NEUFERT'S *ARCHITECT'S DATA* HANDBOOK AND CONTEMPORARY COMPUTER DESIGN SOFTWARE

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„PODRĘCZNIK" NEUFERTA A WSPÓŁCZESNE PROGRAMY PROJEKTOWANIA KOMPUTEROWEGO

Abstract
Ernst Neufert's *Architect's Data*, published in 1936, is widely regarded as a masterpiece. At present, an architect's work is hard to imagine without this book. It is very popular in Europe, but not necessarily in demand in North America, mainly because of differences in units of measurement. Nevertheless, it is worth considering whether here, in Europe, it will still stay in unchanged but continuously extended form.
The basis of *Architect's Data* was an idea that manufacturing was cheaper than crafts and could solve social problems associated mainly with housing. The assumption, that all people have similar vital needs, created a new scientific discipline - ergonomics. Since then, new functions, which were systematized in simple order (ideograms), have been constantly created. Moreover new pieces of furniture, which dimensions were worth knowing, have been regularly added to *Architect's data*. At the same time *Architect's Data* has been expanded by elements that were disregarded by Neufert, for instance, some examples of particular architectural solutions or construction details.
It distorts the author's intention: (1) providing the simplest, yet unchangeable design algorithms that prevent architectural solutions from being copied. Those algorithms are based on ergonomics - the starting point in architectural design and culturally justified pieces of furniture, which were mass-produced. Basic functional and spatial schemas were supposed to be made from those ideograms. Some of various elements (2) were created, based on German building regulations (e.g. bathrooms, kitchens, bedrooms, dining rooms, auditorium, external and internal stairs). Later, those examples of particular buildings were added to the aforementioned Neufert's book. Recently it has been extended with certain construction details (3). Both of them were certainly added to the book against Neufert's idea.
With all the possibilities brought by current technologies, one may ask such questions: whether *Architect's Data* in current form is still needed, for how long it is going to be essential or whether we will find its better replacement in the future. Some circumstantial evidence can be found nowadays by looking closely at how BIM programs work. We can find objects' libraries there with dimensions that are established in advance. However, those dimensions can be changeable to some extent. In the past, *Architect's Data* was crucial to design a table with 8 chairs with proper spacing from one another. Nowadays entering several parameters into the program is enough. It means that we can compare *Architect's Data* to simple information algorithms or even roughly to the way parametric programs work. At this moment, we cannot use a computer program, for instance, to design the whole restaurant with a kitchen area and storage facilities only based on algorithms and parameters. A human being, an architect, is essential now. But no one knows for how long. As soon as artificial intelligence is sophisticated enough, it will be just enough to enter Neufert's guidelines to the computer program together with functional and spatial boundary conditions and the whole design will be done automatically. And what will be the role of an architect then?
A tool that is too efficient (e.g. computer) can foster convenience - we no longer analyze parameters of such a program, as it works after one „click". The introduction of „quantum" computers will intensify this process, which is expressed nowadays by parametrization of architecture. The tool's efficiency will keep separating a designer from the source of design - the humanistic idea, which provoked Neufert to create *Architect's Data*.
The following methods used in the work: intuitive, systematic review and meta-analysis of the primary source, which are the next editions of E. Neufert's *Architect's Data* and referring them to today's architect's working conditions. The result of the research is to find similarities between the „Handbook" and what modern work tools used for design offer.

Streszczenie
Ernst Neufert, wydając w 1936 r. *Podręcznik projektowania architektoniczno-budowlanego*, stworzył dzieło swojego życia. Obecnie nie sposób wyobrazić sobie pracy architekta bez korzystania z tej pozycji. Jednak choć ogromnie popularna w Europie, niekoniecznie jest rozchwytywana w USA – przede wszystkim ze względu na różnice w jednostkach. Warto się jednak zastanowić, czy i na naszym kontynencie pozycja ta będzie nadal istnieć w niezmienionej, choć cały czas rozszerzanej, formie.
Ideową bazą Podręcznika było założenie, że produkcja przemysłowa, tańsza niż rzemieślnicza, rozwiąże problemy społeczne związane głównie z mieszkalnictwem. Zakładano, że wszyscy ludzie mają podobne potrzeby bytowe, co w konsekwencji doprowadziło do utworzenia nowej nauki – ergonomii. Od tego czasu stale powstają jednak nowe funkcje, które warto usystematyzować w formie schematycznych rzutów-ideogramów, oraz nowe elementy wyposażenia, których wymiary warto znać, systematycznie do Podręcznika dodawane. Jednocześnie Podręcznik poszerzany jest o elementy przez Neuferta nieuwzględniane, czyli przykłady konkretnych rozwiązań architektonicznych i detale budowlane.
Wypacza to zamierzenie Autora, jakim było (1) dostarczenie najprostszych, ale niezmiennych algorytmów projektowych, które uniemożliwią naśladownictwo rozwiązań architektonicznych, gdyż bazują na ergonomii – punkcie wyjścia w projektowaniu architektonicznym – oraz kulturowo uzasadnionych przedmiotach/meblach z najbliższego otoczenia człowieka, które miały być produkowane masowo. Z tych elementów miały być budowane podstawowe schematy funkcjonalno-przestrzenne (2), wariantowo rozwiązywane w ramach ówczesnych niemieckich przepisów budowlanych (łazienki, kuchnie, sypialnie, jadalnie, audytoria, schody zewnętrzne i wewnętrzne itp.). Z czasem dołączono, jako przykładowe, rozwiązania konkretnych budynków, a ostatnio - z pewnością wbrew idei Neuferta - również konkretne detale budowlane (3).
W związku z możliwościami, jakie dają nowoczesne technologie, nasuwają się pytania o to, czy Podręcznik Neuferta w obecnej formie nadal jest i jak długo będzie potrzebny albo co zastąpi go w przyszłości. Przesłanki możemy znaleźć już dziś, przyglądając się temu, jak skonstruowane są programy typu BIM. Znajdują się w nich biblioteki obiektów, w których wymiary są z góry ustalone, ale w pewnym zakresie możemy je zmieniać. Kiedyś, aby wstawić stół z ośmioma miejscami siedzącymi w odpowiednich odległościach od siebie, potrzebne było przestudiowanie wytycznych z Podręcznika – obecnie wystarcza wpisanie kilku parametrów do programu. To zbliża Podręcznik do działania prostych algorytmów informatycznych i programów parametrycznych. W tej chwili nie poradzimy sobie z „zaprogramowaniem" np. całej restauracji z zapleczem kuchenno-magazynowym tylko na bazie algorytmów i parametrów. Do tego potrzebny jest obecnie człowiek-architekt, ale nie wiadomo na jak długo. Jeśli rozwinie się sztuczna inteligencja, po wprowadzeniu wytycznych Neuferta oraz warunków brzegowych funkcjonalno-przestrzennych do jej programu całość powinna „zaprojektować się sama". Do czego sprowadzi się więc rola architekta?
Zbyt sprawne narzędzie (komputer) sprzyja wygodzie – nie analizujemy parametrów programu, bo poprawnie działa on już po jednym „kliknięciu". Wprowadzenie komputerów kwantowych nasili ten proces, którego wyrazem obecnie jest parametryzacja architektury. Sprawność narzędzia jeszcze bardziej odseparuje projektanta od źródła projektowania – idei humanistycznej, która sprowokowała Neuferta do stworzenia Podręcznika.
W pracy użyto metod: intuicyjnej, przeglądu systematycznego oraz metaanalizy źródła podstawowego, jakim są kolejne wydania *Podręcznika projektowania architektoniczno – budowlanego* E. Neuferta, oraz odniesienie ich do dzisiejszych warunków pracy architekta. Rezultatem badań jest odnalezienie podobieństw między „Podręcznikiem" a tym co oferują współczesne narzędzia pracy używane do projektowania.

Keywords: software; BIM; Bauhaus; Ernst Neufert; *Architect's Data*

Słowa kluczowe: oprogramowanie komputerowe; BIM; Bauhaus; Ernst Neufert; *Podręcznik projektowania*

INTRODUCTION

The 1936 *Architect's Data* handbook was Ernst Neufert's lifetime achievement. 41st German edition of the book was translated into 17 languages. At present, it is hard to imagine the work of any architect without access to this book. It is enormously popular in Europe, not necessarily in demand in America, mainly because of the difference in units. Neufert, as one of the few originators of Bauhaus never decided to emigrate to United States. Maybe, if he had gone, *Architect's Data* would have never come into being, or would have become popular in America with the use of Imperial units. In the US, the equivalent of *Architect's Data* was the *Architectural Graphic Standards*, which had been published four years earlier and became the first commercial book in the world to present popular, generally accepted architectural practices in a simple, clear, graphic form.

The aim of the work is to find similarities between the Architect's Data and what modern work tools used for design offer and estimate the directions of the architect's profession.

The first sketches for *Architect's Data* were created while Neufert was teaching in Weimar. At the time, he created a catalogue of solutions that helped him in leading obligatory classes in design, based on fast design. The regulations published by the Deutsches Institut für Normung (DIN) 476 (1922), determining, among others, the required measurements of a sheet of paper, were

a great influence. The *Architect's Data* was published in A4, allowing the book to be easily carried in a bag.

1. ANALYSIS OF THE DEVELOPMENT OF *ARCHITECT'S DATA*

Since the book's first edition, many new functions that are worth systematizing in simple plans-ideograms have emerged in architecture; and new furnishings, which dimensions are worth knowing, are regularly being added to *Architect's Data.* At the same time, *Architect's Data* is constantly updated in elements that were disregarded by Neufert, that is the examples of specific architectural solutions and construction details. The first edition of *Architect's Data*, contained were five chapters [E. Neufert 1936]:

1. *Arbeitsvorbereitung* (Preparations),
2. *Entwurf* (Design),
3. *Bauliche Einzelheiten* (Construction Details),
4. *Gestaltung und Bemessung der Umgebung, der Räume und Einrichtungen* (Characteristics of Forms, Measurements, Environment, Space and Furnishings),
5. *Gebäudekunde* (Types of Buildings)

In the latest Polish edition — the translation of the 39th German edition — one can find 20 chapters. Their titles and descriptions are provided in the following table:

Tab. 1. Content analysis of *Architect's Data*

Title	Profile
1. Basics	Description of signs; shortcuts; regulations; units; markings on technical drawings; freehand manual; units; load calculations manual due to DIN regulations; general rules of design for the disabled; human dimensions and proportions; the biology of a building; climate of interiors; rules of optical perception
2. Planning process	General rules of design; a set of questions related to designing and leading an investment; information regarding sustainable architecture; facility management; building within an existing environment; building management; building costs
3. Building elements	Basic information concerning excavations, foundations, insulation, drainage, walls, ceilings, roofs, windows, doors, stairs, glass, elevators, ramps; technical and composition information
4. Housing	History of policy regarding housing construction; functional diagrams, rates for the intensity of housing; orienting buildings towards cardinal points; types of housing (single and multiple person dwellings); examples of floor plans; measurements of furniture and equipment; functional, technical and dimensional analysis of different rooms within a flat
5. Residential objects	Functional, technical and dimensional analysis; guidelines for design; examples of buildings such as: a dormitory, old people's home, orphanage, hotel, restaurant, youth hostel, summer house, motel, campsite
6. Education	Functional, technical and dimensional analysis and guidelines for design; examples of buildings such as: a crèche, kindergarten, school, common room, playground, university, with examples and equipment
7. Culture	Functional, technical and dimensional analysis and guidelines for design; examples of buildings such as: a museum, theatre (including historical background), concert hall (including the basic rules of acoustics), circus, ZOO
8. Offices	Functional, technical and dimensional analysis, guidelines for design; examples of office buildings, libraries (including historical background); examples of forms, construction, equipment and basics of ergonomics
9. Commerce	Chapter based on German law regulations including a functional, technical and dimensional analysis; guidelines for design, examples of commercial buildings with basic information on fire safety measures, dimensions of detailed equipment, breakdown of areas.
10. Industry and craftsmanship	Functional, technical and dimensional analysis, guidelines for design; examples of buildings such as: an industrial plant, warehouse, bakery, workshop, a butcher's shop, sewing room, laundry, fire station
11. Religion	Functional, technical and dimensional analysis, guidelines for design; examples of buildings such as a churches, synagogues, mosques

12. Health	Functional, technical and dimensional analysis, guidelines for design; examples of buildings such as: surgeries, hospitals (including regulations concerning installations)
13. Sport and recreation	Functional, technical and dimensional analysis, guidelines for design; examples of buildings such as: stadiums, sport fields, swimming pools, SPAs, game rooms with examples of equipment required for sport halls, marinas, stables, skiing facilities, etc.
14. Transport	Basics of road building and maintenance, railways, aviation; regulations concerning the design of parking lots, gas stations, public transport, airports, bus and railway stations, cemeteries
15. Landscape	Basics concerning town and country planning, urbanism, landscape architecture: greenery, reservoirs, greenhouses, small architecture
16. Agriculture	Functional, technical and dimensional analysis, guidelines for design; examples of farms divided by functions; characteristics of equipment and measurements of animals
17. Supply and waste disposal	Functional, technical and dimensional analysis, guidelines for design; examples of waste processing buildings and driveways for lorries
18. Services	Information concerning renewable energy, physics of buildings, sunlight, shading, artificial light, fire safety measures, technical equipment for residential housing
19. Bibliography	
20. Index	

source: prepared by the author

2. PURPOSE OF *ARCHITECT'S DATA*

Long before the creation of *Architect's Data*, architects and craftsmen used pattern books as visual aids. According to the *Terminological Dictionary Of Fine Arts*, it is *'a collection of drawings, usually engraved, containing patterns of architectural elements, ornaments, shapes of objects, furniture, dishes, etc., serving artists and craftsmen as an aid in composing products'* [K. Kubalska–Sulikewicz 2002, p. 445]. Such have been created ever since Antiquity, but their creators did not have the same goal as Neufert — the presentation of the simplest elements of composition, meant to unify the principles of design for industrial production, and thus reduce the cost of construction. The templates were to inspire the creators and were written, among others, in the form of treatises such as: *De Architectura* of Vitruvius and *The Four Books of Architecture* by Andrea Palladio. The architect, creating the template, used his practical and theoretical experience. The reader often replicated the given pattern, for example in the form of a building's facade in another country.

The Author's intention was (1) to provide the simplest, but unalterable design algorithms that would prevent the copying of architectural solutions, because they rely on ergonomics — the starting point in architectural design and the design of culturally determined furnishings that actually were supposed to be produced in mass quantities. The basic functional and spatial diagrams (2) were supposed to be built from these elements, optionally arranged in accordance with the then German building regulations (bathrooms, kitchens, bedrooms, dining rooms, auditoriums, external and internal staircases). In time, examples of specific buildings and, recently, specific building details have been added, certainly against Neufert's idea, who in the introduction of *Architect's Data* wrote*: 'A born architect, someone with a vocation to build, will cover his ears and cover his eyes, if he solves the solution, because his mind so fulfills his own ideas and ideals that he needs only elements, all of which will be left alone without anyone's help. (...) This is the idea behind this Architectural and Building Design Manual, in which I tried to reduce the design blocks to the quintessence, bring them to the scheme or abstract, to make it difficult for the user to imitate and force him to look for his own form and content.'* [E. Neufert i inni 2011, p. 6].

3 MODERN METHODS OF INFORMATION GATHERING

It is worth considering whether Neufert's legacy will last in an unchanged, though constantly updated form. At present, architects and generally employees don't necessarily reach his book as their first impulse in search for knowledge. According to KPMG sur-

veys, information gathering takes a lot of time [KPMG 2004]. This means that information behaviors, involving a conscious search for knowledge, must be characterized by high efficiency. Internet is the best tool for this purpose and the most commonly used one. The traditional book is not able to compete with new technologies in terms of speed of reaching specific information through the use of a search engine. The Internet and computer programs offer us many opportunities to check the dimensions of furniture or rooms we need. Some of them are:

- Google search engine: sample room plans, graphics with diagrams, material technologies, construction solutions, topological solutions of completed buildings, opinions about materials, solutions, manufacturers, combinations of materials;
- Pinterest (portal — search engine for images that categorizes results based on keywords and similarity of photographs): realizations including the list of materials used, advice on design of various elements in the home, such as how to utilize an empty wall or arrange a small bathroom;
- Facebook and other social media: on groups and fan pages — access to other architects and producers of materials and equipment, allowing consultations regarding project implementation and valuation (on a notice board-basis);
- ArchiDesk — a portal connecting architects and producers that premiered at the Warsaw Home Expo in October 2018. Created by Przemysław Szklarzewski, it allows you to announce the demand for a given interior-furnishings product with details of availability, price, location and time of realization. Manufacturers respond to announcements, shortening the search. The portal also offers training for architects regarding work in the industry and materials;
- YouTube: access to videos showing production technologies, construction elements, assembly, production;
- BIM programs (ArchiCAD, REVIT) and 3D graphic programs (Rhino, SketchUp): allowing the import

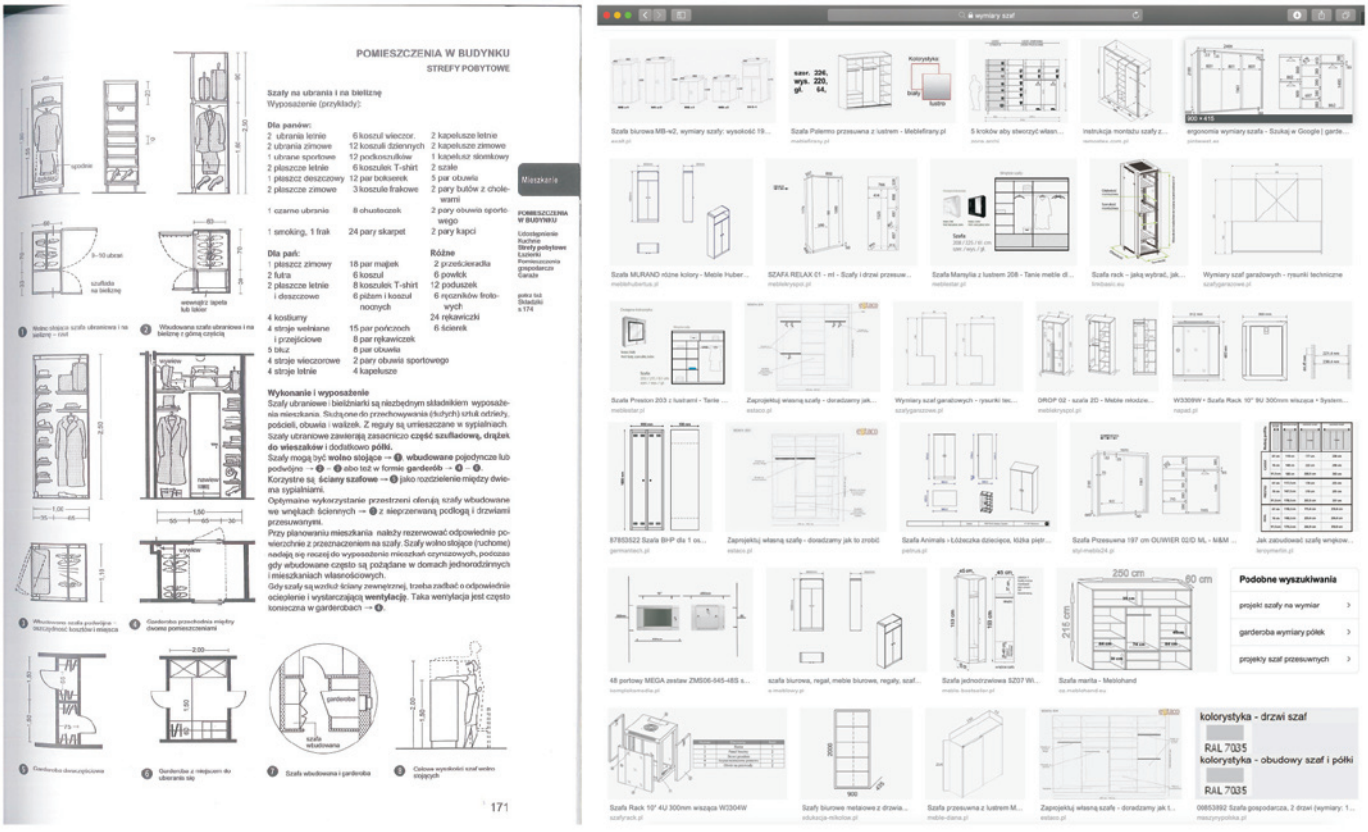

Fig. 1. Comparison of results between attempt at looking for dimensions of wardrobes in *Architect's Data*" and in Google search engine ; source: Neufert E. i inni (2011), *Neufert. Podręcznik projektowania architektoniczno-budowlanego* also: https://www.google.com/search?client=safari&rls=en&biw=1440&bih=740&tbm=isch&sa=1&ei=jFvqXNv2ELWIk74P_MScuAI&q=wymiary+szaf&oq=wymiary+szaf&gs_l=img.3..35i39j0l9.82229.84852..84946...2.0..0.132.1254.11j2.....0....1..gws-wiz-img.....0i67.vrpJAqJUIac (accessed: 05.05.2019)

of ready-made 3D models of specific interior furnishing products and such building elements as windows, doors, typical construction elements with specific dimensions, with the option of editing characteristic features, adding specific wall technology, dimensions, automatic calculation of the correct dimensions of stairs, automatically calculating of configurations

Today's information technology offers numerous solutions and facilitations. Manufacturers compete with numerous offers of 3D models of their products, in correct dimensions, e.g. VOX furniture has its entire collection in the correct extensions. The designer often does not know the exact dimensions of furniture, because he/she imports them directly into the model (e.g. 3D Warehouse — an application dedicated to the Sketchup program), roughly specifying their suitability for a given space. Models can be downloaded but also uploaded, allowing free access and use in another 3D design program such as Rhino or 3dsMAX. This increases the danger of rescaling the project, especially for young designers and students who have not yet learned to 'feel' the scale. With a more thorough search, one can find detailed projects on BIP (Public Information Bulletin) portals where entire projects are published as part of the announced construction tenders. Copying solutions and access to knowledge has never been this easy. Can we say that nowadays, Neufert is everywhere? Below is an expanded table with Neufert's chapters (table A), with the possibilities of obtaining relevant information by means of modern technologies listed [E. Neufert i inni 2011]:

Currently, there is no other comprehensive compendium of knowledge that would be as extensive as *Architect's Data* and would take the form of a single software program or one portal on the Internet. For such detailed information as construction dimensions of plastic storage tanks or a collective treatment of, for example, cross sections of different types of yachts, it would take more time to search the web than to reach for Neufert's work. It simply takes more time to search the web. However, information technology is constantly improving and at some point web-based solution will certainly overtake the book.

4. CONTEMPORARY SOFTWARE FOR DESIGNING AND THE FUTURE OF THE ARCHITECT PROFESSION

In the first decades following publication of *Architect's Data*, despite its existence and a range of systematized graphic solutions in the form of a book, a client still required an architect to design a building or interior. It was he who had the knowledge about technology and the combination of materials, an imagination that allowed him to make aesthetic decisions without the need to create visualizations. Currently, architects often meet with clients who "know" exactly what they want because they have acquired some knowledge and solutions on the web. It turns out that not only *Architect's Data*, but the architect himself is no longer needed. Ideas — "inspirations" are ready, waiting "at your fingertips" on the Internet, and can be customized in free, easy-to-use programs downloaded from manufacturers websites, such as the IKEA programs dedicated to its collection of furniture or VOXBOX — an online application serving the same purpose. A store employee will check the feasibility of chosen solutions for free while helping to complete your order. It is not so straightforward when it comes to designing an entire building, but probably it is only a matter of time. Today, bypassing the services of the architect is still prevented by the law — it is required that a specialist with appropriate permissions should adapt the design of a single family home from a catalogue to a particular plot in accordance with existing regulations. However, there are already solutions waiting to be presented in the form of a simple application that would allow generating real life-sized buildings in 3D form.

One can sense the fear of technology that could take away jobs not only from unqualified, but also professionally trained workers. Such fear can be compared to the fear of change once caused by the rapidly developing mass production. Walter Gropius was confronted with this issue when he established a new design school, the Bauhaus in Weimar. However, he and his co-workers decided that rather than struggle against mass production, they would find a field for collaboration and thus avoid the 'enslavement of man by machines.' The idea was to unite the individual with mass production. Each product was to be designed with mass production in mind, but simultaneously avoiding its mistakes. In order to enable this, in creating his education plan for the architectural profession Gropius devoted a large part of his studies to visiting construction sites and factories, so that the designer could learn about production techniques and design with the production line in mind.

The humanization of the production process, one postulate of the *Architect's Data*, was the idea that industrial production — cheaper than artisanal production — could solve social problems. This was aided by the assumption that all people have similar needs and, consequently, led to the creation of a new science — ergonomics. This standardization was to bring concrete,

Tab. 2. Content analysis of *Architect's Data* and modern methods of information gathering

Title	Profile	Examples of source of information
1. Basics	Description of signs; shortcuts; regulations; units; markings on technical drawings; freehand manual; units; load calculations manual due to DIN regulations; general rules of design for the disabled; human dimensions and proportions; the biology of a building; climate of interiors; rules of optical perception	• Wikipedia,Google search engine • Online calculators for calculating units • Programs for calculating loads: SPECBUD, REVIT, Robot
2. Planning process	General rules of design; a set of questions related to designing and leading an investment; information regarding sustainable architecture; facility management; building within an existing environment; building management; building costs	• Programs for planning and coordinating construction, for example: Planista PLUS, SaberCats, ProgPol; • Programs for cost estimation, e.g. Norm EXPERT, Norma PRO
3. Building elements	Basic information concerning excavations, foundations, insulation, drainage, walls, ceilings, roofs, windows, doors, stairs, glass, elevators, ramps; technical and composition information	• Wikipedia, Google search engine • Manufacturers' catalogs containing technical data
4. Housing	History of policy regarding housing construction; functional diagrams, rates for the intensity of housing; orienting buildings towards cardinal points; types of housing (single and multiple person dwellings); examples of floor plans; measurements of furniture and equipment; functional, technical and dimensional analysis of different rooms within a flat	• Wikipedia, Google search engine • Pinterest, current regulations such as technical conditions on the Ministry's website • Models of specific equipment, for example on the websites ArchiUp.com, FlyingArchitecture.com, material and furniture libraries from ArchiCAD • Apartment furnishing: IKEA planner, VOX BOX, Cad Decor Pro, Cad Kitchens 6x etc.
5. Residential objects	Functional, technical and dimensional analysis, guidelines for design; examples of buildings such as: a dormitory, old people's home, orphanage, hotel, restaurant, youth hostel, summer house, motel, campsite	• Wikipedia, Google search engine • Examples of specific solutions, for example: Arch Daily, Pinterest • Studies on industry portals • Details of solutions: detail-onilne.com, manufacturers' catalogs • Current regulations such as technical conditions on the Ministry's website
6. Education	Functional, technical and dimensional analysis and guidelines for design; examples of buildings such as: a crèche, kindergarten, school, common room, playground, university, with examples and equipment	
7. Culture	Functional, technical and dimensional analysis and guidelines for design; examples of buildings such as: a museum, theatre (including historical background), concert hall (including the basic rules of acoustics), circus, ZOO	
8. Offices	Functional, technical and dimensional analysis, guidelines for design; examples of office buildings, libraries (including historical background); examples of forms, construction, equipment and basics of ergonomics	
9. Commerce	Chapter based on German law regulations including a functional, technical and dimensional analysis; guidelines for design, examples of commercial buildings with basic information on fire safety measures, dimensions of detailed equipment, breakdown of areas.	

10. Industry and craftsmanship	Functional, technical and dimensional analysis, guidelines for design; examples of buildings such as: an industrial plant, warehouse, bakery, workshop, a butcher's shop, sewing room, laundry, fire station	• Wikipedia, Google search engine • Examples of specific solutions, for example: Arch Daily, Pinterest • Studies on industry portals • Details of solutions: detail-onilne.com, manufacturers' catalogs • Current regulations such as technical conditions on the Ministry's website
11. Religion	Functional, technical and dimensional analysis, guidelines for design; examples of buildings such as a churches, synagogues, mosques	
12. Health	Functional, technical and dimensional analysis, guidelines for design; examples of buildings such as: surgeries, hospitals (including regulations concerning installations)	
13. Sport and recreation	Functional, technical and dimensional analysis, guidelines for design; examples of buildings such as: stadiums, sport fields, swimming pools, SPAs, game rooms with examples of equipment required for sport halls, marinas, stables, skiing facilities, etc.	
14. Transport	Basics of road building and maintenance, railways, aviation; regulations concerning the design of parking lots, gas stations, public transport, airports, bus and railway stations, cemeteries	
15. Landscape	Basics concerning town and country planning, urbanism, landscape architecture: greenery, reservoirs, greenhouses, small architecture	
16. Agriculture	Functional, technical and dimensional analysis, guidelines for design; examples of farms divided by functions; characteristics of equipment and measurements of animals	
17. Supply and waste disposal	Functional, technical and dimensional analysis, guidelines for design; examples of waste processing buildings and driveways for lorries	
18. Services	Information concerning renewable energy, physics of buildings, sunlight, shading, artificial light, fire safety measures, technical equipment for residential housing	

source: prepared by the author

positive effects to the everyday life of ordinary people. Mass design, taking into account the appropriate ergonomic dimensions and devoid of solutions typical of artisanal production, was to reduce production costs (because it was industrial), and thus reduce housing costs and prices and allow the less wealthy citizens to buy flats/houses. Architects were striving for the ideal described by Gropius in Sociological premises concerning apartments with a minimum standard of urban industrial population, that is, the possession by each adult of his own, even the smallest room [W. Gropius 2014, p. 149]. Over the years of creating subsequent editions, many institutions and companies joined in the work on *Architect's Data*, helping to update the content of the book. Thus, the *Architect's Data* has become the main tool helping architects to integrate into cooperation with what was initially their enemy — mass production.

Given the possibilities of contemporary technologies, the question arises whether Neufert's *Architect's Data* is still needed in its present form, how long will it be needed for, or what will replace it in the future? Some clues can be found today in looking at how BIM programs are constructed. They contain libraries of objects, in which the dimensions are predetermined, but to a certain extent, we can alter them. Previously, in order to plan how to insert a table with eight seats at appropriate distances from one another, it was necessary to study the guidelines from *Architect's Data*, now it is as easy as entering several parameters into the program. As such, *Architect's Data* is similar to how simple information algorithms and parametric programs operate. At the moment, we cannot 'program', for example, an entire restaurant with kitchen and storage facilities only on the basis of just algorithms and parameters.

For this, we still need a human-architect — but we do not know for how long. If artificial intelligence develops further, after entering Neufert's guidelines, current regulatory norms and functional and spatial boundary conditions into the programme, the entire project should just 'design itself'. What will be the role of the architect then?

A tool that is 'too efficient' (a computer program) favours convenience — we do not analyse its parameters, because it works correctly with just one 'click'. The introduction of 'quantum' computers will intensify this process, which is expressed today by the parameterization of architecture. The tool's efficiency will further remove the designer/architect from the source of all design — the humanistic idea that provoked Neufert to create *Architect's Data*.

This raises the question of how to approach the contemporary situation of the struggle of man against the machine (today a computer)? How, then, following the example of Gropius and Neufert's approach, transform the fight against the computer into a collaboration with artificial intelligence? A century ago, it helped to learn about production techniques [W. Gropius 2014, p. 115]. Today, this would mean learning about programming techniques. The architect of the future may no longer design at the drawing board (currently at the computer screen), but program it instead. Change the lines of code allowing the computer to create — by itself and much faster than a human would — the perfect solution for a given space. This would not only mean entering data into the computer, because this can be done by the client him/herself. Rather, the architect would become a programmer. In today's labour market, the 'architect' is not just someone who designs spaces. Programmers consider themselves architect too, and call themselves 'programming architects'. They deal with the layout of an IT project, divide it into parts, create structures, define the key requirements of the program, decide on the use of detailed elements. The appeal issued by SARP on 4 December 2017, calling for the protection of the architect's name and opposing the use of this title by IT specialists may be at odds with reality.

A 21st century architect spends much more time at the computer than at the drawing board (freehand design). Computer-based technical drawing is incomparably more effective than drawing plans on paper. BIM programs allow not only to efficiently erase a wrong line but also an entire wall, which then has its reflection in the automatically generated cross-section of the building. When using a computer, there are also no losses associated with legibility — when changing the scale, we do not irretrievably lose precision. The latest software also allows you to create free forms using architectural elements contained in extensive catalogues. In addition, the technology is adapted to architects without programming skills — it has a simple graphical interface. For the most part, it still serves the purpose of drawing. However, since parametric architecture has become reality, it is not as easy. When it comes to parametric architecture design, the program 'draws' the spatial form based on the boundary conditions given by the architect. The best example of this is Grasshopper 3D dedicated to the Rhino

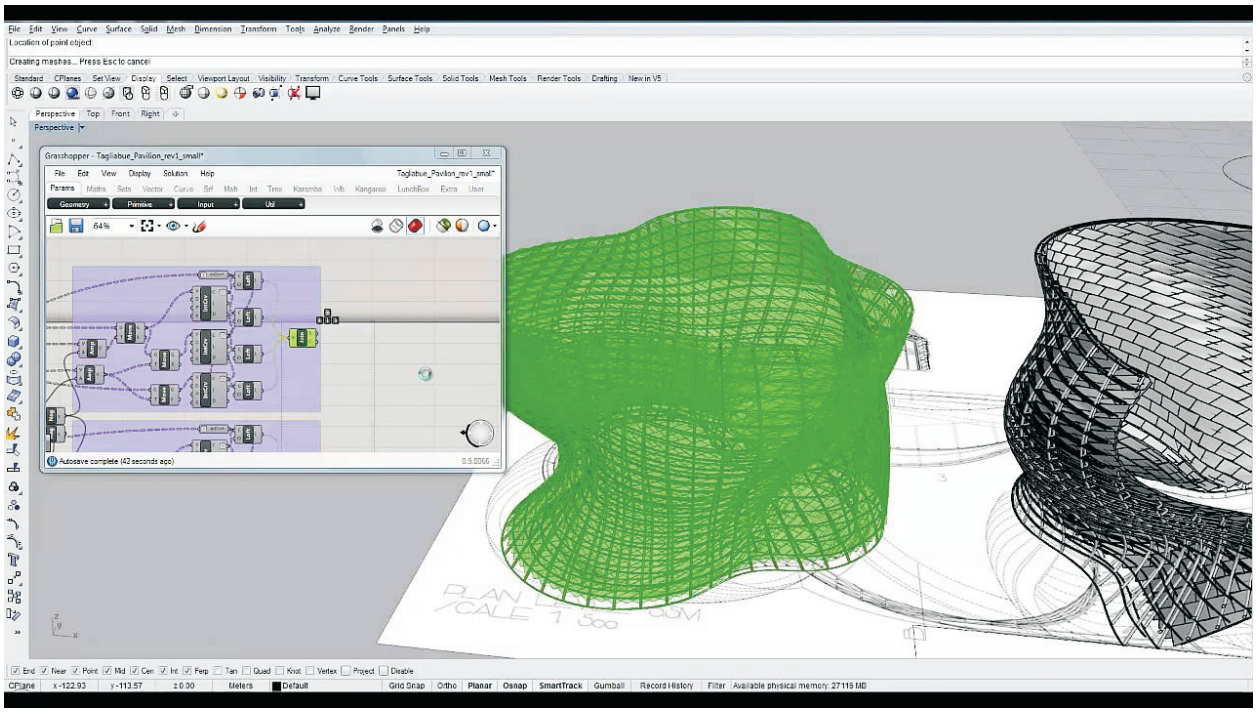

Fig. 2. Interface of Grasshopper software; source: https://www.youtube.com/watch?v=oCfpy8gdATo (accessed: 05.05.2019)

program. The designer creates the algorithm for a new form in the command editor generated in the graphic structure. After entering the variable data into the system, the program creates a form that can be changed by altering the values. The architect's role comes down to experimenting and making decisions. Corrections result in metamorphoses of the shape in real time. The rest just 'draws itself.' More importantly, modelling programs, including those for parametric shaping, will be compatible with BIM, and thanks to that will enter a common digital platform capable of handling the entire design process.

The architect's experience and spatial imagination — which the clients do not have — help him/her in architectural decision-making. In the face of the rapid development of the technology of Virtual and Augmented Reality, this will also change. The help of an architect may be unnecessary for a client who has an HMD device, thanks to which imagining and checking the results of a spatial experiment is possible immediately, in a 1:1 scale, with the use of the HMD apparatus. An investor prepared in this way may only encounter a problem during the 'programming' of the building. Creating the algorithms and dependencies between them — dedicated to a specific task, and which will allow one to create a form by only using the sliders in the program — requires an architect with IT skills, that is, will strengthen his/her market position.

SUMMARY

A century ago a school that had no hang-ups and was not afraid to face the new technology entering everyday life was created. With a strong leader, a small community and an innovative program, it changed the approach of architects to design. As a result, the profession has survived and developed in a new area of activity, today called 'Design' and previously 'Industrial design'. Currently, the attitude of architects towards learning to programme is equally unfavourable as it was then towards industrial production. For the older architect, the presence of simple software/programs is enough, those younger and fascinated by tools, focus on technology and creating forms without context. However, today changes take place faster than a century ago. The market imposes a fast pace, and flexibility has becomes a sought after feature. It is needed not only to survive on the market, but also to shape the market through humanizing it, which is what Bauhaus school did in an analogous situation a century ago.

Who won't adapt, won't survive — therefore, it is likely that the architects' current attitude towards how they work will have to change.

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