teams must impartially and strictly "cut down" the cost, the justification must be done on a professional basis, and the course of this must be systematic. The targeted area - elements, parts - or the factors that make up the largest part of the costs, ~50% (Pareto approach). In addition to cost reduction, the goal is also short-

term feasibility, so the step, solution proposal, which can be implemented in a short time comes to the fore. According to the steps of the value analysis work plan, they proceed from the information phase (understanding the customer's needs) through the function analysis and evaluation phase, and then in the development phase they present their proposals, which may or may not be acceptable ("go/no go"). If the steps as a whole do not result in a 5% cost reduction, then the steps and suggestions become necessary ("must") (Mainardi 2015).

It is advisable to use this methodology primarily in areas where expensive, innovative technology is used and where there is a large volume of production. Today, a testing and introduction phase cannot last for months, there is no time for that, the competition is fierce, and technologies can quickly become obsolete. The product can be completely disassembled and transformed according to changing needs, just think about the enormous development and transformation of mobile phones, even just in the last 5-10 years.

This is helped by disruptive innovation, during which new technology is not developed at enormous cost, but existing technologies are applied to the new product. It involves high risk, contains surprising and unexpected decisions and actions, and can turn the market upside down. This picture is complicated by the appearance of new business models, the appreciation of the role of social media and conscious consumers, and the lean approach of (Fintech) startup companies. Typical examples are the ever cheaper 3D printing, the use of intelligent software (AI) (self-driving vehicles), the Internet of Things (IoT), smart factories (Smart Factory), the appearance and expansion of mobile internet (banking), renewable energies application, but even genetic research can be mentioned. All of these are closely related to digitization, Big Data (data mining), and Industry 4.0.

4.2. Quality Function Deployment and Target Costing

Quality Function Deployment (QFD) is not a new concept; it was already incorporated into the value analysis methodology in the early 1980s. It is a quality planning method according to which customer satisfaction is the only measure of quality. Steps: understand the customer; collect customer opinions (in order of importance); understand and transform these for the value analysis team as a goal to be achieved; develop a matrix to select concepts and identify specifications; finally, these specifications must be connected and brought into line with the production possibilities. The main tool of the analysis is the "House of Quality", which associates a value with each function and the necessary parameters so that they can be measured and compared and looks for correlations between the functions and properties (Bolton et al. 2008; Cariaga et al. 2007).

Thus, it is a quality function evaluation analysis that creates a communication channel between professionals (engineers, logisticians, financiers, marketers, etc.). It clarifies what the desired quality is, what the customer wants and is willing to pay for, the order of importance of the customer's expectations, what is competitive, and what is really feasible.

What makes it considered modern and suitable for today's challenges is that it provides an answer to the problem that cost, quality, and functionality are not in balance; the established goal has become cost reduction. This model does not rule out effective cost reduction either, but it also considers it important to increase the added-value of the product for the customer. After the development of QFD, the next step is target costing, which is the "targeting" of the allowable cost level: target price minus expected profit. This target price depends on the industry and competitors as to whether it can be determined by the company or is a given, but

the logic is the same in all cases. Costs have to be minimized already in the planning stage, since the most and least painful interventions and changes can be implemented at this stage, and with continuous cost reduction, taking into account consumer price flexibility, volume, and depreciation costs. This is where value planning comes into play when we try to minimize the costs that have not yet been incurred. For this, the cost factors have to be find, evaluated, and changed, if necessary. If the allowable cost is lower than the planned cost, then it is necessary to go through the function carriers in order to reduce their cost, applying the function evaluation matrix. The next step is to incorporate the Kaizen philosophy into this process, according to which development does not stop, is not occasional, but consists of continuous and small steps, and every small improvement or cost reduction is valuable, so the risk can be reduced. We create permanent insufficiency, think in terms of processes, involve employees, and look for unnecessary time and costs (Schandl 2014).

4.3. Limitations of the Value Analysis at the business organisation

Besides the many benefits related to applying the Value Analysis and its methodological framework, there are many difficulties that companies might face in adopting and implementing value analysis. These challenges can be the followings (Sharma and Belokar 2012; Sharma 2022):

Difficulty in obtaining accurate and comprehensive data for analysis. The possible reasons can be beyond this one lack of information, usually caused by a shortage of time, furthermore many decisions used to be based on feelings rather than evidence-based facts. The complexity of the necessary information can be illustrated in the Value Analysis Questionnaire in Table 2.

Table 2. Main questions of Value Analysis

Subject	Question	Analysis
Function	What function can be performed?	Can it be eliminate? What alternative methods are available?
Material	What should be the material specification? What quality and quantity of material should be applied?	Can alternative material used? Can the specification amended? Is the size or weight of material excessive? Can the quality reduced? Will a cheaper material serve the same purpose? Is the cutting done economically without waste?
Labour	What are the direct labour costs?	Is it possible to reduce labour costs? Can lesser skilled workers be employed?
Process	Is the best available process or technology used?	Are all the operation necessary? Can be the alternative operation or business running process cheaper? Can assembly operations be modified and how?
Standardization	Are the materials, components or modules standard?	Can the materials and the processes be standardised? Can the product use standard parts?

Source: Own edition based on Nikhila (2022)

Analysis is crucial in the context of creative, cross-functional team work to determine the desirable feature of each product in terms of customer's requirements.

Resistance to change from employees. The attitudes can be rooted in personality traits (habitual thinking distorting or hindering the objective problem perception) or rigid application of standards, customs, and tradition without consideration of changing function, technology or value. In addition, negative attitudes, failure to recognize creativity or innovativeness arising from poor human relations, lack of good communication, misunderstanding, jealousy, and normal friction between people are usually a source of unnecessary cost, resulting sometimes be duplicated and redundant functions (depending the company culture, values, structure and the applied leadership style).

Challenges in integrating value analysis with other management tools or processes. It means misbeliefs, insensitivity to public needs or unfortunate experience with products or processes used in unrelated prior applications. Over specifying, costs increase as close tolerances and finer finishes are specified. Reluctance to seek advice, failure to admit ignorance of certain specialized aspects of project development.

Summary

Due to its functional approach, value analysis is one of the most effective and easy-to-learn problem-solving frameworks that can be used in any sector and in any company, regardless of its business portfolio, structure, size, and ownership structure. In addition, value analysis is an effective decision preparation procedure that can be used not only in projects initiated with the aim of cost reduction and whose defining characteristic is function analysis (Leung 2009; Shen and Liu 2003). The types of value analysis illustrated in Table 3 support its versatile application.

Table 3. Types of Value Analysis

Designation	Description
Value Analysis	Value analysis of an existing product, value improvement
Value Engineering	New product value analysis and value planning
Value Control	Value verification and verification of the implementation of proposals
Value Investition	Value Planning for Investments
Value Management	Value analysis of management processes (Value management: general corporate application of value analysis)
Value Purchasing	Material procurement with value analysis: procurement of materials and components
Value Research	Value Analysis of Experimental and Laboratory Work
Value Improvement	Value analysis of development programs

Source: Own edition based on Nádasdy (2014)

The applications of value analysis can have many positive returns: cost savings (between 10 and 30 percent in volume); improvement of product quality; reduction of lead time; improvement of competitiveness and productivity; better utilization of available capacities; and more effective collaborations both inside and outside the company. Some concrete, real world everyday examples how to apply the different types of Value Analysis in different organisations.

Aadarsh Instruments, located in Ambala, for analysis, which runs the export business of medical microscopes, focused on the adjustment knob of the microscope, and with the critical evaluation of it, you were able to increase the value of the product by substituting another material in place of the one that is currently in use (Sharma and Belokar 2012).

Value generation in the traditional housing design process (in different countries, with different scopes and profiles) Value analysis was applied to determine desired value (DVI) and potential value (PVI) indices that represent the minimum and maximum value needed to meet the client's expectations. The stakeholder who gets the least value in the process is the builder, while in the product, it is the designer. On the other hand, the end-users obtain the most value from both the process and the product. Builders receive little value due to their low involvement in the design process, as they are traditionally incorporated into the construction-related stages. The value losses resulting from the different customer visions (default value losses) are low and are present in the process rather than in the product. Therefore, the main value losses related to the project's performance and not due to conflicts of perspectives between different customers (Giménez et al., 2022).

JCI's Applied HVAC Equipment division previously used organization-based tools like Sharepoint and emailed static files for VA/VE projects, taking weeks to deliver the ideas. This process is similar to many companies and industries that conduct these analyses routinely. JCI wanted to step up its collaboration by implementing CoLab. The initial implementation enrolled eight users in a single location; this access has since extended to more than 180 in four countries. JCI uses CoLab to cover VE processes, e.g., drawing reviews to achieve cost avoidance, and it employs the software for manufacturing process steps and existing products for VA. In addition, they now use CoLab in virtual real-time for efficient collaboration in value engineering and analysis (Kimmel 2022).

Numerous projects focus on sustainable development as a burning issue, which includes significantly more recycled material contents, requiring less energy or water usage, reducing construction waste, increasing natural lighting, and providing tangible contributions to an optimal facility. The value engineering methodology can provide for the identification of alternatives, making comparisons among the alternatives, or identifying the best value alternative. This is accomplished using life-cycle costing along with first-cost estimates. Life-cycle costing will be able to precisely predict the first-cost and full-life-cycle cost differentials of each alternative (Sharma and Belokar 2012).

Linked to industry 4.0-based technologies and digitization, value analysis contains many unexploited opportunities, for example in the field of business intelligence (BI). These are technological solutions that, in addition to company management systems, help companies make informed decisions in the following areas:

- Multidimensional database management
- Business planning (planning), forecasting (forecasting), and consolidating applications
- Reporting applications
- Dashboards and Scorecard systems
- Tools for performance monitoring (Key Performance Indicators - KPI)
- Data, Text and Voice Mining
- Data visualization

To build a BI system, we usually need several pieces of software. Typically, we need a database manager where we will store the data required for the analysis, a data loader with which we can upload a business intelligence system, and a display interface through which we can query the data of the BI system and modify its models. Value analysis can also provide effective help in this area by analysing the functions and costs of different software. Another future-oriented area of value analysis in software function analysis can be corporate architecture. It is a conceptual model that describes the company's business processes, organization, goals, and products and the relationship of these components with the supporting IT services and infrastructure, as well as modelling the organizational logic of the IT infrastructure, its components, and their connection system.

In certain cases, there are potential limitations to value analysis in the context of rapidly evolving technologies and business models. With the rise of Industry 4.0, the functional approach of value analysis may be less relevant in those environments where products are rapidly changing and customer needs are evolving at a fast pace.

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