The Effect of Museums’ Internal Spaces Characteristics
Upon visitors’ Space Use Patterns: Qatar Museums as a Case study

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Abstract: Visitors' space use pattern in museums is the mechanism by which visitors can understand and comprehend the internal display environment through a series of behaviors that begin with Capture, Navigation and ends by stopping to view display content. To find out the effect of the internal physical environment of the display spaces which consist of (the display containers) represented by the surrounding surfaces and (display content) of exhibits, the organizational characteristics of each one had to be studied to know their impact in these different patterns of space use. The relationship between the patterns of display space use represented by (visitors exploratory movement and stopping to view exhibits) and the internal space characteristics represented by (organizational relationships of display container and content) is a phenomenon that didn't have a great deal of studying despite its role in making the museum experience successful. Accordingly, the research aimed at shedding light on the nature of this relationship through studying a group of neutral display spaces for the display containers with their contents along with their different spatial organization between two of international museums within an interactive approach based on the actual analysis of the visitor behavior by observation and tracking in addition to carrying out syntactical analysis for the display halls in the selected samples with Depthmap UCL software. The results of the practical study showed that the matching between the display container and island display content in the spatial organization raises the learning opportunity and going deeply into the display content as well as stimulating the interaction of visitors through focusing on exhibits on one hand, this interaction with display, on the other hand, towards wall display content increases as much as this matching decreases.

Key words: Display container, Display content, Wall display, Island display

1. Introduction:

Many questions about the way that internal display spaces stimulating the visitor behavior through the interaction of both experience contexts (physical and personal) In this regard, many researchers present theories in psychology and human behavior, in order to achieve the goals of museum (educational, recreational and economic) as well as the architect, interior designer and museum curator can understand the spatial structure of museum, in order to organize and coordinate galleries and exhibits within it.

The fundamentals is to deepen and widen the visitor's experience, depending on the prediction of syntactic approach, in additional to interactive one including observation and tracing, which estimate the difference between the model visitor and the model user, the former refers to designer plan and strategy for organizing an exhibition, while the latter refers to visitor's actual experience.
The study classify the visitors’ space use patterns, and there reliant on the spatial configuration of the exhibit container and content. By analyzing previous literature, the research problem and goal stated, by practical application the research find out conclusions and recommendations for interior designers and museum curators.

2. Display Containers and display contents in museum buildings:

Museum buildings, as a spatial type, can be identified through many spaces consist of Presentation Areas which include gallery-display halls, and catchments areas which include assembly and reception spaces (1,2005, p72), the display spaces can be divided into two main components (display container and display content). While display containers consist of (limited surfaces) with physical, visual and symbolic shapes, and (Finite space) identified by these surfaces (21,1992 P.85), the display content can be described as a combination of (display components and the way of organizing those components), this is usually called an (Exhibit unit).

The display components include objects (painting, carving, etc.), Text information, (Audio and video) communication media (9,2011, P.62-63) these contents arranged in a certain way to create a set of spatial relationships between them or relatively to the display space, which affect the behavior of museum visitor in one way or another.

3. Visitor behavior in the internal exhibit spaces of the museums:

Psychologists and sociologists emphasize the reciprocal relationship between man and environment. Visitor's attention distorted, by a large number of stimulus inputs. Capture or attraction visitor's attention happened through the mechanisms of "Orienting or searching", "orienting" is defined as the visitor's awareness of the environment (what he sees, what he does, how he organizes his visit, how he finds his way and where he finds his destination) (7,2010, p.05) The perception of the internal space of the museums is mediated by the visual sensation in the first place, although in some cases acoustic tactile and olfactory may afford information (24,1977, p.186)

"Searching” means trying to find something of potential benefit in exhibit environment (15,2002, P01). Searching have two types; sequential (serial) searching is one thing after another, until find something interesting. Parallel (Simultaneous) searching means inspecting the total number of exciting elements randomly, looking for something surprising for them (7,2010, P.05)

Sandifer classified visitor's behaviors as Attention, Pointing, Touching, and Reading (27,1997, P.691) and he focuses on "time" as an indicator to measure the strength of this behavior, without supposing sequential possibility for this behavior, unlike Bitgood who classified visitor's actions sequentially beginning with looking, ending with approaching and stopping(7,2010, P.28)

That is to say, there are many behavioral indicators including (scanning or glancing, looking, approaching, and finally stopping) which identify visitor's behavior in Museum.

4. Visitors’ space use pattern in exhibition space:

Visitors space use pattern are represented by the exploratory movement and stopping to view the contents of the display. The visitor's movement requires a deeper understanding of the patterns of movement observed in these spaces (7,2010, P.15), which includes "direction and Speed of movement (11,2011, P.318), previous studies focus on visitors’ space use patterns such as navigation, exhibit viewing, and pausing at displays (26,2012, P.01) which considered indicators of behavior, therefore attention paid to the role of the designer in facilitating convergence between visitors and exhibit through spatial arrangement, and to the role of museum curators, by fixing the sequence of exhibits with their explanations (written and auditory) according to a certain sequence in order to make the exhibits accessible and comprehensible (20,1989, P22-40), the exploratory movement directed to unexplored spaces before previously visited spaces, and the process of selecting the path depends on the local information firstly, remembering the previously explored places secondly, and the predictability of unexplored places that increase the information thirdly(23,1990 P.01)
Choi points out that the spatial organization affects the patterns of exploratory movement and the encounter. The term "Encounter" refers to the encounter of the visitor with displays or exhibits only, but not interacting with it. (14, p.01) the more consequential organization the more restricted rules of movement, The more free organization the more unrestricted movement, furthermore the visitor's behavior in exhibition spaces involves group of stopping patterns within display rooms.

4.1. Visitor stopping to view exhibit content:

While stopping, visitor wants to see, to scan the exhibits visually, or to look at the space of the galleries, this type of stop called "scanning stops", which indicates the relative frequency within each stop, which is usually higher in the zones where the movement is concentrated, because viewing stops may not be related to the zones of the exploratory movement, unlike the scanning stops which is related to these zones (25,2009, P06)

Visitor stopping usually considered at least one second while the visitor is looking at an object. (25,2009, P2), also landmarks may affect visitor traffic, not only attracting the visitor's attention but also attracting them and thus affecting the circulation pathway, the physical proximity is important to attract attention, as the majority of visitors tend to pay close attention to the exhibits in close proximity. In other words, the elements that fall within the circulation pathway are the most attractive, as the visitor refuses to make a few additional steps to explore a distant zone in the viewing zone (7,2010, P.16)

4.2. The relationship of exploratory motion with visitors stopping to watch:

Museum Visitors explore the course of their tour freely, and choose to stop wherever they want to view the content of the presentation, but they are also free to ignore many important content, by stating a reference point of his own and arranging those exhibits relatively visitor find his pathway, in case of weak linkage to the exhibition, the visitor tries to establish a strong linkage with the exhibition space by his exploratory movement through it. (13,2005,P2)

Karakji study suggests that museums with clear pathways stimulate the visitor towards the exhibits by increasing their interaction with them, that means the exploration of space may somehow be frustrating to stimulate the visitor towards the exhibits, The museums with unclear pathways stimulate the visitor (Physically and mentally) to space through exploration at visual and movement level, due to the randomization and multiple choice (2,2012, P14), the exploration begin with a transformation into a pattern of contemplation. Thus, visitors will have an incentive to stay in some spaces more than others, this reduces the effect of space organization upon visitor's position. In other words, space will be more effective in describing the dynamic order more than the static one (14,1997, P6)

Many studies suggest that patterns of behavior connected with exploratory movement and viewing of display may be consistent synchronically.

5. Characteristics of display containers affecting visitor behavior:

Display containers have many characteristics, like spatial one, and the exhibition spaces in the museum have various forms according to the method of movement between these spaces and spatial sequence, these different configurations of the spaces enhance the perception of visitor for the direction of his movement (5,2007, P146)

5.1. Physical Space Organization Characteristics for Display Containers

Including the characteristics of the space structure, globally and locally, which affect the visitor's behavior (19,1993, P35)

The global characteristics for organization of the display containers reflect the relationship between any point in the system with other parts (18,1987, P236). This research distinguishes many types of global space organization for display spaces, such as Sequential organization, in which the spaces are sequentially arranged or connected, the labyrinth or matrix organization, where connections in both directions. Room within room organization, where the display space contains another smaller space to
ensure the visual and spatial continuity between them, (26,2012,P4) and finally the Open Plan organization, where free space contain no barriers and partitions (22,2012, P.208).

Previous studies, confirm that the design of galleries with restricted movement motivate visitor's interaction by focusing on and viewing the display (as in sequential organization) (26,2012, P01). While visitor focuses on moving through randomly organized spaces, (such as the labyrinth and open-plan organization).

The local spatial organization of the display spaces represents the direct relationship of the display space with the adjacent spaces (18,1987, P236) in terms of entrances and Exits Positions and numbers, which classified to corner position and central position. The former provides greater permeability than the letter, while the letter (the central position) have entrances in the middle of the barriers (26,2012, P5), and allows movement through the central part of the display space.

Rholoff points out that corner entrances keeps greater visual permeability without interruptions, while the central entrances (opposite or staggered) only contribute in viewing a few adjacent spaces (26,2012, P4-5) It also indicates that staggered entrances create opportunities to change the view direction of the sequential display (26,2012, P9). Melton asserts that visitor chose the nearest exits to him (12,2011, P-358), the exit act as visitor attractor, Therefore the number of exits is inversely correlated with visitor stopping.

**Physical spatial organization** is an effective tool in determining the global & local spatial relationships of the display containers, excluding both the personal and social contexts, the physical spatial organization focuses on the physical relationships of these containers.

5.2.**Visual & Axial space organization characteristics for display containers**

Previous studies shown that the exploratory movement of the visitor affected by the global and local spatial visual relationships of the display spaces. The spatial organization characteristics of the galleries help in the establishing a network of visibility relationships, which enables the visitor observing the exhibits and perceiving the building as a whole (25,2009, P02).

Space syntax studies introduce a method of syntactical analysis for the relationships between spaces within two levels; locally and globally (18,1987, p236), here the spatial organization could be analyzed, visually and axially, the morphological structure could be perceived, enabling the comparison between different spatial systems (17,1984 P93), using axial and convex diagrams the visual and axial organization characteristics could be expressed (17,1984, P90-92). In order to express the visual characteristics as a visible zones, the visibility graph is used to expresses the total visual depth for the entire system of spaces (2,2012, P07)

Space Syntax focuses on the space relationships aspects, where the spatial visual & axial perception begins with local characteristics ending with understanding the whole environment. Thus, the rules of space syntax give a physical and cognitive perception of the display space, because the syntactic characteristics predict the visitor's spatial behavior, therefore, other factors influencing the visitor should be taken into account, as the organizational characteristics of the display contents within environment, then analyzing behavior with observation methodology, as indicated in the interactive approach studies to be addressed later.

5.3.**Visual Non- Syntactic characteristics for display containers:**

Benedict suggested a partial description for the composition of the surrounding visual matrixes, called "Isovist"; which mean the visual data available from the receiver's point of vision, such as “isovist Area” the Amount of visualized space, “isovist Perimeter” Surrounding enclosing surfaces, “Isovist occlusivity” surfaces length that close vision “Isovist maximum-minimum radial” for sight length (6,1979,P47-65).
The advantage of these non-syntactical features is that it focuses on the local characteristics of space only, therefore it is ineffective in determining the visual interaction with the global system for the whole spaces.

6. Display content characteristics affecting visitor behavior
The display content characteristics that affect the visitor behavior include organizational, physical characteristics, and that related with the display container, which the research classified into:

6.1. Spatial organization of display Content
Display content organization is the arrangement manner for the exhibits and their relative location relative in the display space, (the organizational relationship between the container and the display content). In their study “Visitor Circulation through a Changing Exhibits Gallery 2006” Bitgood, Hines, hamburger & ford offered three main types for this organization; (Wall display) in which display content hangs on the container's walls, or as a part of it (for example, various wall paintings and painters' works), (Island display) where the display content is separated from walls and usually located in the center of the display space, and (Peninsula display) where the display content is connected to the wall, but it is jutting from it (10,2006, P268).
Most studies indicate that the visitor's movement influenced significantly by the spatial organization of the (island display) content. Shettel asserts that the (island display) content creates negative pockets, because the flow of visitors does not make all island contents on the same line of sight (28,1976, P43), while the (peninsula organization) may be more interest for the visitor, because it occurs on the same line of sight for the visitor, which means that the relative physical proximity and location for the line of sight affects the visitor space use patterns.

6.2. Display content physical characteristics
Stimulus salience or distinctiveness, such as large-scale element, those isolated from other elements, or in contrast with setting background (8,2002, P8), three dimension objects also tend to draw attention more than the two dimensions, and there are other displays characteristics, such as color tone, and shape. (4,1968, p181-182) In addition to the differences between the characteristics of individual exhibits with those in groups (exhibit organization)

6.3. Organization or layout of exhibit elements
Which is related to the visual and physical access to the display, and is affected by the relative location of the exhibits to the line of sight, and the physical proximity of the person, such as the elements displayed along the path of motion (7,2010, P6), therefore the exhibits height considered one of the important considerations in the organization of exhibits, people choose to see the easiest option, so (6-7 feet) height considered difficult to observe.
Previous studies indicate that the appropriate vision for the exhibits details achieved within one foot higher than the level of view (not more), while the lower level of viewing can be three feet (not more)(16,1980, P339) Also the distance between the visitor and the exhibits was considered equal to the object width to take the best image (30,1970, P21)

The process of decision-making for the visitor produce a set of behaviors (looking at, exploratory movement, or stopping to view the display), caused by the characteristics of the spatial organization of the container and the content, while the qualitative characteristics of the exhibits (Artistic, scientific, technological..) affect the visitor interaction with the content, which considered a subsequent stage, in opposite to the organizational characteristics of the container and the content, which significantly affect the visitor space use pattern.

7. Studies that dealt with the visitor's behavior in the interior spaces
Different studies tried to analyze the behavior of the visitor to museum, Science of Environment Behavior for example, the researchers deal with the relationship between visitor behavior and the environment, Such as the study of Bitgood (2006), which dealt with the effect of exhibits spatial organization and exhibits physical characteristics (size and color) on visitor behavior through one exhibition space. While Museology studies are usually based on different visitors categories depending on the impact of time spent upon the behavior of the visitor to reveal the modes of knowledge communication, such as Sandifer1997 (27,1997, P690). The behavioral studies derived from the space syntax rules, provide a quantitatively analyzing and describing method for spatial and visual organization of the local and global characteristics, such as the study Choi (1997), Rholoof & Wineman (2009), Karcji (2012)& Rholoof(2012).

While the behavioral studies based on the interactive approach pay attention to each of the internal and external factors affecting the visitor of the museum, such as the internal environment, the museum’ visitor and the interaction between both of them. It also deal with pre-visit agendas, psychological, physiological processes, and spatial organization inseparable (11,2011, P322). These studies may be based on space syntax analysis, by following the observation methodology in analyzing visitor behavior, instead of prediction only.

None of the previous behavioral studies were an inclusive study, that is to say, combining the characteristics of spatial organization between both (container) and (content) "together", which may affect the visitor’s experience in space behaviorally (research problem).

8. Research Objective and Methodology

Studying the global and local visual and axial characteristics (for the display containers and their contents together), selected within specific space organizations (sequential, labyrinth or matrix), In order to determine the effect of the spatial organization of the contents (wall, island) upon changing the visual and axial values, and then determine the relationship of (matching the axial and visual zones) with (patterns of visitor space use "exploratory movement and stopping to view contents")

9. Practical study and application requirements:

An analytical study for the exhibition spaces will be carry out in four stages:

A. Documentation stage : Scanning and photography the display container and content assets (organization, locations), and drawing layers to scale by using AutoCAD program, Figures 3,4

B. Exploratory stage: aims to explore the possible relationships between variables. After drawing the layers, it was imported to Depthmap program, which analyzes the visual and axial relationships for the display containers and the contents in each case, then adding layer of moving and stopping visitors, As shown in figures 5,6,7,8. By matching these layers, the research tries to explore the possible relationships between (visual and axial organization) with (the number of people stopping to view the display content, the number of people moving and their paths),

C. Testing stage: It is designed to test the relationship between the independent and dependent variables, hence measuring the higher values of zones and axes, then the least gradually less than (the variables of visual and axial organization in each space), which were analyzed in the Depthmap program., As well as the percentages of stopping and moving visitors numbers in each space, as in tables 2,3
### Table 1. shows the organizational characteristics of display containers and contents in the museums (researcher from the practical study)

| Name of Museum and Symbol | Global Organization of Display Halls | Hall name | Hall Symbol | Global Organization of Display Containers | Local Organization |
|---------------------------|-------------------------------------|-----------|-------------|--------------------------------------------|--------------------|
| Islamic art first floor   | sequential (ring chain)             | Figure in art | R1 | common | 2 | common |
| IAM                       |                                     | Figure in art | R2 | Wall | 2 | common |
|                           |                                     | Writing in art | R3 | common | 3 | central |
|                           |                                     | Arabic calligraphy | R4 | common | 4 | corner |
|                           |                                     | Islamic art | R5 | common | 3 | central |
|                           |                                     | Pattern in art | R6 | common | 4 | corner |
|                           |                                     | Pattern in art | R7 | common | 3 | central |
|                           |                                     | Science in art | R8 | Wall | 2 | common |
| Arab museum of modern art | labyrinth                           | Science in art | R9 | Wall | 2 | common |
| AMMA                      |                                     | Jamaheer | R1 | Wall | 4 | corner |
|                           |                                     | Jamaheer | R5 | Wall | 4 | corner |

![Figure1](image1.png) (Museum of Islamic art) in Qatar Reference: Researcher from study

![Figure2](image2.png) (Arabic museum of modern art) in Qatar Reference: Researcher from study

D. **Data processing stage**: Measurement of independent variables, including:
- Global and local Space Organization for Display Containers:
  - Global space organization: nominal variable that includes (sequential organization (ring chain), labyrinth “matrix” organization), Table 1.
  - Local space organization includes: the number of ports (entrances and exits) for each space, and its location in the containers for both museums, (central, corner, common ports), Table 1.
- Spatial organization of the display content: Wall organization, island organization, and common organization (wall and island), Table 1.

9.1.**Visual & Axial spatial organization of display container and content**
Depthmap program used to obtain visibility graph analysis, & axial map as indicated above, furthermore this analysis take into consideration display content. These variables include:
(Visual Integration, Visual Connectivity, Integration, Connectivity).

9.2. Depending variable:
- The number of stopping people to view the content and positions: the stoppage for at least 1 second while the visitor is looking at an object in "wall or island" display.
- The number of moving people and their movement lines in the display spaces: Identifying high and low density zones of the movement lines and its directions in space,

9.3. Data manipulation and calculation of variables values
- The values of visual zones for the visual organization variables globally and locally, as well as the axial lines, values for each space, are calculated depending on the variable values hierarchy (according to color divergence of the visual zones and the axial lines in Depthmap program) table3
- The number of stopping people at the display content (wall, island display) relative to visual zones, the number of moving persons calculated according to the axes. Table3

Finding the relationship between the variables:
- The correlation between variables of the axial organization with variables of the visual organization in each space, (the correlation between the connectivity & visual Connectivity)
- The correlation between (Matching between visual zones and axes for each space) and (the ratios of moving and stopping visitors in the same space), using Spss program to find correlations for each, Table 3

Figure 3. plan of containers, shows display contents, move and stop visitors in green & red color icons in IAM 1:1000 (researcher from practical study)

Figure 4. plan of containers, shows display contents, move and stop visitors in green & red color icons in AMMA 1:1000 (researcher from practical study)
10. Results and conclusions:
As shown in table 2,3 Chart 1,2, the results are taken in similar halls. Similarities include: characteristics of local organization of spaces (locations and numbers of ports), types of global space organization (sequence, matrix organization), and types of spatial organization of display content (wall display, island display).

**Table 2.** shows the numbers and percentages (moving and stopping) people to view the content (practical study)

| Museum name and symbol | Hall symbol | Number of moving | Number of stopping to view content in the hall | Ratio of moving people in the hall | Ratio of stopping people in the hall | Ratio of stopping people at wall | Ratio of stopping people at island |
|------------------------|-------------|------------------|-----------------------------------------------|----------------------------------|------------------------------------|---------------------------------|-----------------------------------|

**Figure 5.** Relation between (visual connectivity zones plan) and (stop,move) visitors in IAM 1:1000, researcher from practical study

**Figure 6.** Relation between (connectivity axes plan) and (stop,move) visitors in IAM 1:1000, researcher from practical study

**Figure 7.** Relation between (visual connectivity zones plan) and (stop,move) visitors in AMMA 1:1000, researcher from practical study

**Figure 8.** Relation between (connectivity axes plan) and (stop,move) visitors in AMMA 1:1000, researcher from practical study
Symbol | people observed in the hall | Stopping to watch the wall display | Number of moving people/Total number of persons observed | Number of stopping people/Total number of persons observed | ~display Number of stopping people at wall display/Total number of stopping persons observed |
---|---|---|---|---|---|
R1 | 21 | 13 | 8 | 0.61 | 0.38 | 1 |
R2 | 12 | 8 | 4 | 0.6 | 0.3 | 0.33 |
R3 | 34 | 15 | 2 | 17 | 0.44 | 0.55 | 0.1 | 0.89 |
R4 | 12 | 8 | 4 | 1 | 0.66 | 0.33 |
R5 | 27 | 12 | 2 | 13 | 0.44 | 0.55 | 0.13 | 0.86 |
R6 | 9 | 2 | 7 | 1 | 0.22 | 0.77 |
R7 | 24 | 8 | 2 | 14 | 0.33 | 0.66 | 0.12 | 0.87 |
R8 | 10 | 4 | 6 | 0.4 | 0.6 | 1 |
R9 | 6 | 6 | 1 | 1 |

IAM

| AM | R1 | 5 | 1 | 4 | 0.2 | 0.8 | 1 |
| R5 | 6 | 6 | 1 | 1 |

Chart 1. relationship between (matching between movement & vision axis) and visitor space use patterns in halls of shared display halls. (Practical study)

Chart 2. relationship of (correlation between motion axes & vision) with visitor space use patterns in halls of wall display. researcher from practical study
Figure 9. Museums of Islamic art & modern art hall pictures in one tour
(Researcher from practical study)
Table 3. The values of (visual zones, axis) and the correlation values between (movement and vision axis) in the halls of (Islamic Art Museum/ first floor) and (Arab Museum of Modern Art/ ground floor) (Practical study)

| Visual integration | 5.41 | 4.04 | 5.24 |
|---------------------|------|------|------|
| Visual connectivity | 903 | 579 | 297 |
| Integration         | 661 | 376 | 325 |
| Connectivity        | 867 | 927 | 635 |
| Correlation         | 628 |      |      |

| R1                  | 4.88 | 3.98 | 3.74 | 4.38 |
|---------------------|------|------|------|------|
| Connectivity        | 205.2 | 290.57 | 153.024 | 247.97 |
| Correlation         | 202.35 | 352.6 | 197.9 | 254.0 |
| Correlation (IAM)   | 127.0 |      |      |      |

| R2                  | 1186 | 1178 | 1090 | 1009 | 1045 | 899 |
|---------------------|------|------|------|------|------|-----|
| Visual connectivity | 450.0 | 677.0 | 670.0 | 650.0 | 656.0 | 522 |
| Correlation         | 660.0 |      |      |      |      |     |

| R3                  | 1079.0 | 1117.0 | 1102.0 | 1137.0 | 1132.0 | 1132.0 | 1139.0 | 1127.0 | 1113.0 | 1032.0 | 986.0 | 1031.0 | 1054.0 |
|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Visual connectivity | 1046.0 | 1065.0 | 973.0 | 1020.0 | 1018.0 | 1009.0 | 1003.0 | 1001.0 | 1010.0 | 1008.0 | 999.0 | 1017.0 | 861.0 |
| Correlation         | 843.0 | 957.0 | 932.0 | 910.0 | 859.0 | 707.0 | 349.0 |      |      |      |      |      |      |

| R4                  | 4.77 | 3.64 | 3.52 | 4.32 |
|---------------------|------|------|------|------|
| Visual connectivity | 613.0 | 608.0 | 382.063 | 370.75 |
| Correlation         | 593.0 | 593.0 | 457.0 | 457.0 |
| Correlation (IAM)   | 457.0 |      | 331.0 |      |

| R5                  | 4.57 | 4.22 | 3.41 | 3.41 |
|---------------------|------|------|------|------|
| Visual connectivity | 1079.0 | 1117.0 | 1102.0 | 1137.0 | 1132.0 | 1132.0 | 1139.0 | 1127.0 | 1113.0 | 1032.0 | 986.0 | 1031.0 | 1054.0 |
| Correlation         | 1046.0 | 1065.0 | 973.0 | 1020.0 | 1018.0 | 1009.0 | 1003.0 | 1001.0 | 1010.0 | 1008.0 | 999.0 | 1017.0 | 861.0 |
| Correlation (IAM)   | 843.0 | 957.0 | 932.0 | 910.0 | 859.0 | 707.0 | 349.0 |      |      |      |      |      |      |

| R6                  | 4.77 | 3.64 | 3.52 | 4.32 |
|---------------------|------|------|------|------|
| Visual connectivity | 613.0 | 608.0 | 382.063 | 370.75 |
| Correlation         | 593.0 | 593.0 | 457.0 | 457.0 |
| Correlation (IAM)   | 457.0 |      | 331.0 |      |

| R7                  | 4.57 | 4.22 | 3.41 | 3.41 |
|---------------------|------|------|------|------|
| Visual connectivity | 1079.0 | 1117.0 | 1102.0 | 1137.0 | 1132.0 | 1132.0 | 1139.0 | 1127.0 | 1113.0 | 1032.0 | 986.0 | 1031.0 | 1054.0 |
| Correlation         | 1046.0 | 1065.0 | 973.0 | 1020.0 | 1018.0 | 1009.0 | 1003.0 | 1001.0 | 1010.0 | 1008.0 | 999.0 | 1017.0 | 861.0 |
| Correlation (IAM)   | 843.0 | 957.0 | 932.0 | 910.0 | 859.0 | 707.0 | 349.0 |      |      |      |      |      |      |
### 10.1 Conclusions for interior designer:
- In containers (with wall display content), the content does not change the predicted values of (movement and visual) axis.
- In containers (with island and shared content), the more matching between (movement and visual axis) generated by the container and (movement and visual axis) generated by the island content, the more value of the predicted (movement and visual) axis, and vice versa.
- (Permeable visually) island content (lower than the level of sight line) affects the movement axis of the container, and does not affect the predicted visual axis.
- (Non- permeable visually) island content (upper than the level of sight line) affects the movement axis of the container, and affects the predicted visual axis.

The specific results of the relationship between (matching between movement and vision axis) and (visitor's space use patterns) for moving and stopping, have an importance and a vital role, founded in this study, through influencing visitor behavior in museums, these results indicate that:

- More matching (movement and vision) axis in halls with (island and shared) content (in different organization of container, locally and globally), the more stopping people to view content, and with high positive correlation. On the contrary, the less matching between (movement and vision) axis, the more moving people, with high negative correlation, which means that museums containers with (movement and vision matching axis) in (island display) increase the visitor's learning ability through the interaction with contents.
- More matching (movement and vision) axis, the less stopping people to view content in (wall display) (in different container organization, locally and globally). On the contrary, the more matching (movement and vision) axis, the more moving people to view content in similar condition, with positive correlation.

### 10.2. Conclusions and recommendations for museum's curators:
- In museums with sequential space organization, it is preferable to place important and distinctive exhibits of island organization (such as carvings) in halls centers and visual intersections of ports, (also, the same in halls with central ports). The zone adjacent to halls' ports (in halls with shared ports) can be useful, because they receive more visitor's attention
- It is also preferable that these exhibits do not interrupt visual axis of the halls, and allocated lower than the level of sight line, and this is suitable for (small size, or low height) exhibits.

| Arabic museum for modern art AMM | 491.0 499.0 499.0 491.0 491.0 492.0 500.0 500.0 225.0 225.0 213.0 | 0.554 |
| R8 | 3.33 4.53 4.07 | 1186.0 1179.0 1090.0 1009.0 1045.0 899.0 491.0 491.0 492.0 500.0 500.0 225.0 225.0 213.0 | 634.0 608.0 382.063 370.75 373.53 588.0 208.82 588.0 593.0 461.58 459.44 456.622 312.0 | 3.64 3.99 2.98 4.19 |
| R9 | 4.80 4.06 3.72 5.42 | 903.0 579.0 297.0 661.0 376.0 325.0 867.0 927.0 635.0 628.0 | 3.46 3.08 | 0.406 |
| R1 | 5.48 7.80 6.84 | 264.0 255.0 260.0 261.0 257.0 289.0 277.0 | 5.68 5.27 7.58 | 4.10 | 197.0 174.0 218.0 218.0 174.0 194.0 123.0 | -0.263 |
| R5 | 5.6738 7.6081 6.8763 | 204.0 255.0 260.0 261.0 257.0 289.0 277.0 | 7.392 5.998 | 4.24 | 197.0 174.0 218.0 218.0 174.0 194.0 123.0 | -0.263 |
While exhibits that interrupt visual axes because of their large size or are higher than the level of view (such as large sculptures), are preferred to be placed parallel to the visual axes that connect the hall ports (in halls with central ports), in order to obtain the highest match in the movement axes and vision of those halls.

As for the important wall display in the galleries (in sequential and matrix organization), it is preferred to avoid putting in zones close to the ports, where they are often neglected by visitors, and placed in the corner or far from the ports) And wall centers away from ports (in the halls with corner ports) that stop visitors to view the content of the wall display significantly.

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