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# THE IMPACT OF SELECTED ATTRIBUTES OF NEW RESIDENTIAL PROPERTIES ON THE TIMING OF THEIR SALE: AN EMPIRICAL ANALYSIS USING THE EXAMPLE OF A HOUSING ESTATE IN SZCZECIN

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ABSTRACT

The article summarizes research on the impact of selected characteristics of new apartments on the timing of their sale. The analysis covered properties built between 2014 and 2022 by a single developer in Szczecin. The study was based on data on a housing estate with consistent development, divided into four construction stages. Duration analysis and hedonic regression methods were used. Key findings of the study are as follows: window exposure: apartments with south- or west-facing windows sold faster; view from the window: a positive view (e.g., of green areas) accelerated sales, while a negative view (e.g., a railroad embankment) delayed them; location: apartments on the top floors sold faster; construction stage: the fastest sales took place in Stage 2, and the slowest in Stage 1, which was explained by the unattractive surroundings of the construction site; number of rooms: the fastest sales were two-room apartments, which were more affordable and attractive for investment. The survey indicates that the key factors for buyers are the comfort of the apartments, the view from the window, sunshine and the orderliness of the development's surroundings. The results provide valuable guidance to developers and designers, making it easier to tailor new developments to customer preferences.

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## 1. Introduction

When preparing a new housing project: planning the layout of buildings on the plot, the number of rooms in individual apartments or the development of the plot, the developer takes into account a number of factors, starting from the possibility of using the property according to the obtained building permit, through the economic calculus, to the expectations of potential buyers and their financial capabilities. An element that carries with it a lot of uncertainty are the buyers' expectations. What will appeal to customers and what they will look for when choosing an apartment are questions that accompany investors from the start of their investment.

The sale of a residential property, whether on the primary or secondary market, depends on many factors. However, real estate agents agree that the three most important factors are: location, location, and location. The location factor, however, should be considered in a broader context, taking into account not only the location of the property on the geographic map, but also the neighborhood, the surrounding development, transportation accessibility, and - in the case of residential properties - the location in regards to the floor of the building, or the view from the window. These are elements that, in most cases, are beyond the control of the property owner. Wittowsky et al. (2020) distinguished three sets of characteristics of residential properties that should be considered when analyzing a given market. These are: the dwelling's characteristics, the neighborhood's characteristics and accessibility characteristics. The first

group includes factors directly related to the property itself: its floor area, number of rooms, standard; the second: the development of the land around the property, proximity to stores, availability of green areas and playgrounds; and the third: elements of the external environment that affect the comfort of residents, such as proximity to highways or public transportation.

Studies conducted to date sought to find determinants affecting the sale price of residential real estate. It was noted that higher prices were obtained by properties with higher standards, more space, but fewer rooms (Wittowsky et al., 2020). The location of a residential property in regards to the floor of the building was also found to be important (Chau et al., 2001; Chau & Ng, 1998; Conroy et al., 2013; Eng Ong, 2000; Mok et al., 1995; So et al., 1997; Tse, 2002). Apartments located higher were valued more because of the view that unfolded from the windows, but also because of less air pollution and lower noise levels coming from outside. It was also investigated whether a longer time spent in elevators was a negative factor in the choice of upper floors for housing - but this did not transfer over to the popularity of higher floors.

An extremely important factor affecting the price and value of a property is the view from the window, i.e. the neighborhood of the space visible from the property's window. The first studies were conducted as early as the 1960s and looked at the value of homes with and without an ocean view. The differences, in favor of properties with a view, reached up to 30% and were statistically significant (Yorshis, 1968). Subsequent studies confirmed the higher prices or values of properties whose asset was an attractive view from a window. The existence of a panorama was valued higher (Bourassa et al., 2004; Chau et al., 2002; Darling, 1973; Gillard, 1981; Hajnal, 2019; Paterson et al, 2002; Potgieter & Cloete, 2010; Rodriguez & Sirmans, 1994), the effect of waterfronts (Brown & Pollakowski, 1977; Fleischer, 2012; Plattner & Campbell, 1978; Sander & Polasky, 2009), the effect of a view of the ocean (Benson et al., 1998), or lake (Baranzini & Schaerer, 2011; Lansford et al., 1995). The price of the property was also positively influenced by the view of the Acropolis in Athens (Damigos & Anyfantis, 2011), green surfaces (Dombrow et al., 2000; Yamagata et al., 2016; Yu et al., 2016), as well as the view of open space or simply a scenic view (Benson et al., 1998; Chau et al., 2002; Jayasekare et al., 2019; Jim & Chen, 2009; Luttik, 2000; Yamagata et al., 2016). Property with a partial view is valued less than a similar property with unhindered view. Brown and Pollakowski (1977) as well as Goodwin (1977) confirmed the relevance of a view of a park, ocean, lake, etc.: residents valued properties located in an attractive neighborhood more highly, even if it was simultaneously inconvenienced by, for example, emerging crime or the threat of flooding. It should also be emphasized that a view looking out over blue spaces (oceans, seas, lakes) has a positive effect on mental health and well-being, as well aslevels of physical activity (Gascon et al., 2017).

Also related to the window view is the property's exposure to daylight, which is related to the location of the property in relation to the directions of the world. The location of apartments in multi-family buildings limits the possibility of benefiting or limiting daylight, since the windows face a particular direction. When facing northeast, less daylight enters the room, while when facing southwest, there is definitely more of it. Daylight has a huge impact on the health and well-being of occupants (Boyce et al., 2003; Osibona et al., 2021; van Bommel & van den Beld, 2004; Weiss et al., 2016). Thermal comfort in housing is also associated with sun exposure. Dwellings with plenty of sunlight are considered warm, requiring less heating and lighting (Bournas, 2022), but cooling becomes necessary during the summer heat. Apartments with a northeastern exposure, on the contrary, may require more heat for warming and more consumed energy for lighting in the winter, but provide adequate thermal comfort in the summer (Zhong et al., 2022). It is desirable for an apartment to be exposed to different sides of the world, but building design does not always allow for this.

Also important to residents is the land use around the property, in the neighborhood, and the distance to various types of attractions and amenities, such as forests (Tyrväinen & Miettinen, 2000), green spaces (Conway et al, 2010), the coast (Conroy & Milosch, 2011; Lusht & Major, 2004), lakes (Lansford et al., 1995), trails and greenbelts (Asabere & Huffman, 2009), railroad stations (Debrezion et al., 2011), highways (Wittowsky et al., 2020), bicycle facilities (Liu & Shi, 2017), historically significant buildings (Narwold et al., 2008) and open spaces (Irwin, 2002). Green spaces are valued, provided they are close to real estate (Crompton, 2001; Melichar & Kaprová, 2013; Poudyal et al., 2009). The presence of vegetation near the road network reduces secondary particulate emissions and acts as an acoustic screen between traffic and residential areas (Morancho, 2003), and major ecosystem services include the effect of greenery on the urban microclimate and its impact on the


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hydrological cycle (Costanza et al., 1997).

It has also been confirmed that the value of a property is negatively affected by unfavourable surroundings, e.g., the proximity of an airport, groundwater contaminated with chemicals, a landfill or high-voltage power lines (Hajnal, 2017; Kiel, 1995; Kohlhase, 1991; Mendelsohn et al., 1992; Nelson et al., 1992; Thayer et al., 1992), i.e., surroundings that cause pollution or noise (Brandt & Maennig, 2011; Debrezion et al., 2011). Tse (2000) showed that the value of an apartment in Hong Kong is negatively affected by the view of a cemetery from the windows, because the Chinese culture associates graveyards with ill fortune.

Research to date has looked at how various environmental factors affect the price or value of a residential property. However, there has been no research on how these elements affect the time it takes to sell a residential property. This article presents, for the first time, research on the impact of selected determinants on the speed of newly built residential sales. The research was conducted based on the sales of newly built residential real estate of a project implemented from 2014 to 2022 in Szczecin. Time on market (TOM) was defined as the period between the time the developer announces the sale of new units and the signing of the first contract - reservation, preliminary or final - with the buyer.

The purpose of the study was to identify the attributes of new residential properties and assess their impact on the time of sale. Taking into account previous research (on the impact on the price or value of real estate), the following research hypotheses were formulated - shorter selling time is influenced by:

H1 exposure of the apartment to the west or south side,

H2 the view from the window outside the estate

H3 the view from the window without a railroad embankment

H4 the location of the apartment on the top floor

H5 the realization stage of the development.

Determinants that could potentially affect faster sales were extracted: the number of rooms, the location on the floor, the apartment's exposure to the world, the view from the window, the windows facing the outside of the development, the stage of the sale, etc. Since the geographic location of all apartment properties was the same (one development), this factor was not taken into account.

## 2. Materials and methods

### 2.1. Description of the housing estate

The study was conducted on a new residential development under construction in Szczecin between 2014 and 2022. Szczecin is a city located in northwestern Poland, the third largest city in Poland in terms of occupied area (area of 301 square kilometers), with a population of about 390,000 people, with 491 apartments per 1,000 residents in 2022 (Local Data Bank). A number of residential developments are being conducted in Szczecin. Between 2014 and 2022 alone, an average of 2,421 new apartments were completed annually (total - 21.8 thousand apartments), 85% of which were for sale or rent.

The subject of the study is a residential project located in the western part of the city center. The project is very well located, close to the center of Szczecin, on National Road No. 10 (Ku Słońcu Street), near the a tramline, well connected with other parts of the city (Fig. 1). At the same time, it is located in the second line of buildings, which makes the noise associated with car and tram traffic muted (Fig. 2). In the immediate vicinity of the estate, on the eastern side, there is a railroad embankment on which trains run. In the near future, the intensity of their travel will increase due to work on the launch of the Szczecin Metropolitan Railway, which in turn will improve accessibility to other areas of Szczecin and neighboring towns (Szczecin Metropolitan Railway). Not far from the estate, on the south side, across the street, is the Central Cemetery - the largest cemetery in Poland and the third largest in Europe. In addition to the necropolis, the cemetery is also a vast park, where Szczecinians stroll, appreciating its historical and natural values. On the western side, the estate is partially adjacent to allotment gardens, and on the northern side - to the areas of the transport base.

The estate was built in four stages (Fig. 3). The first stage of construction was carried out in an uninteresting environment of ongoing work to demolish existing buildings and prepare the site for the entire development. As the demolition and construction work progressed, the estate gained in attractiveness.

The different stages differ in the number of buildings and apartments built, as well as the height of the buildings (Table 1). All the buildings were realized according to the same design, which contributes to the harmony of the environment. All buildings have one underground floor, where utility rooms and multi-

space garages for residents (492 spaces) are located, available for purchase for an additional fee. An open kitchen, connected to a room, is planned in all apartments. In buildings built in the first three phases, several apartments located on the ground floor include gardens. Spacious terraces are planned for several apartments located on upper floors. The remaining apartments have balconies (only 7 apartments in the entire project have neither a garden, terrace nor balcony). All buildings were equipped with elevators. The total usable area of the estate is 22,788 sqm, on which 418 residential units and 10 commercial premises have been located.

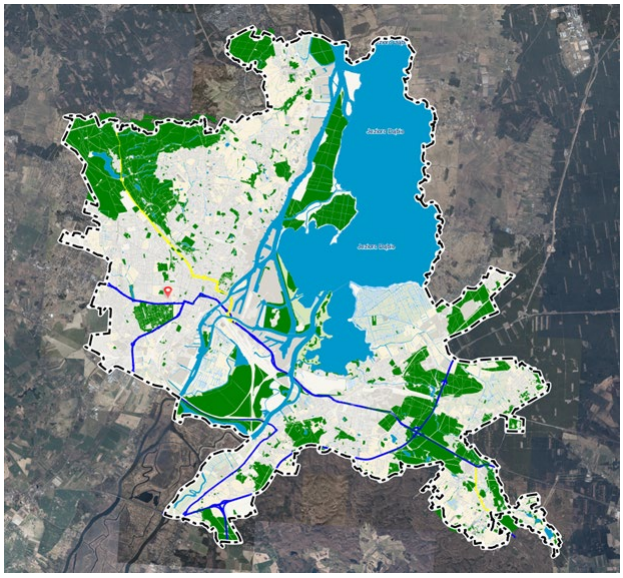

**Fig. 1.** The location of the estate on the map of Szczecin. *Source*: https://geoportal.szczecin.eu/mapa/, access: 22/09/2024.


**Fig. 2.** The detailed location of the estate. *Source*: https://mapy.geoportal.gov.pl/, access: 23/09/2024.

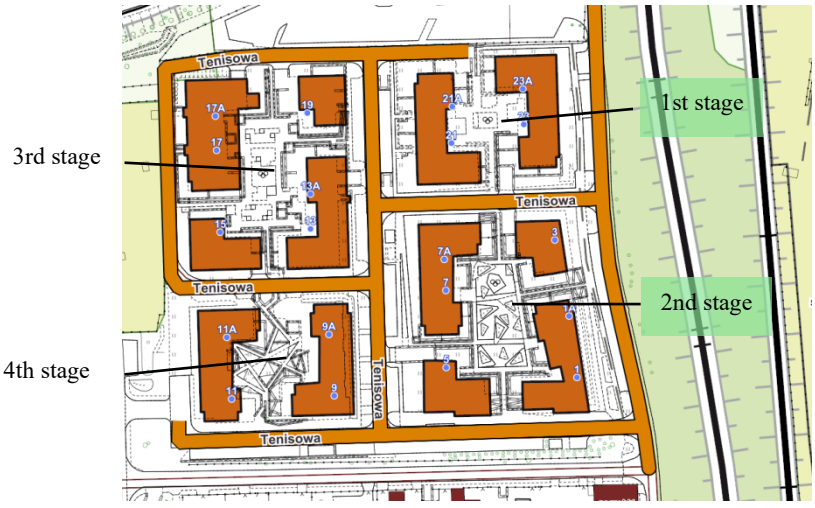


**Fig. 3.** The stages of the estate's construction. *Source*: https://mapy.geoportal.gov.pl/, access: 23/09/2024 and own work.

**Table 1**

Basic information about the estate according to the phases of construction

| Phases of construction | Years of construction | Number of buildings | Number of above-ground floors | Number of apartments | Number of apartments with associated gardens |
|---|---|---|---|---|---|
| 1 | 2014-2016 | 2 | 4 and 6 | 90 | 10 |
| 2 | 2016-2018 | 4 | 4 | 107 | 13 |
| 3 | 2018-2020 | 4 | 4,5,6,7 | 151 | 14 |
| 4 | 2020-2022 | 2 | 4 | 69 | 0 |

*Source*: own study.


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The surveyed development was dominated by apartments with windows facing two directions of the world - 66.5% of the apartments, while nearly 30% of the apartments had exposure to only one direction of the world. The 15 apartments, on the highest floors (so-called penthouses), were designed so that daylight entered the apartment from three different directions.

The estate's infrastructure has been carefully thought out. The estate is spacious, and the distances between buildings promote comfortable living. The areas inside the buildings, built in one stage (phase), were developed as recreational areas: playgrounds, greenery, etc. The different stages were further separated by internal roads, along which free parking spaces were prepared.

### 2.2. Research methods

Two methods were used to study the impact of selected attributes on the time it took to sell housing: duration analysis and hedonic regression. The time a residential property is on the market is the time from the start of sales by the developer to the signing of the first contract (reservation, preliminary or final). The time defined in this way is a random variable $T$.

#### 2.2.1. Duration analysis

Methods of duration analysis have found application in actuarial statistics and demography, and have subsequently been used in medicine, technical sciences, and in the study of socioeconomic phenomena: unemployment and business duration (Bieszk-Stolorz & Markowicz, 2019), population economic activity (Landmesser, 2013), the dynamics of poverty in urban and rural households (Sączewska-Piotrowska, 2016), credit risk (Matuszyk, 2015), the duration of residential real estate offerings for sale (BuHamdan et al, 2021; Cirman et al., 2015; Gdakowicz & Putek-Szeląg, 2022; Star, 2006) or rental (Allen et al., 2009; Cajias & Freudenreich, 2018; Gdakowicz et al., 2023; Ruf, 2017; Yilmaz et al., 2022). The main concept is the duration function expressed by the formula:

$$S(t) = P(t < T) = 1 - F(t) \quad (1)$$

where:
$T$ – duration of the phenomenon,
$F(t)$ – the cumulative distribution function of the random $T$.

The above function determines the probability that the duration (selling time) for a given unit (residential property) will be longer than $t$. The distribution of a random variable $T$ – the distribution of the time of offering a property on the market - is usually unknown, so in order to estimate the duration function, an appropriate estimator must be used (Elandt-Johnson & Johnson, 2014). An estimator that does not require information about the distribution of the random variable, and takes into account truncated observations, is the Kaplan-Meier estimator (Kaplan & Meier, 1958), expressed by the formula:

$$\hat{S}(t) = \prod_{j:t\ j \le t} \left(1 - \frac{d_j}{n_j}\right) \quad (2)$$

where:
$d_j$ – number of terminal events at $t_j$,
$n_j$ – number of units at risk during the period $t_j$.

The duration function (1) tells us what the probability of an event not occurring at least until $t$ is. The distributor $F(t)$ expresses the probability that an event will occur at the latest by the time $t$. In the study being conducted, the event is the sale of a new residential property. The estimator of the duration function (2) tells us what the probability of remaining in the developer's base - not selling the property is, while the estimator of the distribution allows one to determine the probability of selling the apartment.

The log-rank test (Mantel, 1966) was used to determine the significance of differences between the duration curves determined for groups of attributes of new apartments. This test is designed to compare two or more groups, for censored data, when the distribution for the duration curves is unknown. The null hypothesis states that there are no differences in duration curves for groups $H_0$: $S_1(t) = S_2(t)$ against the alternative hypothesis of significant differences in the duration functions of each group $H_1$: $S_1(t) \neq S_2(t)$ . The test statistic is the $\chi^2$ statistic:

$$\chi^2 = \sum_{k=1}^{r} \frac{(\sum_l^s (O_{kl} - E_{kl}))^2}{\sum_{l=1}^{s} E_{kl}} \quad (3)$$

where:
$O_{kl} = \sum_{i=1} d_{lki}$ – observed number of events in layer $l$, $k$ group,
$E_{kl} = \sum_{i=1} e_{lki}$ – expected number of events in layer $l$, $k$ group,
$s$ – number of layers,
$r$ – number of groups.

Statistic (3) is characterized by a chi-square distribution with $r$-1 degree of freedom.

#### 2.2.1. Hedonic regression

Hedonic regression is a statistical method used to analyze and value goods whose value depends on a number of characteristics or attributes. In the context of the real estate market, consumer products or other


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commodities, hedonic regression makes it possible to estimate how much of the final price is caused by particular attributes of a good. Initially (in the 1920s and 1930s) hedonic regression models were used to determine the price of agricultural goods: vegetables, fertilizers, land, cotton (Griliches, 1988). Formal development of hedonic analysis methods occurred in the 1960s and 1970s, which Griliches (1961) and Rosen (1974) contributed to. Hedonic analysis methods have been used to estimate product prices, including real estate prices (Conroy et al., 2013; Jayasekare et al., 2019; Melichar & Kaprová, 2013), or to determine indexes of price changes (Putek-Szeląg & Gierałtowska, 2016; Widłak, 2010).

The hedonic model of the time of sale of real estate is based on the assumption that the sale of a heterogeneous good such as an apartment can be represented as an aggregate of its characteristics. Hedonic models are a specific form of econometric models, in which the explained variable is the time of sale (TOM), and the explanatory variables - the quantitative and qualitative characteristics of a residential property that affect its speed of sale: number of rooms, area, floor area, exposure to the world, stage of construction, etc. A general regression model of the form was used to determine the hedonic regression function:

$$TOM = \mathrm{f}(S, N, A) \tag{4}$$

where:
$TOM$ – dwelling's time on market, which is a function of explanatory attribute of dwellings:
$S$ – structural dwelling's characteristics,
$N$ – neighborhood characteristics,
$A$ – accessibility characteristics,
or:

$$TOM_i = a_0 + \sum_{j=1}^{n} a_j \cdot z_{ij} + e_i \tag{5}$$

where:
$TOM_i$ – time on market of the $i$-th apartment,,
$a$ – regression coefficients,
$z_{ij}$ – vector of $j$ characteristics (attributes) of the $i$-th apartment sold,
$e_i$ – the random component.

The hedonic regression method most often uses linear, semilog and log-linear models. The coefficients of regression models are interpreted as the average values of individual residential characteristics, which inform about the relative importance of variables in explaining the timing of apartment sales.

## 3. Empirical study

### 3.1. Descriptive statistics variables

The study of the timing of the sale of new apartments depending on the attributes of these apartments was carried out based on 418 apartments built and sold between 2014 and 2022, in a selected housing estate in Szczecin. Each residential property was described by a set of variables:

- construction stage,
- area of the dwelling ($m^2$),
- number of rooms,
- date of commencing apartment sales,
- date of reservation of the apartment,
- date of conclusion of the notarial deed,
- location of the apartment in relation to the directions of the world,
- building line,
- a zero-one variable describing whether the apartment has windows with a view of a railroad embankment,
- a zero-one variable describing whether the apartment has windows with a view of the outside of the housing development,
- a zero-one variable describing whether the apartment has a balcony,
- a zero-one variable describing whether the apartment has a garden,
- a variable describing which floor the apartment is located on,
- the number of floors in the building.

The starting date for the sale (date of listing) of units in each stage is different (Table 2). For the first stage, it was 01.01.2015, for the second stage it was 01.12.2016, for the third stage it was 01.05.2018, and for the fourth stage it was 01.06.2020. In each stage, the reservation of the last apartment (or its sale) is the date when sales ended. The longest sales period for the 3rd stage of the analyzed housing development (42 months) was largely due to complications related to the COVID19 pandemic. It took slightly less time - 39.7 months - to sell the first stage. The fastest buyers were found in apartments built in the fourth and last stage (30 months).

According to the average time on the market of a single apartment (Table 2 and Fg. 4), the longest waiting time for buyers was for apartments built in the first stage - 22 months (the first apartment was sold more than 11 months after the announcement, while the last apartment was sold after more than 3 years), and the shortest - in the second stage,10 months (the


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first apartment was already sold on the 10th day after the announcement).

**Table 2**

Summary of selected attributes of apartments by stages of construction

| Stages | Date of listing | Date of completion of sale | Average time on market (months) | Average apartment area ($m^2$) | Average number of rooms | Average price per 1 $m^2$ (PLN) |
|---|---|---|---|---|---|---|
| I | 01.01.2015 | 06.04.2018 | 22 | 55.3 | 2.6 | 5143.9 |
| II | 01.12.2016 | 25.06.2019 | 10 | 56.1 | 2.7 | 5622.8 |
| III | 01.05.2018 | 21.10.2021 | 15 | 56.5 | 2.9 | 7018.4 |
| IV | 01.06.2020 | 30.11.2022 | 12 | 56.4 | 2.9 | 8566.0 |

*Source*: own study.

The area and number of rooms of the built apartments were at similar levels in all stages of construction (Table 1, Fig. 5, Fig. 6). The smallest apartments ranged in size from 31.5 sqm (Stage 3) to 37.8 sqm (Stages 2 and 4), while the largest were over 90 sqm (even 93.6 sqm in Stage 1). One-room apartments were built only in Stages 1 and 3, 2 for each stage. The largest number of apartments in each stage were 3-room ones (more than 50%, 213 apartments in total) and 2-room ones (about 40%, 167 in total). The largest apartments, 4-bedroom units, accounted for almost 8% of all apartments built. The range of apartment layouts and floor areas was very wide - buyers could choose according to their own preferences and financial possibilities as to the number of rooms and the number of square meters (4-bedroom apartments had similar floor areas to 3-bedroom apartments; Fig. 7).

The average price per square meter of newly built apartments, from stage to stage, was higher. The minimum price, the average price, and the maximum price increased as well (Fig. 8, Table 2). In Stage 4, the average price was 66% higher than the average price from Stage 1. The price increase was also observed in the successive days of sales of each stage: the longer the apartment waited for a buyer, the more expensive it was.

### 3.2. Duration analysis of newly built apartments

Conducting a duration analysis requires that the source data (apartments) include observations for which the event under study has already occurred (sales) and those that are still waiting for the event to occur (still waiting to be sold). Therefore, in the first step, the median value of sales days was counted for each stage and then the properties for which the reservation time was less than or equal to the median were classified in the group of events that have already occurred (sold), with the remaining properties considered unsold.

The correlation of housing offer time was carried out taking into account the following variables: number of rooms, windows of the apartment facing outside the housing development, building line, apartment with balcony, terrace, garden, floor on which the apartment was located. The Kaplan-Meyer estimator, Formula (2) was used, and the results are presented in graphical form of duration curves, while Formula (3) was used to determine the significance of differences between individual attributes - the results are summarized in Table 3. The duration curves for selected housing attributes are presented below.

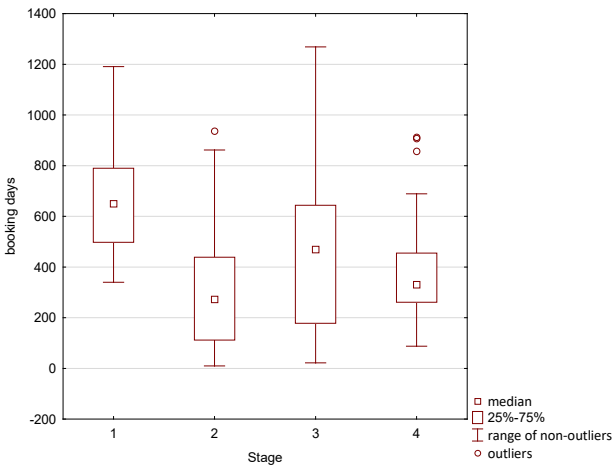


**Fig. 4.** Time on market structure of apartment sales by construction stages. *Source*: own study.

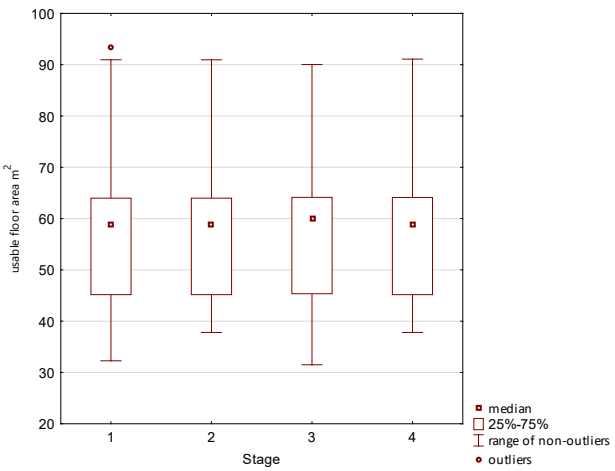


**Fig. 5.** Apartment area structure by construction stages. *Source*: own study.

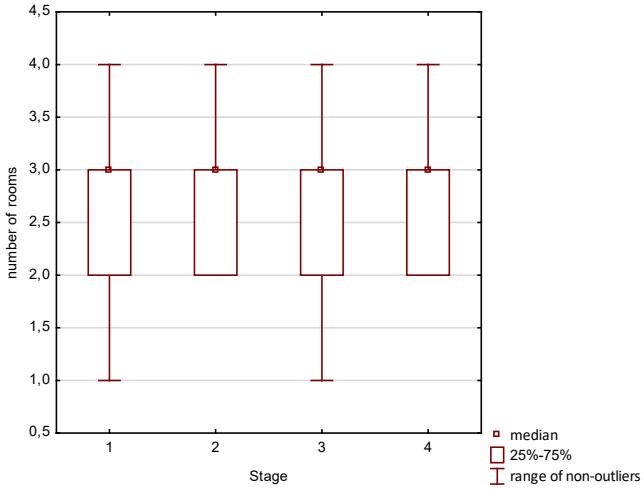


**Fig. 6.** Number of rooms structure in apartments by construction stages**.** *Source*: own study.

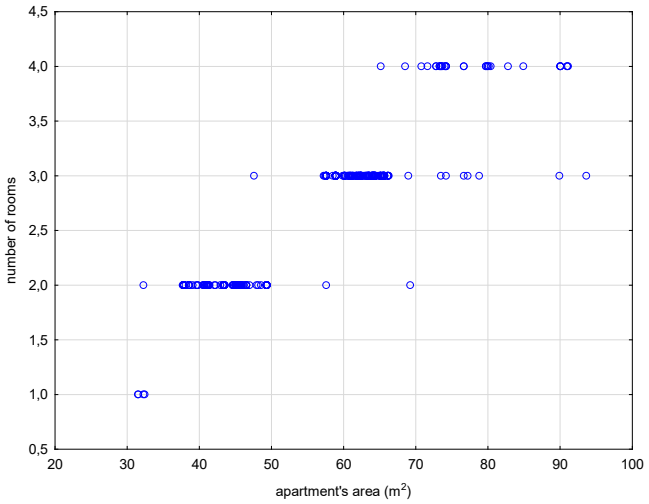


**Fig. 7.** Correlation diagram of area and number of rooms of apartments. *Source*: own study.

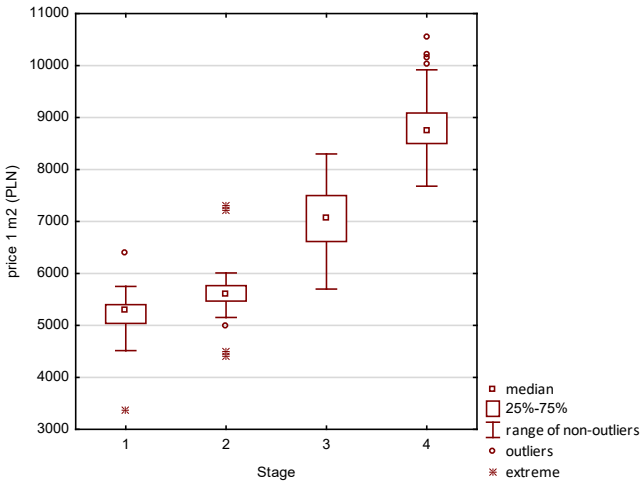


**Fig. 8.** The price structure of 1 m$^2$ (PLN) of an apartment by construction stages. *Source*: own study.

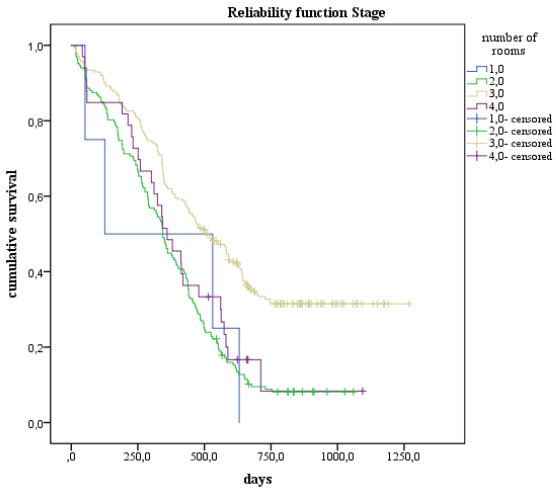


**Fig. 9.** Duration curves for the time to sell new dwellings according to the number of rooms. *Source*: own study.

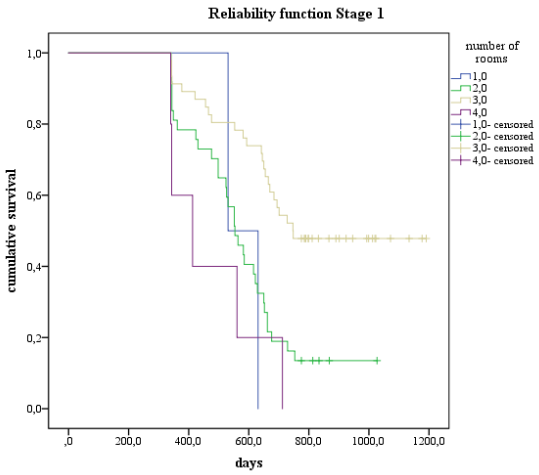


**Fig. 10.** Duration curves for new housing sales in Phase 1 by number of rooms. *Source*: own study.

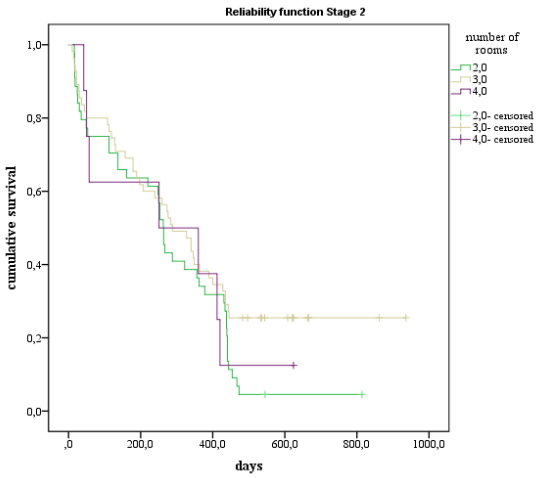


**Fig. 11.** Duration curves for new housing sales in Phase 2 by number of rooms. *Source*: own study.


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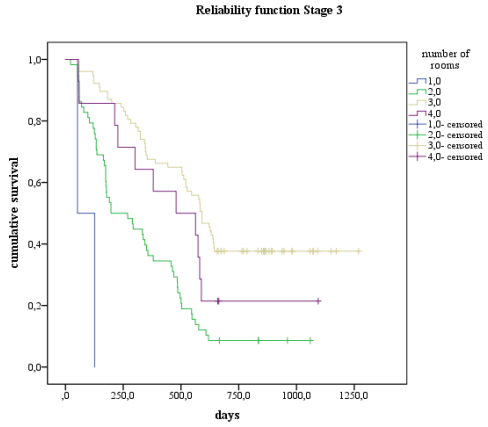


**Fig. 12.** Duration curves for new housing sales in Phase 3 by number of rooms. *Source*: own study.

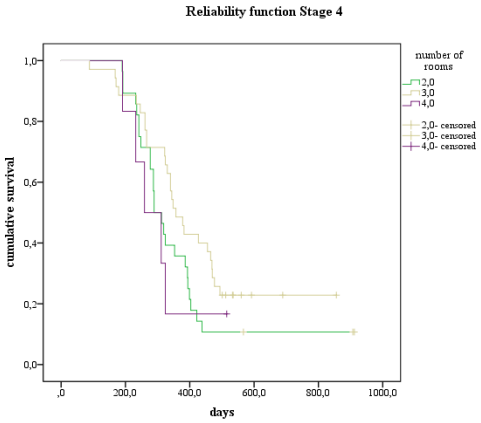


**Fig. 13.** Duration curves for new housing sales in Phase 4 by number of rooms. *Source*: own study.

**Table 3**

Summary of the significance of differences between the duration curves determined for the studied attributes of new apartments according to the construction stages

| Attribute | 1 Stage | 2 Stage | 3 Stage | 4 Stage | Total |
|---|---|---|---|---|---|
| Number of rooms | $\chi^2$=20.885; $p$=0.000 | $\chi^2$=3.148; $p$=0.207 | $\chi^2$=45.124; $p$=0.000 | $\chi^2$=3.684; $p$=0.159 | $\chi^2$= 16.762; $p$=0.000 |
| Windows in flats facing outside the development | $\chi^2$=3.318; $p$=0.069 | $\chi^2$=9.353; $p$=0.002 | $\chi^2$=10.343; $p$=0.001 | $\chi^2$=2.866; $p$=0.090 | $\chi^2$=0.024; $p$=0.876 |
| Building line | $\chi^2$=2.766; $p$=0.096 | $\chi^2$=7.532; $p$=0.006 | $\chi^2$=21.108; $p$=0.000 | $\chi^2$=1.308; $p$=0.308 | $\chi^2$=6.530; $p$=0.011 |
| View of a railway embankment | $\chi^2$=4.673; $p$=0.031 | $\chi^2$=3.064; $p$=0.080 | – | – | – |
| Presence of balcony and garden | $\chi^2$=1.525; $p$=0.467 | $\chi^2$=0.417; $p$=0.812 | $\chi^2$=1.510; $p$=0.470 | $\chi^2$=3.729; $p$=0.053 | $\chi^2$=0.004 $p$=0.950 |
| Sides of the world | $\chi^2$=23.953; $p$=0.001 | $\chi^2$=13.207; $p$=0.105 | $\chi^2$=56.321; $p$=0.000 | $\chi^2$=56.321; $p$=0.000 | $\chi^2$=6.076; $p$=0.014 |
| Storey | $\chi^2$=6.323; $p$=0.276 | $\chi^2$=2.628; $p$=0.450 | $\chi^2$=15.150; $p$=0.019 | $\chi^2$=29.859; $p$=0.004 | $\chi^2$=14.423; $p$=0.000 |

*– this attribute was not analyzed in these stages.*

*Source*: own study.

First of all, the study checked how fast apartments are sold depending on the number of rooms. Fig. 9 shows the duration function for all newly built apartments in the estate.

The fastest to be booked and sold were studio flats, but it should be noted that the number of these was the lowest (4). Next, two-room and four-room flats were the most popular. At the very end, three-room flats found buyers. There is a significant difference in booking time between the three-room flats and the others (Table 3).

When flats were sold at the first stage, four-room flats were booked the fastest, followed by two-room flats, and lastly three-room flats, which were booked the latest (Fig. 10). At the second stage, all flats sold in a similar time regardless of the number of rooms (Fig. 11). In the third stage, one-room flats sold fastest, followed by two-room flats, then four-room flats, and three-room flats once again took the longest time to sell (Fig. 12). At the fourth stage, four-room flats were booked the fastest, followed by two-room flats and, finally, three-room flats (Fig. 13).

The great popularity of four-room apartments results from the interesting location of these apartments: they are often located on the highest floors of buildings, so-called penthouses. The popularity of small apartments (1 and 2 rooms) is influenced by the relatively low price of the apartment and these are often apartments purchased with an investment in mind. The greater popularity of four-room apartments over three-room apartments may also result from their surface area - when buying the same amount of square meters, you buy an apartment with an additional, separate room.

The next attribute analyzed was the view from the window, analyzing all four phases together shows no

significant differences in the time to sale of flats depending on whether the windows in the dwellings face the outside of the development or the inside. However, the analysis of this attribute across the different stages of construction proved to be significant (Table 3). For the sale of flats in the first stage, the location of the windows did not have a significant impact on the timing of the sale, this is due to the fact that, during construction of this stage, the surroundings on all sides were unattractive (demolition work on the remaining land). On the other hand, in the second and third stages, when the construction site had already been partially cleared, the view from the windows had a significant impact on the speed at which the flats were sold: in Stage 2, flats without windows on the outside of the development were sold faster, while in Stage 3, flats with exposure to the outside were sold faster. Flats built in Stage 2 with window exposure to the outside of the development largely meant exposure to the railway embankment. In Stage 3, on the other hand, external window exposure meant a view of the surrounding green areas. In Stage 4, again, the view from the windows was not significant - the flats built in this stage have a view either of the flats on the estate (inside) or of the flats of other estates (outside).

The building line attribute was important for the timing of sales of new flats in the analyzed housing estate (Table 3). The fastest selling properties were those located in the fourth building line. These are flats overlooking green areas (allotment gardens). There was similar interest in flats located in the second and third building lines. It should be noted that an internal road passes through the middle of the estate (between the second and third building lines) with parking spaces on both sides, which makes the distances between the buildings quite large.

The building line significantly influenced the time to sell for the 2nd and 3rd Stage sales. In the second stage, flats located in the second building line (further away from the railway embankment) were sold significantly faster, and in the third stage, significantly faster sales were noted for flats in the fourth building line, overlooking the allotment gardens, were sold significantly faster.

For flats built in Phases 1 and 2, it was examined how the neighboring railway embankment was a significant factor affecting the time to sale (Table 3). In both stages, flats without a view of the railway embankment were sold faster (in Stage 1 the difference was statistically significant)

There were no significant differences between the time of sale of flats with a garden or balcony at the different stages of the development.

The last attribute of the flats analyzed was the location of the property on the floor. Analysis of the total of all flats built (Table 3, fig. 14) indicates that flats on the top floors were significantly more popular, especially those located on the 6th floor (flats with terraces).

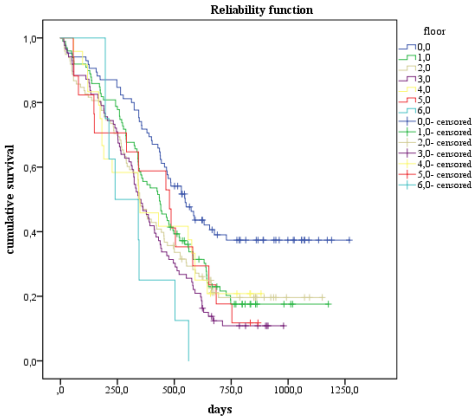


**Fig. 14.** Duration curves for new housing sales by property location per storey *Source*: own study.


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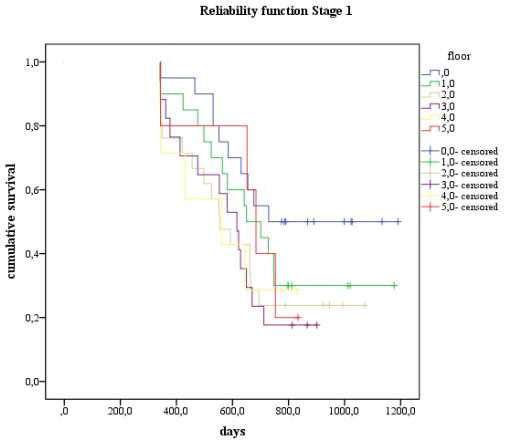


**Fig. 15.** Duration curves for new housing sales in Phase 1 by property location per storey. *Source*: own study.

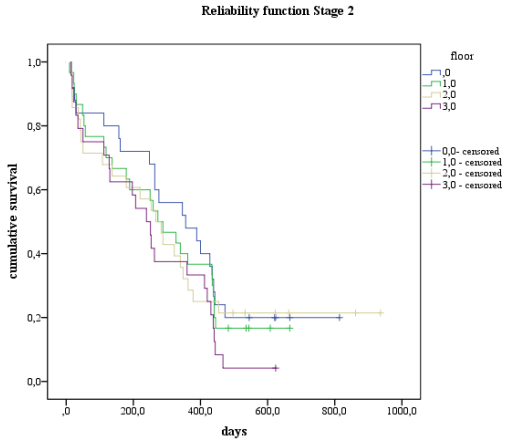


**Fig. 16.** Duration curves for new housing sales in Phase 2 by property location per storey. *Source*: own study.

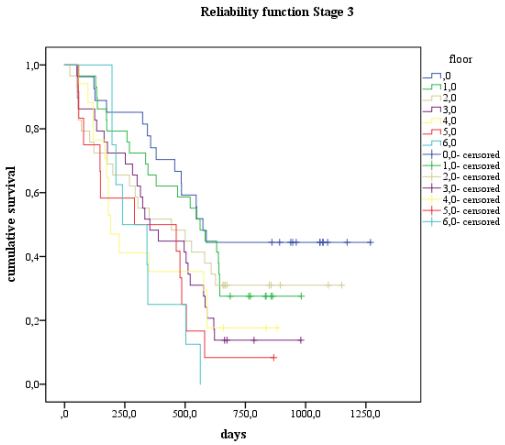


**Fig. 17.** Duration curves for new housing sales in Phase 3 by property location per storey. *Source*: own study.

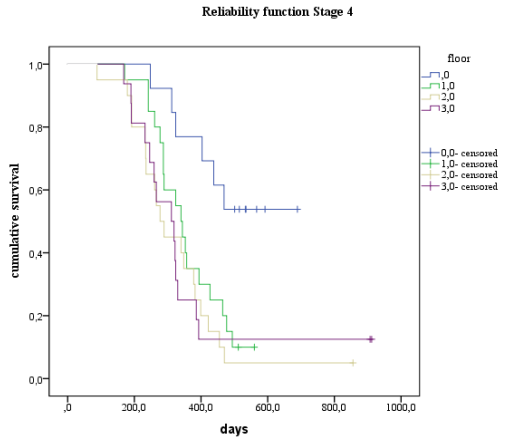


**Fig. 18.** Duration curves for new housing sales in Phase 4 by property location per storey. *Source*: own study.

In the first stage of the estate construction, apartments on the 2nd, 3rd and 4th floors were booked in a similar time, while apartments on the ground floor were the least popular, though the differences in the booking time were not statistically significant (Fig. 15, Table 3). In the second, third and fourth stages, apartments located on the top floor were booked the fastest (these were the 3rd, 6th and 3rd floors, respectively), while apartments located on the ground floor were booked the slowest (Figs. 16-18). The differences in the speed of selling apartments by location on the floor for the third and fourth stages were statistically significant (table 3).

### 3.3. Hedonic regression of newly built dwellings

The next stage of the research carried out was to determine to what extent selected attributes of newly built flats influence the speed of their sale. The attributes included in the study were the number of rooms, the location of the flat on the floor, the exposure of the windows to different world sides, and the stage of construction of the flat. The reference level for the following variables was respectively: 2 room flat, 1 storey (ground floor), east and stage 1. There were only 4 1-bedroom flats and they were omitted from the study. Linear hedonic regression was used. The estimated parameters are presented in Table 4.

The time to sell dwellings (TOM) was very strongly influenced by the location, understood as the stage number. Flats in the first stage took the longest to sell, while the fastest to find buyers were dwellings built in the second stage, on average 372 days (over a year) faster than those in the first stage (Table 4).

Three- and four-bedroom flats took significantly longer to sell (206 and 170 days longer respectively) than two-bedroom flats - these were the most desired by buyers.

The storey also significantly influenced the TOM. Premises located on the fifth floor had the shortest selling time, i.e. 297 days less as compared to those located on the ground floor. Units located on the third

and fourth floors also had significantly shorter selling times compared to units located on the ground floor (131 and 155 days respectively).

**Table 4**
Structural parameters of the hedonic regression function of the time of sale (TOM) of newly built dwellings

| Variables | *b* | Error std. | *p* |
|---|---|---|---|
| Intercept | 681.256 | 33.046 | 0.000 |
| 3 rooms | 206.395 | 26.217 | 0.000 |
| 4 rooms | 169.910 | 51.262 | 0.001 |
| 2nd storey | -89.184 | 27.771 | 0.001 |
| 3rd storey | -130.570 | 32.684 | 0.000 |
| 4th storey | -154.684 | 59.277 | 0.009 |
| 5th storey | -296.506 | 83.416 | 0.000 |
| 6th storey | -98.420 | 39.397 | 0.013 |
| West | -62.128 | 23.459 | 0.008 |
| North | -29.279 | 28.684 | 0.308 |
| South | -158.309 | 30.385 | 0.000 |
| 2nd stage | -372.047 | 32.328 | 0.000 |
| 3rd stage | -171.534 | 30.087 | 0.000 |
| 4th stage | -300.188 | 35.927 | 0.000 |

*Source*: own study.

Another variable significantly reducing the time to sale was the exposure of the flat to the direction of the world. Flats with southern exposure were the most popular (TOM shorter by 158 days). Considering the exposure of the windows to the direction of the world. flats with eastern exposure took the longest to sell. For flats built in the first and second phases,. in the first line of development, this meant a view of the railway embankment from the window.

## 4. Discussion

The research presented here concerns the time on sale (TOM) of newly constructed residential properties in a selected housing estate in Szczecin. The study used the methods of duration analysis and hedonic regression to determine the significant attributes of the properties influencing TOM. The analyzed attributes related to the dwelling's structural characteristics (number of rooms, location on the floor, balcony or garden, exposure of the dwelling's windows to the directions of the world or to the outside of the housing estate) and neighborhood characteristics (neighborhood of the railway embankment, view from the window). It should be emphasized that the research presented here investigates the impact of selected attributes on the time of sale of a property, whereas the research conducted to date has focused on the price or value of a property. The results obtained largely confirm the observations made in the cited studies.

Flats located on the top floors of buildings were sold faster, although the buildings analyzed in the present study were much lower than those presented in the literature (Chau et al., 2001; Chau & Ng, 1998; Conroy et al., 2013; Eng Ong, 2000; Mok et al., 1995; So et al., 1997; Tse, 2002).

Flats with the same area but more rooms were more popular. In contrast, Wittowsky et al. (2020) indicated the opposite relationship. It should therefore be assumed that the possibility of an extra room and increased functionality of the flat is more important to Polish buyers than was the case in Dortmund, Germany.

Similar to the literature cited (Dombrow et al., 2000; Yamagata et al., 2016; Yu et al., 2016), the view from the windows was important for the timing of property sales. Flats with more favorable views were sold faster. Depending on the stage. this was a view of the housing estate (instead of the railway embankment) or of the green areas - Stage 3.

Also the immediate surroundings of the building affect the TOM. An undeveloped and untidy area with remains of previous buildings negatively affects the time to sell the property, as observed for flats built in Stage 1. An analogous relationship was described by (Hajnal, 2017; Kiel, 1995; Kohlhase, 1991; Mendelsohn et al., 1992; Nelson et al., 1992; Thayer et al., 1992).

Adequate natural exposure of the property was also important for new residents of the estate. Dwellings with southern and western exposures were sold faster than those with northern and eastern exposures, confirming observations by Boyce et al. (2003), Osibona et al. (2021), van Bommel & van den Beld (2004) and Weiss et al. (2016), about the impact of daylight on the health and well-being of residents.

## 5. Conclusions

This paper presents a summary of research into the impact of selected attributes of newly built residential properties on the swiftness of their sale. An initial database of new dwellings built within a single housing estate between 2014 and 2022, by a developer in Szczecin, was obtained and then supplemented with a number of attributes relevant to the purpose of the study. The entire development is characterzsed by coherent development, a well thought-out development concept and attractive residential units. Construction was divided into 4 phases.

Duration analysis and hedonic regression were used to analyze the impact of attributes on TOM. The results obtained allow the following conclusions to be drawn:

1) TOM is influenced by the exposure of the flat's

windows to the directions of the world. Flats with a western or southern exposure sold faster (confirmation of H1),

2) the view from the window to the outside of the estate accelerates the sale of the property, but provided that the view is favourable. In Phase 3, the windows outside the development faced green areas and these flats sold faster, whereas in Phase 2, the windows outside the development faced the railway embankment – with the unfavourable view lengthening the time to sell (verification of H2, conditionally),
3) verification of H3 that a view from the window without the railway embankment reduced the time to sell the flat,
4) flats located on the top floors of buildings, regardless of the stage of construction, sold faster (confirmation of H4),
5) the stage of sale had an impact on the speed of TOM. The fastest flats were sold in Phase 2, the slowest in Phase 1 (confirmation H5).

The study presented here indicates that the condition of the immediate surroundings, the immediate vicinity of the buildings in which the flats are located, as well as the view from the window and the sunlight exposure of the premises, are extremely important elements for purchasers of new properties. The reason for the prolonged sales time of Phase 1 can be attributed to the very unfavorable environment of the ongoing construction. The site, at this time, was just being prepared by the developer for the next phases to be carried out, and hence there were remains of previous buildings and waste from earlier activities on the property. As work (including clean-up) continued, the property gained in attractiveness.

Buyers choose flats that will provide them with adequate comfort, hence less interest in flats with windows directly facing the railway embankment. At the moment, the embankment is poorly used, but in a few years' time, a much higher number of passing trains should be expected due to the opening of the Szczecin Metropolitan Railway. Noise and floating dust limit interest in these flats.

Flats with windows facing green areas (allotment gardens), as well as those with southern and western exposures, which provide thermal comfort and adequate light, sold faster.

The results also provide important practical information, for investors, developers or architects preparing to develop new land, on the preferences of potential customers. Purchasers of new flats value tidiness on the construction site, the absence of noise in the flat, a view of green areas from the window and adequate sunlight in the dwellings.

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