

## LOGISTIC ARCHITECTURE AS NEW METHODOLOGICAL AND THEORETICAL CONSTRUCT

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**Abstract.** *The primary discussion of spatial organization that includes the analysis of the impact of logistics processes on flexibility, the transformability of spatial solutions and the transparency of space, has not been able to provide the theoretical and methodological interpretation of their spatio-temporal flow. This paper will point out the modalities of 'logistic architecture' production that break the design process tradition, as it turned out as unable to support creativity-based modes of reception of architectural ideas. The introduction of the 'logistic architecture' concept announces a new methodological and theoretical approach to the spatial syntheses of different processes in a building, aimed at achieving optimal spatio-temporal conditioning by the logistics system in relation to the use of creative strategy, as a part of the urban renovation. As my research field, this research observed the comparative flow of produced vehicles from the factory end line to the multi-story parking structures within two factories: Fiat Factory in Kragujevac, Serbia and Volkswagen Transparent Factory in Dresden, Germany.*

**Key words:** *logistic architecture, spatial organization, intralogistics system, comparative method*

### 1. INTRODUCTION

Current trends in architectural design, especially office building design, set very important requirements for the construction of parking garages, because commonly the buildings of great height are placed in a proportionally small plot and require a large number of parking spaces that cannot be placed in an open area of the parcel. Since the multi-story parking structure was built for temporary purposes and for the purpose of vehicle sales in a new factory Volkswagen (VW) in Dresden (the Gläserne Manufaktur), there has been an overall increase in the number of client visits to the factory complex. Clients have seen an advantage in this system because they could inspect the exhibited cars and take over a new car within the factory site. The observed trend has shown that there is a need to research a wider impact the new logistics system has on linking the

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automobile manufacturing with parking vehicles, in relation to the architectural parameters and impact achieved in the environment.

On a broader scale, the observed trend is reflected in the culture of consumerism, which finds a prominent place in the company's strategy to mediate between the creativity of the architect, basic technological requirements of the manufacturing process and local strategies of urban development. Beyond this issue, there is a specific context around the consumer apparatus which, followed by the current trend of online shopping, dramatically extends the expectations and demands of the client. Therefore, in the 'real world' expectations are reflected in looking for multiple options such as those in the virtual world. In this process of transformation, the most important concerns are: the relationships between manufacturing, consumption and transparency.

Accordingly, the manner in which these manifestations of the mentioned relations will participate in shaping architecture and urban space depends on the problematization of contemporary cultural context. This is in accordance with the widespread belief set by Charles Landry. He stated that culture, "as a way of addressing problems, seemed like a process of discovering and then enabling potential to unfold", where the term creativity denotes a special form of creativity in addressing the given problem and unique response required in the observed situation. Likewise, it presumes "the method of exploiting these resources and helping them grow" [1], where different forms of creativity are expected from different types of strategies.

So far, the impact of logistics processes on flexibility, the transformability of spatial solutions and the transparency of space, has not been able to provide the theoretical and methodological interpretation of their spatio-temporal flow. In the primary discussion of the spatial organization, in order to introduce new architectural strategies, firstly, key influential parameters that modify the established relationships between manufacturing, consumption and transparency have to be defined. In the research the comparative flow of produced vehicles from the factory end line to the multi-story parking structures within two factories will be addressed: the Fiat Factory in Kragujevac, Serbia and the Volkswagen Transparent Factory in Dresden, Germany. From this process, an optimal spatio-temporal conditioning by the logistics system in relation to the use of creative strategy, was attempted, as a part of the urban renovation.

Traditional design process involves the work of architects alone on the basis of the technological demands of motion and car parking and complete logistics solution. In the essence of logistics, a whole car manufacturing process, a progressive assembly, must be treated first. Manufacturing involves several stages: manufacture of car bodies, engine assembly, painting, installing car interior, final work on the vehicle, final cleaning and polishing of cars and the delivery of a car to the storage area for the purpose of temporary parking. Storage space is the sensitive area which, in addition to the transportation and handling demands characteristic of the previous phases, covers a wider treatment of spatio-temporal parameters in relation to external storage parameters. Requirements regarding the characteristics of the car storage area are different in terms of size and capacity. The parameters that change during the commission are: delivery time, storage time, as well as vehicle occupation area.

In the current conditions of the Fiat factory in Kragujevac, the storage for manufactured vehicles has been placed in the open parking area for more than 60 years. This inherited condition from the Zastava Automobili factory has a fair number of negative consequences

due to: the large areas of land occupation, moving trajectories of vehicles within the factory area, the risk of damage and theft, etc. On the other hand, in the case of "transparent" Volkswagen car factory in Dresden, new technological solution has a number of benefits: high levels of safety, less land occupation, simple mechanized system of the parking garage, parking positioned close to the final stage of production, the exclusion of theft, mechanical damage or fire, there is no car moving until the moment of delivery, etc. Moreover, an extra quality is the overlap of activities, the transparency of the production process in its final stage (in one part the storage serves also as a gallery), the consideration of user on-site demands and, most importantly, a complete automation of delivery and pick up service is enabled by using the management informational system of pillar cranes. It has only been four years since this system was integrated in the mechanized storage that recorded a high growth of visits to the factory premises.

## 2. DESIGN REQUIREMENTS AT MULTI-STORY PARKING STRUCTURES

The possibilities of recomposing the existing spatial relations within the factory complex aim to enable the potential synthesis of architecture and logistics, which has not been examined in scientific terms so far. The work contents are typically: car delivery to the storage area and client presentations service, networking and the segregation of trajectories for moving manufactured vehicles, employees and visitors, which are to be solved between the inherited and new architectural structure. In accordance with the stratification demonstrated through the demands, this aspect was identified as an opportunity to re-examine and re-compose the following trajectories:

- A place with the level of original and deep knowledge coupled with new demands - a capacity to communicate in line the buyer-the seller. Demands: attractivity and transparency.
- To have a sound financial basis in relation to the storage capacity. Demands: the flexibility of system due to seasonal variability of storage capacity and handling of short-term capacity requirements.
- Imbalance between business people, artists, the perceived needs of decision-makers, technologists and actual opportunities.
- Where the capacity exists to deal with the complexity and uncertainty about future changes and reflect the current and future needs of clients.
- The prevention of structural instability of the whole process within a controlled context.

The effective compliance of all stages of the car manufacturing process in a controlled context was not recognized in the Fiat factory in Kragujevac. The paper argues that new methods can be designed to overcome this deficiency, and they should be sought in the wider spatial context rather than focusing solely on processes and logistics. The problem of current open space conditions which are labeled inappropriate for efficient ways of storing, was bridged through the conveniences of a multi-story parking structure. The justification of these multi-story solutions is the implementation of the moving trajectories of clients where they can participate directly at the final stage of the car manufacturing process. In respect of architectural design process, this procedure actively involves logistics engineers for the purpose of solving architectural issues. Therefore, the methodological intervention, the introduction of *logistic architecture*, is emerging as an essential element of the future

design methodology. The neologism *logistic architecture* denotes a new concept of logistic function characterized by: the concentration of labor and logistic activities, the synthesis of various processes and factory equipment in the facility while predicting their levels of compliance in relation to the observed parameters, the integration of technical, informational and the automated management functions, optimal operational and dispositional layout and the distribution of cars. A need for the harmonization of spatial parameters between the old and new architectural structure inevitably puts forth the attitudes of designers toward the urban environment and incorporates a multifunctional structure of the whole factory complex into analysis.

New logistics solution for use in storages depends on the location that the factory occupies in the city and is adapted to satisfy variable capacity requirements, which are often seasonally determined at an economically feasible cost. In order to handle short-term capacity of dynamic storage requirements, circular spatial configuration is considered and vertical storage organization was implemented. Storage systems within the intralogistics have a special significance in terms of activities, not only considering the fulfillment of various technological requirements in the final stage of car finishing, but also because of differences in equipment and the car handling technology [2]. In order to constantly maintain the basic level of capacity requirement and provide the necessary modernization of manufacturing, former conventional approach to the segregation of activities has been replaced by new customer service model. Dealing integrally with spatial configurations imposed specific demands and announced a client access in managing the process of finishing. This way, the basis for their future strategic implementation was provided. In this context, storage activities are heterogeneous and dynamic and the operating procedure presents a special visual attraction. It also features some degree of transparency, which can be an incentive for the launch of new investments for the purpose of engaging the toolbox of urban renovation of the entire factory complex. Since visitors can see and participate in the final stage of automobile manufacture, the proposed creative strategy of architecture presents an opportunity to recognize and achieve the potential of "creative" problem solving.

The implementation of "creative" problem solving in the multi-story storage system is likely to include the initiation of the following actions: (1) to reflect on how to add value to location, (2) to create innovation, and (3) to increase an overall urban quality. Performing these actions is important in order to encourage place-making and the storage design that assures an effective property management, including a reduction in the use of existing land around the Fiat factory in Kragujevac. Storing cars outdoors affects significant losses and presents serious technological problem, because after leaving the production hall, security conditions were not provided. In order to overcome the above deficiencies, logistics is understood crucial in closing and ensuring the entire system of manufacturing [3]. In addition to confirming that there is no financial loss, the key points of manufacturing process would impact to close-circuit the operations: the degree of harmonization of various functions in the area, the circulation of people and means securing the manufacturing operation, and the places of incidents. The entire analysis should point at the possibilities of providing new solutions, primarily their flexibility and transformability, noticeably improved by the quality of time that is consistent with the logistics processes. Based on the listed requirements, it was hypothesized that the role of logistics is important in enhancing the flexibility and transparency of the storage space and exhibition spaces, including the innovation and urban quality developed in the context of a mixed-use space and a completely new theatre effect.

### 3. ARCHITECTURE AND URBAN CONTEXT OF THE NEW TYPE OF PARKING GARAGE

The complex of Zastava Automobili, the Fiat factory today, has been integrated in the industrial zone located in the center of Kragujevac and became one of the oldest preserved urban industrial landscapes in this part of Europe. Its prominent position in the city and the popularization of the whole area by turning it into incubators for public activities, enabled the urban potential to unfold. In the context of developing creative methods to design the Fiat factory complex, the challenge for architects was to spatially connect different processes and activities. Planned activities in the old preserved urban industrial landscape directly rely on the rest of the Fiat factory site where the production is carried out today.

In that sense, a complete transformation from horizontal to vertical automobile storage configuration (Fig. 1), as part of the end production line moving from the production hall to the multi-story parking structure, anticipates certain technical conditionality. Storage spaces allows for such logistics solution whereby the entire infrastructure needs different spatial settings. The positive principle is based on a possibility to overlap functions for more efficient sales. The act of combining various functions within the project of industrial block renovation presents the strategic framework for the introduction of new methodological and theoretical approaches to the architectural design. Despite being largely under-explored field of successfully developed creative strategies in the public sphere, which directly influence new methodological and theoretical approaches to design, individual cases have shown that under certain circumstances (public-private partnership, creation of a commercial wing to recycle profit) they can address urban complexities and turn out the general criteria of success [4]. This type of design methodology does not only anticipate the issue of form characteristic to architectural practice, but creatively engage design together with engineers from other professions who work together to manage the series of conditionalities. In this way, the proposal of creative urban strategy involves a special form of creativity as a response to the given problem solving and uniqueness of responses that are required in the given situation. The present case deals with the manifestation of architectural components in the proposed multipurpose architectural solution, which is reflected through their spatial-temporal dependence on the logistics system. In the transparent storing system, the gallery user is able to propose onsite new combinations and subtleties in car design in terms of fabric, leather, veneer, paint, etc.; materials can be seen and touched instead of relying on the catalog. It also allows the user to observe the final finishing. In that regard, the Fiat factory is running this particular strategy as well, which is reflected in establishing distinctive cultural entity of the enterprise [5]. This process is now being visible on several levels: from making specific design solutions, symbols, and finally affecting the image of the city through the textured layers of history labeling frozen automotive traditions back in the 1950s.

Moreover, vertical parking lot for storing finished cars, delivered directly from the adjacent manufacturing plant to the tower basement, can be declared a "branding device" paradigm in the city – making. Planning a landmark building and integrating multipurpose space associated with the scenic affect of tower configuration – the site of a festive light display and film screenings on the surface of the façade – promotes an increase of urban quality, Fig. 1. "Branding device" principle focuses largely on visitors' attractions by providing: (1) **the visual strategy of "gaze"**, derived from the simulations of visual continuity presenting past and future city developments (fictive projection image that reflects

the company's new identity); (2) **the strategy of “multipurpose“**, by introducing an interactive environment for visitors to virtually test a drive (with motion base technology and computer generated scenery), a computer-based car configurator that enables visitors to design the cars, and a media-enhanced delivery experience for customers taking possession of new vehicles.



Parking garage in VW Dresden Factory, Architekten, 2000



The garage of Marina City towers, architect HENN Bertrand Goldberg, Chicago, Illinois 1964

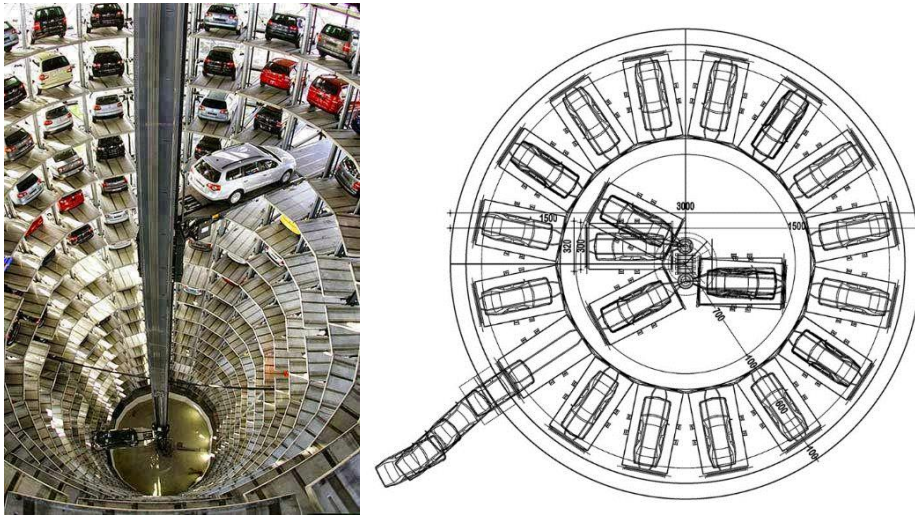
**Fig. 1** Example of parking garages – vertical configuration

(Sources: photo 1: <http://www.alamy.com/stock-photo/glaserne-manufaktur-volkswagen-transparent-car.html>, accessed October 2016; photo 2: Katarina Andjelković, taken in Chicago 2016)

In our case, *branding* as urban strategy pleaded primarily for representing the prosperity of automotive industry to become a metaphor for the visual and spatial identities of the city. This strategy is in direct contradiction with the existing system of car storing characteristic to the horizontal configuration, which is not visually accessible to citizens and visitors apart from the "bird-eye" perspective. If the production unit, the car, stands as a metaphor at the juncture of consumerism and identity, we can identify the fundamental values of this connection from Benjamin's review on the integration of commodity in the image of the city, as the central aspect of modernity that caused the discussion of spatial and architectural configurations, thenceforth today. Verily, Benjamin's analytical problematization of the theoretical sphere of commodities as the central aspect of modernity largely influenced the theoretization of spatial and architectural configurations, from the modern period to the present. As Anne Friedberg provided a more precise connection throughout this period to the present day intellectual settings, let us introduce the concept she proposed. Anne has set significant parallels between the consumer gaze and the intrusion of display

windows into building facades [6]. Her research includes one of the most important aspects of directing spectator's attention to the visual aspect of the urban environment, for which she claims to be determined by the new attitude towards the role of goods in the image of the city. In our case, the client involvement in the concept of visual attraction was designed to support building culture in terms of a continual visual perception built on the street level, and addresses the issues of building design. Friedberg's conclusion is based on a visual registry and the predominance of the visual in capitalist society, and seems directly affected by visual manifestations of this phenomenon in architecture. Accordingly, from the theoretical perspective, Anne has demonstrated that the commodity experience can become a positive principle of urban development by engaging the theme of the mobilized gaze of the shopper and the power of the visual in the configurations of architectural design. By applying different strategies of urban development, the strategy of reviving gaze in the urban space practically promotes creative urban strategies in recent decades [7]. Practical transition from the aforementioned thesis to a contemporary urban design solution is positioned on the threshold between the context of increased flexibility and transparency of the storage and exhibition spaces, and pleading for innovation and urban quality of the area. Under that influence, the assessment of urban strategy was executed in relation to two aspects: (1) architectural configurations: the visual strategy of the "gaze" and "multipurpose", (2) the apparatus of *logistic architecture* or an industrial syndrome. I believe that this would allow me to formulate architectural interventions that are at the same time visionary and pragmatic. In order to create innovation and contribute the overall urban quality, on the occasion of the factory complex renovation it is necessary to include both architectural and logistics into analysis. This way, the problematization of logistics is approached through the corresponding lines of enquiry, considering the representation of the end production line to the multi-story storage trajectory, architectural configurations and a toolkit for creative renovation of the complex. Finally, I conclude that the implementation of the construct I call *logistic architecture* aims to re-compose a direct connection between architecture and the logistics support to developing activities, as well as to organize spatial configurations that anticipate the permeation of mix-used spaces. It can be regarded as an expanded form of institutional critique but something crucial changes in the management of the enterprises worldwide, which is: celebrating distinctiveness of the particular enterprise in a homogenizing world.

Finally, the question was asked "how to measure and propose creative strategy within the urban renovation of the factory block"? Perhaps the most important analytical tool at this stage of the research is to assess a successful creative strategy. It would provide an overview of all inventive projects in the city or district and assess the potential to get ideas or projects implemented, so that the demanded synthesis of activities is generated. This would lead us to assess whether the factory block is a creative milieu or has the potential to be one. In this process of analysis, the proposed creative strategy is concerned less with implementing imaginative projects than with finding creative ways to pursue the proposed idea to the realization stage of the process. For the purpose of this research, movement, flexibility and transparency, and elevation, were taken as key factors to a successful creative strategy, as results need to be seen. Although landmark projects are not always the most effective regenerators, the resulting analysis of the Dresden factory landmark configuration has shown new confident and highly competent methods for future strategies.



**Fig. 2** Garage plan within the factory Volkswagen in Dresden

(Sources: Photo on the left: <https://www.pinterest.com/pin/>, accessed October 2016; drawing on the right: Katarina Andjelković, 2015)

Namely, observation of the impact that vertical storage system in Dresden has on its city district revealed far more impact in long-term period than it was predicted in the studies that preceded the drafting of the parking garage in Dresden (pilot project and the environmental impact assessment). Developing successful creative strategy in industrial settings manifests itself as the objectives of the manufacturing and storage processes, which are, except for the achievement of the basic technical requirements, equipment and technology at work, connected and harmonized with the users' growing demands. This way, adoption of these strategies can contribute to an additional value of both logistics, architecture and functionalities of the complex, Fig. 1.

#### 4. PLANNING APPROACHES IN PARKING GARAGE DESIGN: CRITICAL SUCCESS FACTORS IN CREATIVE STRATEGY

The basic premise of this research set the importance to the role of logistics in enhancing the flexibility and transparency of the storage and exhibition space along with creation of innovation and urban quality. In order to frame potential future trajectories, the design propositions projected the common issues between architecture and logistics – **the notions of flexibility and transparency** – to be examined in detail from the perspective of architectural approach. In that sense, the basic issues of the parking garage design address the car motion in limited areas with the required maximum capacity of parking and visual accessibility. Historical turn in the development of the parking garage design is reflected in the transformation from an open to a closed parking garage system, and the transformation that occurred in the vertical and horizontal motions – ramp system, Fig. 3.





Miami Parking Garage. Robert Law Weed and Associates, Miami, FL. 1949.

Marina City. Bertrand Goldberg. 1964  
Chicago, Illinois, the USA

**Fig. 3** Classic parking garages with ramps

(Sources: photo 1: <http://www.archdaily.com/333251/ezra-stoller-beyond-architecture>, accessed October 2016; photo 2: Katarina Andjelković, taken in Chicago 2016)

The functions of automatic motion control and parking vehicles in the garage without crew is implemented primarily due to the economic and spatial conditions. Such an approach is essential for the development of both public and industrial garages during the 20<sup>th</sup> century, while achieving the highest density becomes a dominant parameter for the garage design and conditions its basic types. The most important requirements that mandate the selection of architectural typology for the purposes of this research are: the accumulation of vehicles, time occupation and area available per car, all of which condition vertical transport either by ramp or elevator. The problematization of the aforementioned technical conditions emerges through the polemics that they deeply influence the design of the buildings. Attempting to integrate garages into the architecture of the city, it can be concluded there is certainly more than one influential parameter to the design, which is evidenced in architectural tendencies of the corresponding period throughout the 20<sup>th</sup> century. There are several examples to indicate this situation (Fig. 1, Fig. 3). Following a way to the critical success factors in creative strategy, three abstract concepts were analyzed:

- a) movement,
- b) flexibility and transparency,
- c) elevation.

They form basis for the implementation and execution of the comparative method applied to the study of parking in the Fiat Kragujevac and the VW Dresden. They are all preceded by the discussion about change in developing the parking garage's spatial framework. This quite pedagogical approach helped in recognizing the corresponding garage concepts in articulating spaces:

- a) The study of “**movement**“ focuses primarily on the system of ramps and elevators and their integration into the stationary surfaces of the building. Recent study of their application in the garage system was provided by [8]. She covers the evolving early designs and notes a strong competence between the ramp-based garage and elevator-based garage. In her research, she also emphasizes that the latter has an advantage of moving vehicles to floors and arranging them in an optimal manner, so as to maximize the number of vehicles parked. In terms of architectural and urban quality considered, the notion of movement embraces dynamic potential of a garage, the overlapping of activities, the semiotics of movement and rhythm. As praxis and discipline, architecture has always represented the socially sanctioned forms of representation and construction of knowledge, which is conceived as a way to establish and organize the categorical order of reality. We are acquainted with Le Corbusier’s method to be the metaphor for the flexibility of architectural plan, considering the articulation of juxtaposed activities towards the creation of a new order of reality. In the wider context, these functionally-topological transformations paved the way throughout the 20<sup>th</sup> century as the paradigm of all future creative architectural strategies. For example, the Fiat Lingotto Factory Garage in Torino by young architect Matté Trucco sublimed a truth of the original meaning of the ramp set in Le Corbusier’s architectural treatment of *plan libre* [9]. Accordingly, the parking of vehicles which is, as in this case, planned as a multiple condominium garage by system of landing vehicles via ramps (Fig. 4), has achieved a multiple flexibility in the context of spatial configurations. Coming from Le Corbusier’s five points of architecture [10], identified issues on spatial configurations necessary point to fulfill the requirement of *plan libre*. Following Le Corbusier’s position, the architect performed adaptation of the plan to the turning circle and parking of vehicles, by employing the structural potential of the garage in relation to the notion of movement. He uses a track for car testing created on the factory rooftop to make his point, Fig. 4.



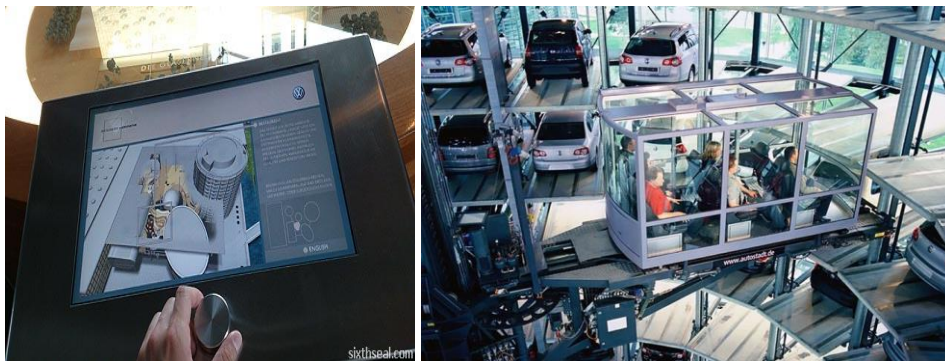
**Fig. 4** Fiat Lingotto Factory, architect Matté Trucco, Torino, 1923.  
(Source: <https://www.pinterest.com/pin/>, accessed October 2016)

- b) The study of “**flexibility and transparency**” was provided by [11], who outlines a three-phase history of parking garages: a protean phase where prophetic notions emerge from earlier forms like a stable; a minimalist, post-war classic phase that leads to the present moment; a baroque phase characterized by either technique or a striving “delirious in its search to create new forms“. This architectural timeline is closely bound up with the growing integration of garages not only physically but also into architectural tendencies of the period, and responding to cultural and technological change. The case of minimalist Miami Parking Garage, designed by Robert Law Weed and Associates (1949, Fig. 3), demonstrated a way to directly connect the urban form of cityscape, the intralogistics of parking and defined the boundaries of the object. The paradigmatic example of minimally expressed architectural values with a fully liberated ground zone of public spaces, democratizes the temporal overlap of activities and expresses a remarkable tendency to a complete transparency of the parking garage. This way, an insight into the positive sides of the transparency manifested through the creative design of the VW Factory Dresden was provided, and will remain to this day a dominant parameter of attractiveness in designing generally.
- c) The study of “**elevation**” focuses primarily on the mash up of ramps and vertical infrastructure as form of symphonic resolution. Throughout the modern period garages were excluded from the city and their managing meet different architectural, urban and logistic demands from the postmodern garages, which are a fully integrated organ in the body of the city. Accordingly, the modern culture of using public spaces, moving through the building and observing the collection of Guggenheim Museum (Frank Lloyd Wright, 1959) is planed as the continuation of the city grid with continuous spaces flowing freely one into another and into the spiral. It seems that architectural concept, once made for the purpose of convenient use of public space, stimulates the relationships between the works that are exhibited and integrating the city narrative into the cultural institution. Incorporated in the city center, the demand to sustain a continuation of street into the building structure reflects in one of the first non-enclosed parking garages ever incorporated into the design of a residential high-rise, Marina City Towers (Fig. 1, Fig. 3) in Chicago. The practice of incorporating a spiral parking garage from the street level to the first nineteen floors, flowing into the residential area, has resulted in an ability to articulate a fictional “garage” narrative and spatialize movements introduced from the street. As a consequence, it started revealing its urban qualities and thus interfering the cityscape “as part of urban creativity” indicated in *Creative City* [12]. Along with Simon Henley’s remarks in her *The Architecture of Parking*, these observations affirm the garage strategy of VW Dresden to aspire the creative approach to landmark architecture and fully integrate Fiat Kragujevac into the city.

##### 5. COMPARATIVE METHOD IN THE STUDY OF PARKING GARAGES IN FIAT KRAGUJEVAC AND VW DRESDEN

Standard systems of industrial garages are based on the concept of a test driver who operates cars from the end of a factory production line to the parking area, moves vehicles within the parking area and dispatches cars from the garage. In this way, he is conducting

significant maneuvering operations of movements, which is the most common mode of parking vehicles in the Fiat Automobili factory in Kragujevac. A typical parking system requires large areas of urban space, which are three to four times larger than the area occupied by cars at a standstill (25-33 m<sup>2</sup> considering 8 m<sup>2</sup> per parked vehicle). Regarding mechanical garages, there are no significant operations of maneuvering cars, the movement of vehicles with the engine running is reduced to a minimum and only to the front of the parking module. Vertical transportation to the place of destination is provided by an elevator, located inside the tower, from there, they are lifted into position via mechanical arms (a completely centralized WMS) that rotate and run along a central beam, moving vehicles in and out of their places at a speed of two meters per second, Fig. 5, left. Picking up vehicles operates in the reverse order. Parking system in VW Dresden is very flexible and allows for complete transparency of parking places, to provide the overview of each vehicle (and through the garage) to the potential customers and tourists, Fig. 5, right. By selecting the pillar crane system, which is very easy to use, the execution time of manipulating vehicles was precisely defined, which results in a relatively limited garage capacity. During the review of vehicles in the garage, the direction of lifting and positioning the car is achieved from the booth for the remote control and / or central WMS.



**Fig. 5** The interior of the parking garage in Dresden with control desk

(Sources: photo 1: [www.sixthseal.com](http://www.sixthseal.com), accessed October 2016; photo 2: <http://www.designboom.com/technology/volkswagen-parking-lot-towers-at-autostadt/>, accessed October 2016)

Unlike conventional garages, there are spatial and economical motives for designing mechanical garages [13]:

- it reduces the required unit area by exclusion (or reduction) of the area for car access to the parking places,
- it reduces the required unit area by using mechanical systems for vertical transportation instead of ramps,
- it excludes the presence of individual users, eliminate the need for planning extra footpaths,
- it provides significant savings in equipment and operating costs (ventilation, lighting, signalling, etc.)
- it provides horizontal and vertical displacement of cars mechanically by elevator without using car engine, no chimney, no emissions of harmful substances and

waste materials, no additional maneuvering, no noise, no breaks in the manufacturing process, which inspire all users to maintain order and cleanliness in the plant,

- the electronic control of vehicles is fully implemented, serving to set the vehicle to the desired position etc.

The VW Dresden, due to its multiple effects, has been released from additional work activities, directing and using its energy to the development of other technologies and new products. The VW architectural design allows customers to focus on the performance of the car, which creates additional value of the vehicle, a better knowledge in the use of cars, better integration into the urban interior, and perhaps most importantly, the method for motivating employees contributed considerably both within the plant and beyond.

## 6. CONCLUSION

This paper presented not only a macro-level view of what is necessary to take into consideration in the design and function of car garages, but precise and specific micro-level suggestions and requirements for optimal design. From contemporary architectural and urban design perspective, the garage is often designed as a monolithic structure and rarely offered more than basic aesthetic value. However, the expansion of a city affects the way we think about the roles and functions of the garage.

The main disadvantages of mechanical garages are their relatively time-consuming operations and they are, as a rule, applied in the long-term model of parking garages made for special purposes, or for known users (employees, residents, etc.). The introduction of automation and the improvement of electro-mechanical equipment facilitates in overcoming these disadvantages, and with increasing spatial and environmental issues in the cities, should we expect their increased use in the future. The impact of creative technology solutions on the capacities within the logistics processes is possible to measure by overlapping different functions in time, the area of utilization and static capacity, the number of stored vehicles, reducing the number of workers, etc.

There is no doubt that the role of logistics needs to be largely invested in increasing the flexibility and transparency of the storage and integrated exhibition spaces, followed by the creation of innovation and urban quality. This hypothesis was tested with regard to the existing system of parking vehicles within the VW factory, in a separate unit. To this unit I brought forth the other type of structure, which is connected and fully integrated both in the city and in the factory, and therefore plead for both architectural and urban qualities. For the purpose of this research, movement, flexibility, transparency, and elevation, were taken as key factors to a successful creative strategy, as results need to be seen in the harmonization of urban, architectural and logistics issues. Although the multi-story structures designed as a landmark project have not always turned out to be the most effective regenerators, the resulting analysis of the Dresden factory landmark configuration has shown new confident and highly competent methods for future strategies. It was confirmed that the logistics support can contribute significantly to providing a variety of spatial solutions. Moreover, with the inclusion of creative strategies as new approach to designing, this paper pointed out the modalities of *logistic architecture* that break the design process tradition.

Moreover, the additional value of mechanical garages is reflected in taking over and transporting vehicles faster, lifting and driving, thus increasing the degree of mechanization. The time required for parking or removal, further taking the vehicle which is positioned in

front of an open elevator, transporting to the free parking space, taking off and returning along a central beam, or removal of another vehicle, is measured in all systems to last at least one minute. In theory, this means that maximum capacity can be estimated at the rate of up to 60 vehicles per elevator/hour, which is much less than in conventional garages. Managing pillar crane through the approximately 48-meter tall silo can be either from the panoramic elevator cab or from the central point. The control facility is put into operation with the push of a particular button, which automatically manages all operations to position the cars or pick them up from or to the parking space. In any case, new solution can provide the maximum parking capacity in a relatively small area and is suitable for the implementation in both the industrial and public parking garages.

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5. In 1904, within the company, a section dedicated to automobiles is inaugurated. Beside repair services, certain car parts are also manufactured. In 1939 it begins assembling Chevrolet military trucks. After World War II, the plant was renamed *Zavodi Crvena Zastava* ("Red Flag Institutes"). In a referendum held on August 26, 1953, 96% of the employees of then *Zavodi Crvena Zastava* voiced their desire to produce automobiles. Source: [https://en.wikipedia.org/wiki/Fiat\\_Automobili\\_Srbija](https://en.wikipedia.org/wiki/Fiat_Automobili_Srbija).
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## LOGISTIČKA ARHITEKTURA KAO NOVI METODOLOŠKI I TEORIJSKI KONSTRUKT

*Primarna diskusija o prostornoj organizaciji koja obuhvata analizu uticaja logističkih procesa na fleksibilnost, transformabilnost prostornih rešenja i transparentnost prostora, nije bila u mogućnosti da pruži teorijsko i metodološko tumačenje njihovog prostorno-vremenskog toka. Ovaj rad će ukazati na modalitete postavke „logističke arhitekture“ koja prekida tradiciju procesa projektovanja zbog njene nemogućnosti da podrži režim kreativne recepcije arhitektonskih ideja. Uvođenje koncepta „logističke arhitekture“ najavljuje novi metodološki i teorijski pristup u viđenju prostorne sinteze različitih procesa u arhitektonskom objektu, sa ciljem da se postigne optimalna prostorno-vremenska uslovljenost logističkim sistemom, u pogledu na upotrebu kreativne strategije u sklopu urbane obnove. Oblast mog istraživanja biće komparacija proizvodne linije vozila iz završnog proizvodnog toka u fabrici ka višespratnom parking objektu. Biće upoređen slučaj u dve fabrike vozila: Fiat u Kragujevcu (Srbija) i Volkswagen Transparent u Drezdenu (Nemačka).*

*Ključne reči: logistička arhitektura, prostorna organizacija, intralogistički sistem, komparativni metod.*