

Original article
UDC 111; 140; 378; 005.7; 531-4; 316.4
doi: 10.17223/15617793/477/8

Study on a conceptual model for campus transformation of classical universities in the digital era

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Abstract. This article presents a conceptual management model of campus space 4.0 (CS4.0), in which CS4.0 is viewed as a condition for the transformation of classical universities in the digital era. To create this model, we used the systems approach as well as complexity theory, focusing on the ontological, spatial, axiological, social, psychological, and management aspects. The model not only defines the systems status of CS4.0 and describes the three types of properties inherent in CS4.0. This model also explains why, in the digital era, CS4.0 can become the agent of change for a classical university that has had a long history. This model of CS4.0 will not destroy the university's cultural identity and academic values; rather, it will serve the interests of all groups within the university community. This conceptual model can be the key to understanding one of the possible management strategies for the development of the classical university in the digital network society at the beginning of the Fourth Industrial Revolution.

Keywords: campus space 4.0, classical university, digital era, hybrid ontology, systems approach, complexity theory, conceptual model, university management

Acknowledgement: We would like to thank Jean Kollantai, MSW, Tomsk State University, for proofreading this paper, and for her support and assistance.

For citation: Kuzheleva-Sagan, I.P., Galazhinsky, E.V., Spicheva, D.I., Kruckeberg, D. & Polyanskaya E.V. (2022) Study on a conceptual model for campus transformation of classical universities in the digital era. *Vestnik Tomskogo gosudarstvennogo universiteta – Tomsk State University Journal*. 477. pp. 74–84. doi: 10.17223/15617793/477/8

Introduction

The inevitability of transformation of classical universities in the network society has been discussed by many researchers [1–5]. However, some scholars consider classical universities' rich history and culture to be burdens of the past; they believe such universities cannot react quickly to the challenges of our time [6, 7]. The Fourth Industrial Revolution (4IR) [8], with its total digitalization, has only exacerbated this contradiction. This assumption about universities that had been founded in the nineteenth century or even earlier is quite understandable: in the pursuit of current trends, classical universities can lose their cultural identity and their academic values that have been shaped for several centuries. Nevertheless, understanding that there may be some negative consequences does not preclude the desire of classical universities to participate in the 4IR, because they realize that, by neglecting these trends, they may risk being ignored by talented students, professors, and researchers, thereby losing their high positions in university rankings and thus their

competitiveness. Such trends accelerate the process of transformation of classical universities, encouraging them to attract different resources.

One resource for university transformation is the restructuring of campuses. The transformation of universities is impossible in the old spatial culture that does not correspond to the new standards of quality of life, education, and professional activity of the university community that are conditioned by the digital era and the beginning of the 4IR. Thus, university spaces that are transformed with digital technology are becoming “agents for change” [9. P. 30]. An additional reason for universities' desire to restructure their campuses is to position themselves as among the most innovative universities worldwide [10, 11]. According to Whitton [12. P. 255]:

Spaces and materials are exploited to ensure that intelligent student consumers know where their fees have been spent and are contented enough not to exercise “free market” choice and look elsewhere for an education.

The problems of organizing institutional and social spaces are discussed in many theoretical publications [13,

14]. However, scientific publications about university campuses in particular are not numerous. They are focused mostly on policies and reforms in higher education that cause changes in the campus space [15]; the architecture, design, and ecology of this space [16, 17]; how campus space is connected to the city, safety, and management [18]; and organizing students' activities on campuses [19, 20]. These pay special attention to the social spaces of the campus that are considered, not only as an important condition of the "ecology of training" [21] that creates student social capital [22], but also a criterion of the innovativeness of the campus and its desire be suited to the times [19].

As a rule, researchers consider campus renovations to have a positive influence on the image and activity of universities. However, not long ago, some publications were warning about the risks related to extensive use of innovative disruptive technologies on campuses [23]. Moreover, some researchers (for example, Whitton, 2018) [12] critically analyzed the impact of the super modern campus as an institutional space and place of social interaction, that is, on the daily life of the academic community, due to the complex relationships between the campus and the shaping of individual, social, and professional identity of members of the academic community.

Also, universities have not demonstrated the ability to think radically about the types of environments necessary in the future [12. P. 260], and they have not created generalized concepts that could help classical universities to develop their own management strategies to reconstruct their campuses in the era of the 4IR.

We believe universities should pay attention to the necessity of changing existing models of university management. Even such a democratic model as "shared governance," which has been used in university education worldwide for many years [24], must be reconsidered, taking into account the new problems that universities are facing today [3, 25, 26]. The digital transformation of universities means, not only the total digitalization of university campuses, but also considerable changes in their organization and management culture and in the values upon which this culture is based.

All of this is especially important for classical universities that have a distinct cultural identity and academic values, but that are now seeking radical transformation in compliance with the new challenges of the digital era and the 4IR. We raise this question: What type of campus space can become the driver of this transformation without damaging the cultural identity and academic values of a classical university that has a long history serving the interests of all groups within the university community?

The main hypothesis of this research is that campus space 4.0 (CS4.0)¹ can be this type of space if:

1) It is organized as a social communication space that has hybrid ontology that is inherent to the network society in the stage of the 4IR, which space also possesses corresponding technological infrastructure, planning, and architecture.

2) It is considered within the systems methodology and complexity theory that reveal its systems status and basic characteristics.

3) It includes a management subsystem that contributes to finding balance between introducing technological and cultural innovations to the university environment, on one hand, and retaining traditions and classical academic values on the other, as well as between the management space and the interests of different groups within the university community.

Thus, this research seeks to develop and to justify the generalized conceptual model of CS4.0 as the condition (the agent) of the transformation of a classical university in the digital era. This model has been based on the experience of Tomsk State University, the first classical university in Siberia [27, 28].

Theoretical Bases

No single systems method can provide a comprehensive description of a complex system, and CS4.0 can definitely be characterized as a complex system; therefore, we have searched for the combination of different systemic and other methodological approaches that are most relevant to our research. This theoretical complex includes several aspects (Table 1).

Table 1

Theoretical framework of research

Aspects	Theories and conceptions
Ontological	<i>Theories and concepts of the global network information and communication society</i> (Castells, Luhmann, Mitchell, Attali, Bauman, Urry, Brey, Makimoto, Manners, Turkle, Hayles, Latour, Haraway) and <i>the Fourth Industrial Revolution</i> (Schwab)
Systems	<i>General systems approach and interdisciplinary complexity theory</i> (Prigogine, Stengers, Haken, Gleick, Luhmann, Jackson); <i>axiological systems theory</i> (B.P. Hall, M-L.W. Hall, Parra-Luna, Judge) and <i>Values-Based Management</i> (Dolan, Garsia, Diegoli, Auerbach); <i>The concept of the autopoietic identity of a classical university</i> (Lenartowich, Shaw)
Spatial	<i>Spatial theory</i> (Lefebvre), as well as the concepts of "space of flows" (Castells), "post-sedentary space" (Mitchell), "mobile spaces" (Urry), "electronic cottages" (Toffler)
Social and psychological	Basic Psychological Needs Theory, BPNT (Deci & Ryan)
Management	<i>Theory 'Y'</i> (McGregor); <i>Theory of Structural Power in Organizations</i> , "delegation of authority" (Kanter); the concepts of "shared governance" (Crellin; Honu); "creative destruction" (Schumpeter); and "disruptive innovation" (Shwab, Christensen); the three-modus management system "run-change-disrupt" (Gref)

Results of the Theoretical Research: The Conceptual Management Model of Campus Space 4.0

The conceptual management model of CS4.0 as the agent of change (transformation) of the classical university in the digital era is the space of social communication of the university community that has the hybrid ontology generated by the technologies of the digital era and the newest advances of the 4IR (virtual reality, augmented reality, mixed reality, artificial intelligence, Internet of things, and others). This ontology is characterized by the absence of clear boundaries between the real and the virtual, the digital and the analog, and the natural and the artificial. The social and communicative nature and the hybrid ontology of CS4.0 provide the seamlessness of its social and technological infrastructure as a result of integration of many separate elements—buildings and services; computer, digital, and social technologies; and social and value-based networks. The hybridity of the CS4.0 ontology determines its architecture both as the space of place and the space of flows.

The architecture and planning of CS4.0 as a space of place implies different types of locations: large, middle-sized, and small; open and closed; and interconnected and isolated. Altogether, they form a comprehensive surface communication scheme with the corresponding channels (passages) and nodes (crossings). The architecture and design of CS4.0 are based on the idea of continuity of the traditional academic values of a classical university, their high potential for the university's development in the digital era, and the ability to be combined with the ethical values and the technologies of the 4IR. However, when CS4.0 is seen as the space of flows, its architecture is

invisible and complies with the network logic.

In the context of the systems methodology and the theory of complexity, CS4.0 takes an ambivalent position in the systems hierarchy: on one hand, CS4.0 is a subsystem of a university (a more complicated system), and, under certain conditions, it is able to perform the functions of the agent of change (attractor) for the university; on the other hand, CS4.0 is a part of the external environment of a university². CS4.0 has a combined status in the sense that this simultaneously represents: (a) an open complex social system with undefined, penetrable, and flexible boundaries, which contributes to all kinds of emerging innovations, including value-based ones; and (b) an operationally closed (self-referential) system that is responsible for preserving the cultural identity and classical academic values. The academic (classical and emerging) values of a university are the attractors for CS4.0 as a (sub)system. The classical values, as permanent attractors, create the patterns of autopoiesis of the (sub)system, keeping its cultural identity. The emerging values, as strange attractors, lead the (sub)system, together with the (super)system, to the new current and strategic goals.

Due to its social and communication essence, the hybrid ontology, the ambivalent position in the systems hierarchy, and its compound systems status, CS4.0 possesses three types of properties. First is the universal properties common for all complex systems. The second type is the substantive (mono)properties manifested in CS4.0 as both an open and closed system. The third type is substantive paired ambivalent (dialectically opposite to each other) properties; every property can be more apparent, depending upon whether CS4.0 is seen as an open or closed (sub)system (Figure 1).



Fig. 1. Types of systems properties of CS4.0

The management core of CS4.0 (and the whole university management system at the same time) is represented through two main management parameters. The first parameter (shared governance) ensures the necessary diversity of the possible states of the (sub)system of CS4.0 that is needed for its self-organization and self-development. Due to this parameter, the CS4.0 (sub)system can perform the largest number of management functions concerning organization of different types of students' and professors' activities, and,

therefore, increases the number of possible states of the university as a (super)system.

The second parameter is the three-modus management parameter run–change–disrupt that maintains the consensus/balance of the traditional and the emerging academic values. The run modus is responsible for the order and equilibrium of the CS4.0 (sub)system (that is, for the management of its basic processes and structures and preserving cultural identity). The change modus, as management of soft change (or changes of the first level

within the traditional cultural, value-based, and technological paradigm), is able to lead this (sub)system to the edge of chaos as the most productive state for this (sub)system. This is the modus of experimenting with educational, creative, and other practices; the most suitable laboratory for these can become the 4.0 campus. Disrupt, as a modus of managing the cardinal changes (changes in the second level within the new paradigm and the new identity), is connected with great risks, as high as the transition of the (sub)system to the state of utter chaos. Essentially, this means management faces multiple headwinds. Therefore, the disrupt modus cannot be applied simultaneously to all the levels of the university (super)system or its campus (sub)system.

These two CS4.0 management parameters, together with the three types of systems properties, ensure the balance between (a) introducing different types of innovations into the university campus, on one hand, and, on the other hand, preserving classical values and traditions; and (b) the conceived management space and the interests of different groups of the university community.

All of these contribute to the implementation of both: the strategic direction of the transformation of the campus and the classical university in the digital era and of the individual and group strategies of student and professor self-development; and the attractiveness of CS4.0 for all groups in the university community. CS4.0 can produce new interest groups and value-based networks, while broadcasting the existing academic values and creating the new pragmatic and ethical values that correspond to the challenges of the 4IR.

Discussion

The Ontological Aspect

The ontological arguments refer to the first statement of the hypothesis of this research. Classical universities, which largely determine the strategies of mass consciousness development, relate to the key social structures “organized around electronically processed information networks” that are described by Castells [29]. In addition, society as a whole and its individual structures cannot exist without communication [30], and “space is the expression of society” [29. P. 440]. Consequently, communicativeness is the ontological characteristic of universities and campus spaces. Spatial concepts by Lefebvre, Nicholson-Smith, and Harvey [13], Mitchell [31], and Urry [32], together with the basic psychological needs theory (BPNT) by Deci and Ryan [33], also give ground to state that it is necessary to consider CS4.0, not only as a place with high-tech constructions, but, first of all, as a result of production and reproduction of social relations and as a space of social communications of the members of the university community.

Hybridity is another ontological characteristic of CS4.0, because this is inherent to all the spaces of contemporary social reality [34–37]. Relying on Lefebvre’s spatial triad, we can state that hybridity defines a fundamentally new everyday spatial practice (or perceived space) of the “inhabitants” and “users” of CS

4.0; all of its spatial representations (or conceived space); and also representational space (or lived space). This hybridity is expressed through the idea that, thanks to the general technological convergence of the 4IR era [8] and the new media, functioning as “multipliers of new worlds” [37. P. 2], CS4.0 acts as a certain interface between these two worlds. Different ontologies—reality and virtuality—do not oppose one another; rather, they are closely connected. Inhabitants and users of CS4.0 have an opportunity to act simultaneously in two and more ontologically different environments. For example, real laboratories, libraries, museums, and other campus spaces can deal with virtual objects created with technologies VR, AR and MR. In a certain sense, inhabitants and users of CS4.0 are becoming cyborgs themselves [34]. In addition, a completely virtual learning environment (VLE) can be created on a campus.

VR and MR suggest a new channel of perceiving the environment, making learning quicker and giving an opportunity to apply knowledge into practice at any time and at any place [38]; this is especially important for those researchers and students who choose the way of life of a global or urban digital nomad [39, 40]. CS4.0 is a Plato’s Academy of the digital era in which professors and students can have open-space discussions without relying only on their memory, but by having immediate access to all the necessary data [31. P. 150]. The intersection of the real and the virtual creates a completely new type of space for interaction [41] and new mixed (hybrid) objects [42]. The most vivid example of interpenetration of the analog and the digital worlds is IoT [43], one of the leading technologies of the 4IR [8], which space of implementation can be CS4.0. AI is making itself a full participant of different processes that take place on the campus, being engaged in the dialogue with the natural intelligence of people [44–46]; also, artificial and natural intelligence together are creating hybrid cognitive systems [38, 47] and hybrid actor-networks [36].

The hybrid ontology defines the seamlessness of connection of different technologies within the structures of a campus that is interconnected in one social and technological infrastructure. These seamlessness and systems connectedness are important conditions for the effective functioning of the CS4.0. As Schwab and Davis [38. P. 15] mention, “It is tempting to focus on technologies themselves, when what really matters are the systems that deliver well-being.” In the network society, the social and technological infrastructure of the campus must follow the logic of the network as the space of flows and of the status that a university claims to have in the global networks (scientific, educational, innovative, and technological). Accordingly, the infrastructure of CS4.0 must include these three layers, creating [29. P. 441–448] the material support of the space of flows: (1) a circuit of electronic impulses; (2) hierarchically organized nodes and communication centers (websites) of a university that are constantly evolving and are connecting the campus (as a place) with global networks; and (3) managerial elites, managing university networks around which the space of the university ecosystem is built. The network dimension turns the campus into a highly adaptable and flexible

structure, contributing to the transformation of a classical university as a whole within the context of the main challenges of the network digital society. If the network of the university suggests the most topical agenda for the world-wide academic community, it is becoming the main node in the global networks for a certain time.

The architecture of CS4.0 is also viewed through the lens of hybridity: as the architecture of both the space of places and the space of flows [29. P. 453–459]; as real public spaces and continuous fields of network presence [31. P. 156]; and as a merger of real (analog) and virtual/digital architecture [48, 49]. The architecture and planning of CS4.0 as the space of places suggest distribution of clusters of common spaces (local hubs) and of locations of different types needed for meeting the basic psychological needs [33], as well as the necessary level of psychological comfort and confidentiality [50]. Altogether, they create a comprehensive terrestrial telecommunication system with “channels” (transitions) and “hubs” (intersections) that are convenient for making “virtual campfires”: online seminars and discussions [31. P. 158]. This approach to planning allows for the organization of campus space for different types of people, depending on their tasks, psychological characteristics, and emotional states. The architecture and design of CS4.0 as the space of places [29] and conceived space [13] are built upon the idea of the continuity of values of a classical university, of their high potential for the university development in the digital era, and of their compatibility with the ethical values and the technologies of the 4IR, as well as on the idea of creating “cultural bridges” between the spaces of places and flows [29. P. 459]. The architecture of CS4.0 is complex and diverse: the “old” facades can conceal super-modern and high-tech locations — “electronic cottages” [31, 51] for “sedentary” users, and “electronic oases” for “digital nomads” [40, 52].

The Systems Aspect

The systems aspect of the theoretical grounds refers to the second statement of the hypothesis of this research. Having a socio-technological nature and hybrid ontology, CS4.0 is not explicitly a “human” nor a “nonhuman” system; rather, principles of analysis of different types of complex systems can be applied to CS4.0. In addition, it is necessary to remember that the problem of an exact description of complex systems is considered unsolvable [53. P. 21], especially as it concerns social systems [54].

Thus, according to the main principles of the systems approach and of complexity theory, universities, as systems, include subsystems that can be considered systems in-and-of-themselves that influence other university systems [55. P. 43–44]. The campus is the largest university (sub)system, if this is viewed as the “space of place”, that is, the space with all the terrestrial constructions and the university infrastructure. If the campus is considered “the space of flows”, the field for all kinds of internal and external social interactions of the members of the university community in the digital era, its status in the systems hierarchy changes: the campus becomes a part of the external environment in which the university functions.

Our statement about the combined status of CS4.0, which is a simultaneously open and closed (sub)system, is the result of using, not only interdisciplinary complexity theory [56–58], but also the concept of autopoietic identity of a classical university [4, 59], which is connected to the theory of social systems by Luhmann [30]. As a rule, universities are described only as open social systems, having all of the resulting characteristics (for example, Holtzhausen [60. P. 118]). Put another way, being living dynamic systems, universities have to be responsive and adaptable to the changes of outside circumstances and the environment if they want to survive [61. P. 429]. However, according to a more recent view, the astonishing viability of classical Humboldt-type universities is explained, not by their openness, but by their closedness as social systems. To be more precise, their autopoiesis that ensures constant reproduction of cultural identity of a classical university is structurally connected with the environment; however, it is not controlled by this environment. Lenartowicz [59. P. 959] states that universities “*change only to be able to remain unchanged*”. Thus, a classical university is an open and closed system at the same time. We state that this combined systems status can also be applied to CS4.0. Otherwise, it is impossible to explain how CS4.0 can remain simultaneously the space of innovations and cultural traditions in the digital era.

In the context of axiological systems theory (AST) [62–64], CS4.0 is a complex social and technological (sub)system that has a common cultural identity with its (super)system, the classical university. The basis of this cultural identity is a certain combination of values, in which values perform the function of attractors. This combination can be viewed in terms of each of these perspectives that correspond to different classifications of values: 1) control and developmental values; 2) variable and constant values; and 3) end-values and instrumental values [64–66]. The control values are those that assign the inhabitants and users of the campus, as members of the university community, the patterns of behavior that contribute to managing the current processes. These are: effectiveness, discipline, responsibility, and punctuality. The developmental values that perform the functions of strange attractors that take CS4.0 to the new levels of development are trust, creativity, freedom, and commitment to innovations. The variable values are those that are inherent to the culture of a specific classical university and its campus³. The constant values are those that are common to all classical universities as social institutions, that is, traditional Humboldt values⁴, which act as end-values that define the definitive (classical) status of a university as an educational institution. The instrumental values are system internal values, leading CS4.0 to self-governance, self-organization, and self-development. These are the principles of shared governance and the three-modus management model run–change–disrupt.

Taking into account AST and the combined status of CS4.0, we consider that there are at least two types of attractors in CS4.0. First are constant attractors, assigning the patterns of autopoiesis of CS4.0 and the

classical university as a whole. Constant attractors keep the core of their common cultural identity, and, as a consequence, are conditioned by the control, constant, and end types of values that can be defined as basic values. They ensure that CS4.0 functions as a closed (sub)system. The second type is strange attractors, leading the CS4.0 (sub)system, together with its (super)system, the university, to the new current tasks and strategic goals. This type of attractors is the development, variable, and instrumental types of values inherent to CS4.0 as an open (sub)system. We define them as emerging values. They are conditioned by the necessity of changes that are connected to the challenges of the digital era and the 4IR. The balance and coevolution of these basic and emerging values significantly determine the success of the functioning of CS4.0 and of the classical university as a whole. They ensure the conditions when the “system and environment change in response to one another and evolve together” [53. P.116].

Three Types of Systems Properties of CS4.0

We state that, in addition to the universal properties—continuity, emergence, goal seeking, structuredness, adaptability, nonlinearity, and others that are inherent to all complex systems [52, 56–58] — CS4.0 possesses substantive (mono)properties that are reflected in CS4.0 as both an open and a closed (sub)system and substantive paired ambivalent (that is, dialectically opposite) properties. The latter is based on Prigogine’s [67] thesis about the existence of paired opposite qualities in self-developing systems. Each of the substantive ambivalent properties is manifested more vividly depending on whether CS4.0 is viewed as either an open or a closed (sub)system. The ambivalent properties sustain the constant conflict inside CS4.0, which is one of the drivers of its development as a social (sub)system. The presence of all these three types of interconnected properties is conditioned by the hybrid ontology, the social and communicative essence, and the combined systems status of CS4.0.

The substantive (mono)properties of CS4.0 are its sociability, multidimensionality, multifunctionality, symbolization, axiological and semantic fullness, comfortability, attractiveness, and affectiveness. Sociability is the immanent tendency of CS4.0 “to making” social contacts as one of the basic psychological needs of people [33]. Multidimensionality is the ability of CS4.0 to be reflected in several dimensions and spaces: real, virtual (VR), augmented (AR), and mixed (MR) [68]; network and electronic [29, 31]; architectural and landscape; perceived, conceived, and lived [13]; and others. Multifunctionality in relation to CS4.0 has two meanings: (1) the ability of campus to perform different functions: sociable, managerial, educational, and others; and (2) the alterability of campus infrastructure and layout for different tasks and functions. Symbolization is the property of CS4.0 to represent the symbolic university values, both classical and emerging, through the corresponding culture codes [13, 29]. Axiological and semantic fullness is the ability of CS4.0 to generate

continuous “semantic communication” [30] that is responsible for self-organization of this (sub)system. This process of self-organization includes coevolution of different types of values: traditional academic (Humboldt-type) and innovational or emerging values that are connected to the beginning of the 4IR, end-values and instrumental values, and those focused on control and development.

Comfortability is compliance of CS4.0 with international and national standards of campus space arrangement (safety, ecological elements, inclusiveness, catering, information accessibility, and other standards), the orientation of CS4.0 to satisfy all the basic human needs, and the ability to produce positive psychological and physical sensations in its inhabitants and users.

Attractiveness is the property of CS4.0 to attract present and future members of the university community; this also acts as an attractor, leading the university to the new orbit of its development. Affectiveness is CS4.0’s possession of unique natural and artificial, real and virtual objects and artifacts (for example, rare plants, monuments, and archeological finds) as “points of attraction” that create spatial attachment of visitors to the space and the sense of affect. These artifacts play the predominant role in preserving the cultural identity [13, 32].

We interpret the substantive paired ambivalent properties of CS4.0 as follows: openness/closedness. Openness is manifested through involvement of CS4.0 in the city environment and in the global network in its accessibility for the public and internet-users and also in the ability to superstruct and expand itself with the help of VR and MR technologies and electronic communications. Closedness means that CS4.0 has boundaries as a result of differentiating itself and the external environment and in its self-description [30]. These contribute to keeping the core of its cultural identity. If the processes connected to openness are obviously dominant, CS4.0 can move into chaos, destroying the cultural identity; if the processes connected with closedness are dominant, the external boundaries constrict, and the campus can head into stagnation.

Liquidity/structuredness: Liquidity [69] is inherent in CS4.0 as the space of flows and as a post-sedentary space belonging to the global network and also as a space for social communications provided with wireless connection. Structuredness is the property of CS4.0 as the space of places and as a sedentary space that is a part of a certain area [29, 31, 32], with a certain structure and separate elements (objects and locations). Liquidity is more connected to spontaneous and organized communications (meetings and events) and structuredness to permanent work at special locations (laboratories and classrooms).

Delocalizedness/localizedness: Delocalizedness is conditioned by the invisible electronic networks. To Mitchell, because of these networks, campuses

“<...> as habitats no longer consist of single or contiguous enclosures, but have become increasingly fragmented and dispersed. They are no longer bounded by walls, but by the reach of our networks” [31. P. 16].

Consequently, in CS4.0, there are no boundaries between the outside and the inside, and the “order is not made in one discrete inside neatly separated from a hostile outside...” [31. P. 16].

The delocalized CS4.0 is the “field of presence” [31. P. 144] of its inhabitants in different parts of the global world simultaneously, whereas localizedness of the campus is defined by its certain (geographical) boundaries of the constructions of the campus.

Chaoticity/fractality: These properties can be observed at multiple levels of CS4.0 as a complex social and technological (sub)system. However, most of all, they characterize its social and communicative nature: communications (online and offline) can be spontaneous and chaotic in time and place, but fractal [70] from the point of view of the repeated patterns because the models of communications behavior are oriented at certain values and goals [71]. We suggest that some of these fractal patterns help keep the cultural identity of the campus, conditioned by classical academic values; the others gradually create new values corresponding the spirit of the new digital era in CS4.0.

Dehierarchicity/hierarchicality: This means that this space represents the system of simultaneously horizontal (colleague-to-colleague and student-to-student) and vertical (manager-to-subordinate and professor-to-student) social communications. The dehierarchicity / hierarchicality of relations is defined by social contexts. In CS4.0, “each network defines its sites according to the functions and hierarchy of each site, and to the characteristics of the product or service to be processed in the network” [29. P. 444].

Thus, even in the social networks of the campus, there is clear hierarchy, but this hierarchy is always a result of interactions, because “they are not predefined, like those of armies and corporations” [31. P. 34]. That is why network communications in CS4.0 are hierarchical and de-hierarchical at the same time.

Self-organization/organization: In CS4.0, self-organization/organization, together with self-development/development, follow from its openness/closedness as a (sub)system. Self-organization is manifested at the level of horizontal connections (shared governance) and organization at the level of vertical communications. The processes of self-organization, leading to system order of the new type as a new level of self-development of the (sub)system, occur when this (sub)system is at the edge of chaos as a result of subtle change made at the right time and in the right place [53. P. 118]. Self-development as a property of CS4.0 always includes the factor of proactive, creative, and innovative behavior of the members of the university community and a priori suggests the openness of this (sub)system. Development, by contrast, suggests quantitative, rather than qualitative, changes (for example, increasing the number of similar buildings in the campus). This development can occur within the operationally closed (sub)system.

Mobility/stationarity: CS4.0 can be viewed as a hybrid mobile (sub)system that consists of moving elements – various objects and environments that intertwine with

each other while moving [32. P. 50–54]. Their new configurations are created every time. The most important factors here are not people and objects (for example, phones or computers) involved in the movement, but the structured routes in which they circulate: for example, pedestrian paths and cycle lanes and mobile and computer networks [72]. Thanks to the modern technologies, CS4.0 as a post-sedentary space [31. P. 143] possesses mobility [32]: CS4.0 is able to “travel” along social networks, the Internet, and, in the end, around the world through the spread of suitable content. Stationarity of CS4.0 is its geographical reference to a certain location and the format of existence as a huge “electronic cottage” with all kinds of wire and wireless connection [51].

Globality/locality: These characteristics of CS4.0 flow from its previous properties, which are mobility and stationarity. Travelling along the network, the digital visualizations of the campus and its textual content make the campus recognizable throughout the world, and CS4.0 becomes global as a place [32]. The extent of notability of CS4.0 shows its globalization and the level of formation of a university brand as a whole. This global reputation is as important for the university as are the intellectual products that the university produces. The globality of CS4.0 is conditioned, not only by the high level of its digitalization, but also by its openness to the global culture, and is achieved through the production of suitable cultural content. The locality of CS4.0 is its linkage to a certain geographical location that has its natural, social, economic, and cultural features. This is the ability of CS4.0 to keep its original national and regional cultural identities that exist as the space containing the unique cultural objects.

Innovativeness/traditionality are the multi-aspect properties of CS4.0. According to Schumpeter [73], innovations, together with creative destruction, are the basic driving forces of prosperity and progress. Innovativeness of CS4.0 is manifested as follows: being equipped with the newest technologies of the 4IR (Internet of Things/IoT, in particular), making significant changes in research and education, creating conditions for generating innovative ideas, and producing and implementing the innovations to the university ecosystem (including disruptive innovations [8, 74], as well as creating the new values, new social capital, and new elements of cultural identity. The innovativeness of the campus is also reflected through the fundamentally new architectural decisions. This property of CS4.0 largely determines the competitiveness of the university on the global educational market. The traditionalism of CS4.0 lies in preserving the classical academic values and the core of cultural identity of the university; maintaining the standards (educational, scientific, and management); using existing social capital; and preserving the architectural elements and artifacts connected with the history of the university.

The Management Aspect

The management core of the (sub)system of CS4.0, which is also the core for controlling the whole classical university as a (super)system, has two main parameters:

shared governance and run-change-disrupt. These parameters are based on: the premises of the systems approach and complexity theory, with the focus on the values, as well as on Y theory [75]; theories of structural power in organizations and delegation of authority [76]; the concepts of shared governance [26]; disruptive innovations [8]; and the run-change-disrupt three-modus management model [77].

A classical university is an organization in which most of the staff members are by definition highly intellectual, hardworking, and creative people; they are able to be responsible, work in teams, and conduct self-monitoring. This means that the management style should be based on trust in the staff members, giving them freedom in their professional activity and using their creative potential, as well as on the decentralization of power and on other principles related to the theories by McGregor [75] and Kanter [76], as well as on the model of shared governance.

CS4.0 is the common communicative space, which, by virtue of the diversity of its infrastructure and the systems characteristics discussed above, has great opportunities, not only for implementing the shared governance model in any student and professor activities, but for their extensive unlimited communication based on common shared values to constantly improve this model [25, 66]. Applying the shared governance model ensures horizontal connections within the university community and the diversity of its spatial practice leading to the diversity of representations of CS4.0 as the lived space [13]. Thanks to this parameter of management, the CS4.0 (sub)system is able to undertake a great number of managerial functions when organizing different kinds of students and staff activities and communications, increasing in this way the diversity of possible states of the university (super)system. The latter is one of the indispensable conditions for its evolution from the point of view of complexity theory.

The three-modus system run-change – disrupt [77–79] is the second important parameter for managing CS4.0, in which the successful transformation of CS4.0 and the university as a whole occurs in the digital era. In certain situations in the academic environment, the run modus supports the traditional vertical connections (manager-subordinate), as well as the classical basic university structures (faculties, departments, scientific schools, and student groups), the processes (for example, fundamental scientific research, online and offline education), standards (educational and scientific), traditions (student initiation ceremony or handing the academic robes), and end-values (Humboldt-type). Thus, this modus sustains the university (super)system and the CS4.0 (sub)system in the state of relative rest. It maintains their closedness, keeping the original cultural identity.

The change modus, managing soft changes [53], is responsible for the constant modernization of CS4.0 and of the university within the existing cultural value and technological paradigms. Changes that do not destroy, but complement and modernize the existing practice, can be introducing the new format of education (project-type, remote, or flipped classroom); creating new transdisciplinary research and educational structures,

learning start-ups, and social spaces; transition to the new working schedule (for example, all-night library halls); and creating new traditions and developing values [66]. The change modus is like a testing laboratory for spot testing of new educational, research, and other instruments using disruptive technologies (VR, AR, MR, VLE, AI, and IoT). The change modus is responsible for the openness of CS4.0 and information and energy exchange with other systems and is able to take CS4.0 to the edge of chaos as the most productive state.

The disrupt modus leads the CS4.0 (sub)system and the university (super)system over the borders of the well-established paradigm through the systemic use of disruptive technologies (VR, AR, MR, VLE, AI, IoT, and others) [38], breaking down the traditional basic structures, processes, programs, standards, and values to their foundations and replacing them with the fundamentally new ones [80, 81]. For example, disruptive Ph.D. programs [82] can become a fully personalized (adaptable) environment [83]. The disrupt modus is the modus of radical changes (or changes of the second level) that can lead to the formation of the new identity of the university within the new cultural, value, and technological paradigm. This is connected to the highest risk of taking CS4.0, as well as the classical university as a whole, to the state of irreversible chaos, destroying the university identity. Therefore, this modus cannot be applied to multiple elements and layers of CS4.0 at the same time.

Run-change-disrupt is the model of simultaneous coexistence of three management cultures [77, 84]. This model allows the use of the features and potential of the university staff and students of different types, ranging from those who believe in traditional academic values to audacious innovators who are striving for radical changes.

We state that the two management parameters of CS4.0 (shared governance and run-change-disrupt), together with its hybrid ontology and the systems properties (universal, substantive, and ambivalent), are the main conditions for campus space to become the driver of transformation for a classical university in the digital era—transformation without destroying the university's cultural identity and not touching the academic values of the classical university with its long history, but serving the interests of all the groups of the university community. Hence, the art of managing the (sub)system of CS4.0, and the university (super)system as a whole, is largely defined by the combination of these two management parameters (shared governance and run-change-disrupt) at each period of time and at each particular level of functioning of the (sub)system. The subtle alliance of these two parameters will contribute to balancing introducing innovations to the campus, on one hand, and preserving the classical traditions and values on the other, as well as to the planned management space and the interests of different groups of the university community.

The three aspects of the conceptual model of the campus (ontological, systemic, and managerial) describe CS4.0 as the agent of change or as a strange attractor for the university (super)system. The agent of

change represents a quasi-steady (relatively balanced) state (or stage of development) of the campus, characterized by certain ontological, social, cultural, technological, and other parameters, defining the vector and the dynamics of the classical university transformation in the digital era at the beginning of the Fourth Industrial Revolution.

Conclusion

How radical is our vision of the campus of the classical university that has begun its transformations in the digital era? We have developed a conceptual model that is not restricted by understanding the campus only as an architectural and infrastructural complex that is intended to ensure comfortable conditions for students and to maintain the image of a modern innovational university. As a complex social and technological system, the campus needs different types of descriptions and self-descriptions.

Our conceptual model describes campus characteristics and management which combination makes the campus the agent of change of a classical university as a whole, placing it into the orbit of the 4IR without destroying the value core of its cultural identity and the balance of interests of all groups of the academic community.

This interdisciplinary research can make a theoretical contribution to studying the management processes connected with university transformations in the digital era at the beginning of the 4IR. Its main novelty is:

- discovering the special features of the hybrid ontology of the CS4.0;
- defining the combined systems status of CS4.0 as a university (sub)system and as part of the university external environment, as well as on a closed and open system;
- describing the systems properties of CS4.0 of three types: universal, for all the complex systems, substantive (mono)properties, and substantive paired ambivalent properties;

– interpreting the management core of CS4.0 as a combination of two basic management parameters: shared governance and run–change–disrupt;

– establishing the possibility of preserving the value core of cultural identity of a classical university in an age of changing technological paradigms, maintaining the balance between the traditional processes and structures as well as on the soft changes and disruptive innovations and between the conceived space of the campus 4.0 and the interests and potentials of all the groups of the academic community.

The practical importance of our research is that, because the pace of digitalization, as a process of system change, is different for different classical universities, the analysis of the current state of their campuses through the lens of this conceptual model CS4.0 can be key to a general understanding whether this process is successful and whether the state of their campuses is quasi-stable or at the edge of chaos. This conceptual model can help create the rankings of campuses of classical universities that have accepted the challenges of the digital era and the 4IR and have begun these transformations.

We hope that this research will contribute to the scientific discussion of other conceptual models of the campus of a classical university and the principles of its management in the digital age.

Note

We began this research in “peacetime” and finished during the pandemic of COVID-19. We consider that the cardinal changes in higher education that are connected to the pandemic are making this research even more relevant. Understanding the CS4.0 hybrid ontology, its system status, and substantive properties and principles of its management is important for the success of hybrid or blended learning that will probably become ubiquitous.

Besides, even in the time of pandemics and lockdowns, the network structure makes CS4.0 the uninterrupted field of presence and space of flows for all of its inhabitants and users.

Notes

¹ The 4.0 code means that the space is inherent to the 4IR.

² This ambivalence, as mutual implicitness, conditions the further use of the terms “(sub)system” for CS4.0 and “(super) system” for a university as a whole.

³ For example, celebration of the date of the university foundation; the university anthem; some special traditions.

⁴ Search for truth, unity of teaching and research, and academic freedom.

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The authors declare no conflicts of interests.

*The article was submitted 01.04.2022;
approved after reviewing 20.04.2022; accepted for publication 29.04.2022.*