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Effect of CMC and Surfactant on the Physical Properties of Micro Nanofibrillated Cellulose Coating Colors

Abdelaâdim Tibouda, Benoit Delcroix, Éric Loranger, and Patrice Mangin
Lignocellulosic Materials Research Centre, Canada

Abstract: Rheological characteristics and physical properties of the micro nano fibrillated cellulose suspensions play an important role in curtain coating of paper. In curtain coating layer, curtain stability remains an issue to control the coating operation. The curtain stability is associated with rheological characteristics and physical properties of the micro nanofibrillated cellulose (MNFC) suspensions such as the viscosity and dynamic surface tension. Thickeners are used to control the viscoelasticity of the MNFC suspensions. Use of surfactant has been recognized as useful approach to increase the curtain stability because low dynamic surface tension is desirable to get a stable liquid flow. Effect of carboxymethyl cellulose (CMC) and anionic surfactant (Niaproof4) on viscoelasticity and dynamic surface tension was examined and compared. The change of air bubble content brought was also investigated. Our study showed that CMC didn't influence the dynamic surface tension of MNFC suspensions. Conversely, viscoelasticity decreases with increasing the amount of CMC in the MNFC suspensions. Furthermore, surfactant didn't have effect on viscoelasticity of MNFC suspensions but decreases significantly dynamic surface tension. In addition, we have observed that the use of CMC increases air content, but surfactant was more effective. The use of both at once generates more air bubbles in the MNFC suspensions.

Key words: micro nano fibrillated cellulose, viscosity, dynamic surface tension, elastic modulus, content of air bubbles, curtain coating

1. Introduction

Nanocellulose is a cellulosic material composed of fibrils and/or nano-sized cellulose crystals (as far as diameter or width is concerned). As cellulose is a naturel abundant organic compound originating from biomass, nanocellulose is also considered as renewable natural forest product. Micro Nanofibrillated Cellulose (MNFC), a cellulose filament with micro dimension in length and nano dimension fibrils in width, has become relatively straightforward to produce both in the laboratory and pilot scale.

Being a type of nanocellulose or "cellulose filaments", the micro-nano-fibrillated cellulose (MNFC) has a good potential for application in papermaking. Today, the use of MNFC in papermaking processes is becoming a renewed research topic [1]. As it has been shown that micro-fibrillated cellulose may well succeed in improving the mechanical and barrier properties of paper [2]. The integration of MNFC in paper products attracts more interest. The MNFC can be added with two methods. The first aim to mix the MNFC with the pulp before forming the paper [3, 4], which leads to a significant increase in the mechanical properties of the sheet (up to 21% for the tensile index for an MNFC amount of 4%). In the second method, the MNFC is applied to the surface of a wet paper sheet [5], which increases the barrier properties, such as the very significant drop in paper air permeability (from 6.5×10^4 nm $Pa^{-1}.s^{-1}$ to 360 nm.$Pa^{-1}.s^{-1}$ with a 8 g.m^{-2} MNFC coating).

The general approach of our project is to incorporate a layer of MNFC into the paper structure. To do this, it is necessary to intervene before the end of the

Corresponding author: Abdelaadim Tibouda, Ph.D.; research areas/interests: science and engineering of lignocellulosic materials. E-mail: Abdelaadim.Tibouda@uqtr.ca.

formation of the paper so in wet part on the formation table of the paper machine. It's proposed to apply MNFC during papermaking as a structuring layer within a Thermomechanical Pulp (TMP) sheet to improve the mechanical and barrier properties of TMP sheet. It can be done commercially through the use of a Hydra-Sizer^{TM}, a curtain coating equipment to be integrated at the wet-end of a paper machine, provided by the GL&V Group. To maintain the properties of MNFC in order to improve the mechanical properties and barriers, the fibrils must preserve their micro-nano dimension: they must not agglomerate and must then be well dispersed. For this reason, we thought to use Carboxy Methyl Cellulose (CMC) as dispersing agent. The effect of CMC on fiber dispersion at the micro level has been the subject of several studies [6-8]. The adsorption of CMC on cellulose nanofibrils was investigated by S. Ahola et al. [7], who demonstrates that the adsorption of CMC is reversible on the nano-fibrils film surface and that CMC adsorption results in dispersion effects. Another study by P. Myllytie et al. [6] shows the effect of CMC on the surface of fibrils using light microscopy to see the fibrils in water. The results show that when the fibers treated with CMC, the fibrillar structure on the surface of the fiber becomes very extensive and finely dispersed. On the other hand, understanding the rheology of MNFC is important to ensure a stable MNFC curtain. Regardless of how the suspension is obtained and its source, Micro Fibrillated Cellulose (MFC) in an aqueous environment reveals shear thinning behavior, i.e., as the shear rate increases, the viscosity of the suspension decreases [9, 10]. Independently of the concentration (between 0.125 and 5.9 wt %), MFC suspensions show gel-like behavior and values of storage modulus are rather high. These results show that at the lowest concentration of 0.125 wt%, MFC suspensions will form a rather strong network [9]. Other studies stated that higher concentrations result in increased yield stress and higher viscosities [11]. Furthermore, the effect of the CMC on the rheology of MFC was shown in the study of A. H. Vesterinen et al. [12]. For the (MFC+CMC) solution, the strongly shear thinning behavior of MFC disappear. The authors predict that CMC have a dispersing effect in the MFC, and that it probably decreases the amount of free water in the suspension. The rheological analyses presented, are still insufficient to formulate a proper explanation of the peculiar behavior of MFC. In this study, CMC is used to extend the dispersion of MNFCs observed at the micro level to the nano level.

The MNFC coating mixtures for curtain coating need to have curtain stability and extensional property that withstand the change in surface area and stretching in machine direction. Curtain stability is associated with the increase in surface area of the free falling curtain layer. The dynamic surface tension of the coating color is often used to see the curtain stability. To control this property diverse chemical approaches may be used which include the use of surfactants. Use of surfactants has been recognized as an easy and useful approach to increase the curtain stability since low surface tension is highly desirable to get a stable extensional curtain flow. To understand the effect of CMC and surfactant addition, the dispersing effects of CMC and surfactant effect on MNFC is researched. In other words, the effect of CMC and surfactant on viscoelasticity and surface tension of MNFC mixtures will be studied. Moreover, use of surfactants, however, tends to increase the foaming tendency of coating mixtures. Addition of surfactant to MNFC coating mixtures can generates more air bubbles that cause coating defects. The surfactant may cause rapid absorption that's why it's important to select a surfactant that increases curtain stability and at the same time causes less foaming and printing problems. The effect of surfactant and CMC on the air bubble content of MNFC coating mixtures was studied.

2. Material and Methods

2.1 Micro Nanofibrillated Cellulose

The MNFC was produced by Omya International AG with the Masuko grinding equipment. Bleached Eucalyptus fibers are co-processed with ground calcium carbonate (Hydrocarb 50–GU, Omya) in the ratio of 80% cellulose and 20% filler to improve the fibrillation of the cellulosic fibers. The obtained MNFC has a diameter varied from 20 nm (nano-part) to 15 µm (micro-part) and a length of up to 1 mm, hence the MNFC name. For our work, the MNFC suspension was diluted to a concentration of 0.5 (wt %) fibrils. The characteristics of MNFC are presented in Table 1.

2.2 Carboxymethylcellulose

In our experiments, carboxymethylcellulose (CMC) as dispersant is the Finnfix 10 from CP Kelco. It is a commercial product of minimum 98% purify grade with small amounts of sodium chloride and sodium glycolate. Its degree of substitution (DS) is 0.8, molecular weight is about 60 g/mol. The calcium carbonate used to prepare the (CMC+$CaCO_3$) solution is provided by OMYA International AG. It's the same calcium carbonate used in the grinding process of OMYA International AG to manufacture the MNFC.

2.3 Surfactant

The surfactant proposed is NIAPROOF 4 of anionic nature, i.e., with a hydrophilic part negatively charged. The critical micellar concentration is 2.1 mM and a molecular weight of 316.4 $g.mol^{-1}$. NIAPROOF 4 is a good wetting agent. For effective wetting, the concentrations considered of NIAPROOF4 are 0.01; 0.03 and 0.05%. Many types of MNFC coatings colors were prepared to examine the effect of CMC, surfactant and combined effect of these two modifiers on the physical properties of MNFC coatings colors. The MNFC 0.5%+CMC 0; 2; 4; 6% and MNFC 0.5%+NIA 0; 0.01; 0.03; 0.05% are simply referred as M-CMC 0; 2; 4; 6 and M-N 0; 0.01; 0.03; 0.05 respectively. Similarly, the $CaCO_3$ 0.125% + CMC 0; 8; 16; 24% solutions are referred to as C-CMC 0; 8; 16; 24 respectively. The different colors are presented in Tables 2-4.

Table 1 Characteristics of MNFC.

	Solid content (%)	Fillers Ratio (%)	Fibrils Ratio (%)
MNFC	3.52	0.71	2.82

Table 2 MNFC suspensions preparation to test CMC addition effect.

	M-CMC0	M-CMC2	M-CMC4	M-CMC6
Fibrils (g/g_{MNFC})	0.5			
$CaCO_3$ (g/g_{MNFC})	0.125			
CMC (g/g_{MNFC})	0	1E-4	2E-4	3E-4

Table 3 MNFC Suspensions preparation to test surfactant addition effect.

	M-NIA 0	M-NIA 0.01	M-NIA 0.03	M-NIA 0.05
Fibrils (g/g_{MNFC})	0.5			
N (g/g_{MNFC})	0	5E-7	15E-7	25E-7

Table 2 MNFC Suspensions preparation to test CMC and surfactant effect.

	M-CMC 2-NIA0.01	M-CMC 6-NIA0.05
Fibril (g/g_{MNFC})	0.5	
$CaCO_3$ (g/g_{MNFC})	0.125	

2.4 Viscoelasticity and Dynamic Surface Tension

Viscosity and dynamic modulus were determined using Rheologica rheometer Stresstech from ATS Rheo-System. For all the rheology measurements, parallel plates P20 is used and the gap is set as 1mm. Before each rheology measurement, 0.2 ml sample is deposited on the plate by using the syringe and is allowed to rest for 10 minutes. During measurement, the temperature is controlled to be constant at 21°C. We have implemented the following procedure to fully describe the rheological behavior of MNFC coating colors under moderate shear stresses:

- The MNFC coating colors were prepared and allowed moderate agitation during all tests.
- A conditioning step (21°C, shear rate 10 s^{-1} followed by an equilibrium step 21°C).
- A continuous shear ramp (21°C, 1 s^{-1} to 100 s^{-1}).

The MNFC coating colors were centrifuged and

dynamic surface tension of the supernatants was measured with a bubble pressure tensiometer. During measurements, the temperature is controlled to be constant at 25°C. Surface tension is a very important factor in curtain coatings because curtains can be stably formed if the interface expands rapidly. Surface age is the time required for the curtain to eject and escape onto the substrate. Therefore, the surface age depends on the height of the curtain, and the surface tension at each height is different. The bubble pressure tensiometer adjusts the surface age by varying the air injection rate in the capillary. For example, if the air is injected quickly and the bubble formation cycle is short, the surface age is low. In the process of forming the curtain, the lower the surface tension, the better it is.

2.5 Measurement of Bubble Content

To measure the bubble content in MNFC suspensions, the entrained gas tester (EGT) is used. The EGT uses Boyles Law for gases to determine the amount of air in a sample. One atmosphere of pressure is applied to the sample in the EGT by turning a Knob. A trapped air bubble in the Pressure Indicator indicates the pressure and one atmosphere is reached when the bubble is reduced in size by one half. At this time, it is compressing the volume of all the air in the sample by one half. Since the total volume of the sample chamber is a known constant, there is just a simple percentage of air constant factor for each full revolution of the Knob. Simply stated, after the one atmosphere is reached, all one has to do is count the number of revolutions it takes to get the Knob all the way back out. Then subtract the correction factor and multiply by the percentage of air factor to get the final answer in percentage of air.

3. Results and Discussion

3.1 Effect of CMC

The content of CMC didn't have effect on the dynamic surface tension of MNFC suspensions (Fig. 1). Low surface age gave higher surface tension. The dynamic surface tension for all suspensions (M-CMC0; M-CMC2; M-CMC4 and M-CMC6) at a low surface age (order of 1s) is close to the surface tension of the water (≈ 72 Nm/m at 25°C). Indeed, as the content of the CMC in the MNFC coating colors increases, the phenomenon of thickening of the coating liquid does not intensify and the pressure at the time of formation of the bubble remains almost constant. On the other term, intermolecular forces between CMC, MNFC and water are low. The interaction potential generated by these intermolecular forces contributes to reducing the energy of the fluids, and to stabilizing them. In general, the dynamic surface tension of the MNFC suspensions decreases with the age of the surface. This leads to say that the dynamic surface tension decreases with higher curtain height since a higher curtain height increases curtain velocity and available surface age.

In Fig. 2, All the MNFC suspensions present shear thinning behaviour (viscosity decreases as shear rate increases). Without CMC, MNFC suspension presents the highest viscosity value. Moreover, MNFC suspensions show some slight disturbances at high shear rate (between 10 and 100 s^{-1}).

As the addition of CMC is from 2 to 6%, the increased proportion of CMC contributes to the decrease of the low shear rate viscosity but the slight instabilities at high shear rate remain. Furthermore, when the addition of CMC is increased to 6%, the behavior of the viscosity remains the same at low shear rate, but at high shear rates (between 50 and 100 s^{-1}), the viscosity of the MNFC suspension becomes almost

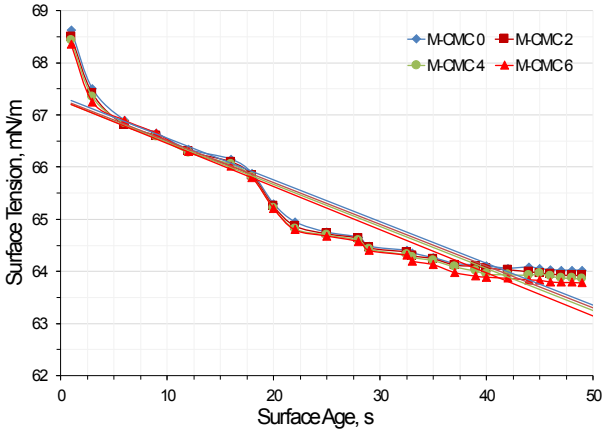

Fig. 1 Effect of CMC on MNFC suspensions surface tension.

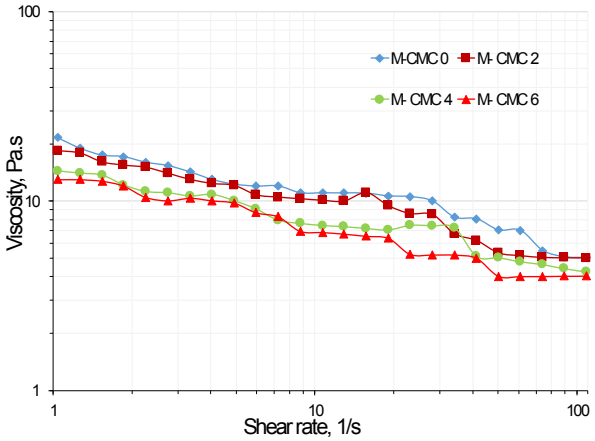

Fig. 2 Effect of CMC on MNFC suspensions viscosity.

constant. The action of the CMC is a little visible from 2% but is clear with 6% of CMC. The CMC makes it possible to have a more homogeneous suspension with smoother rheology curves. Rheological tests are here used to explore the influences of CMC on the rheological characteristics and the intern structure of MNFC suspensions as an indication to fibril-fibril interactions. We interpret the rheological results obtained by the ability of CMC to prevent fibril-fibril interactions within the internal structure of the MNFC.

Elastic modulus shows almost similar tendency with viscosity. MNFC suspensions with low CMC content (2%) showed lower elastic modulus than suspension without CMC (Fig. 3). This can be explained by the fact that the CMC disperses the MNFC and prevents it to forming flocks. This means also that the CMC decreases the rigidity of the MNFC and prevents it from behaving as a gel.

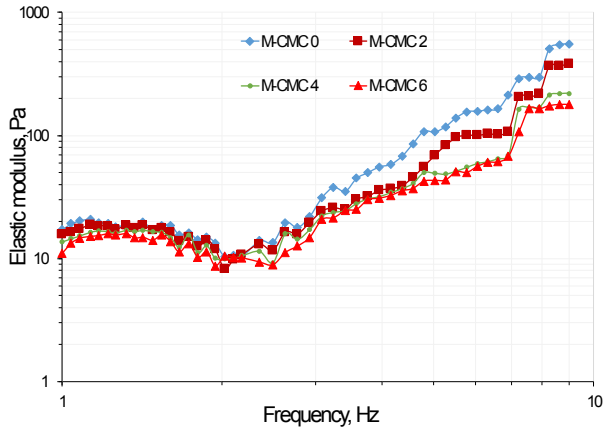

Fig. 3 Elastic modulus of MNFC suspensions with CMC.

3.2 Effect of Surfactant

The content of surfactant (Niaproof4) have significant influence on the dynamic surface tension of MNFC suspensions unlike the CMC (Fig. 4).

Even a small amount of surfactant decreases surface tension significantly. The maximum bubble drop measurements showed the surface tension of all MNFC suspensions to decrease with low surface age, although by varying degree. This can be explained by the activity of the surfactant that reduces the surface tension of the MNFC suspensions due to adsorption at the surface (Van Der Waals interactions with the fibrils of the MNFC). At high surface ages, the surface tension remains almost constant. This can be explained by the fact that the effective surface tension of the MNFC coating colors tends towards the surface tension of the anionic surfactant at high surface ages.

The effect of the anionic surfactant (Niaproof4) on the viscosity of the MNFC coating colors is presented on the Fig. 5. We observe that the amount of the surfactant does not visibly influence the viscosity of the MNFC coating colors. The rheological behavior of the suspensions is always shear-thinning behavior. As the addition of surfactant is from 0.01% to 0.05%, the increased amount of surfactant contributes very slightly to the decrease of the viscosity with the appearance of some slight instabilities at high shear rate. This can be interpreted by the low interaction between the surfactant and the MNFC fibrils.

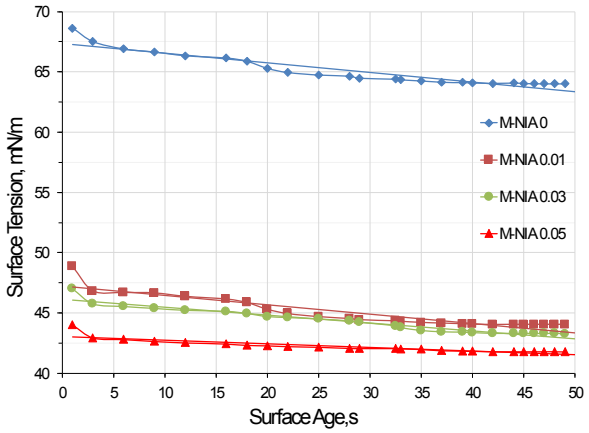

Fig. 4 Effect of surfactant on MNFC suspensions surface tension.

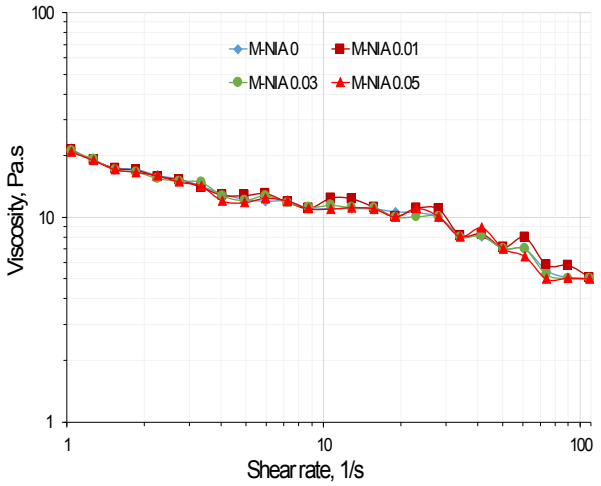

Fig. 5 Effect of surfactant on MNFC suspensions viscosity.

Elastic modulus shows similar tendency with viscosity. MNFC coating colors with low surfactant content (0.01%; 0.03% and 0.05%) showed a slight decrease of elastic modulus than suspension without surfactant (Fig. 6). This can be explained by the fact that the surfactant disperses the MNFC but with a less degree than the CMC and prevents suspensions to forming flocks. This means also that the surfactant decreases the rigidity of the MNFC and prevents it from behaving as a gel.

3.3 Combined Effect of CMC and Surfactant

The content of CMC and surfactant have significant influence on the dynamic surface tension of MNFC suspensions (Fig. 7). The surface tension of the both MNFC suspensions decreases as the concentration of the two constituents (surfactant and CMC) increases. The action of the surfactant remains visible even in a mixture with the CMC. The maximum bubble drop measurements showed the surface tension of both MNFC suspensions to decrease with low surface age. Surfactant activity is evident even in the presence of CMC. At high surface ages, the surface tension remains almost constant and tends towards the surface tension of the anionic surfactant. We can deduce that even in a tertiary mixture (MNFC, CMC and surfactant), the action of the surfactant on the surface tension is clear but it decreases with a degree less than in the case of a binary mixture (MNFC and surfactant). The result can be interpreted that in the presence of CMC with the surfactant in a MNFC suspension, the hydrogen interactions of water on the surface are more than in the case where the surfactant is alone.

In the case of combined effect of surfactant and CMC, the both MNFC suspensions have a shear thinning character: The viscosity decreases as a function of the shear rate. The action of the CMC remains visible even in a mixture with the surfactant As the addition of CMC and surfactant (2 and 6% for CMC; 0.01% and 0.05% for surfactant), the increased proportion of CMC and surfactant contributes to the decrease of the low shear rate viscosity but always the slight instabilities at high shear rate remain. This confirms the absence of action of the surfactant on the viscosity of the MNFC suspensions shown in the dedicated part to the effect of the surfactant (Fig. 8).

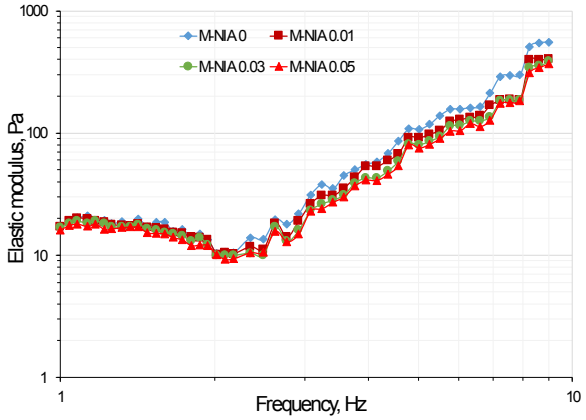

Fig. 6 Elastic modulus of MNFC suspensions containing surfactant.

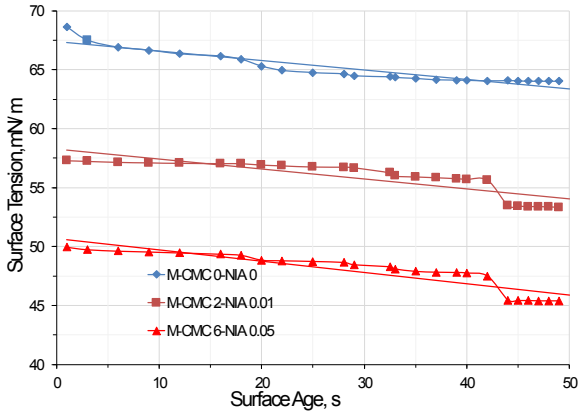

Fig. 7 Combined effect of CMC and surfactant on surface tension of MNFC suspensions.

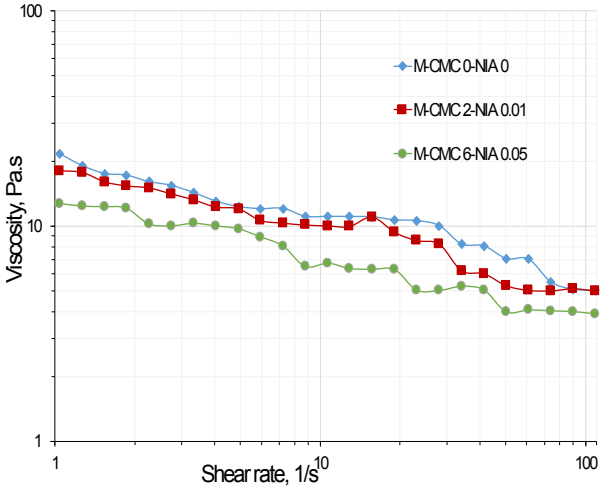

Fig. 8 Combined effect of CMC and surfactant on viscosity of MNFC suspensions.

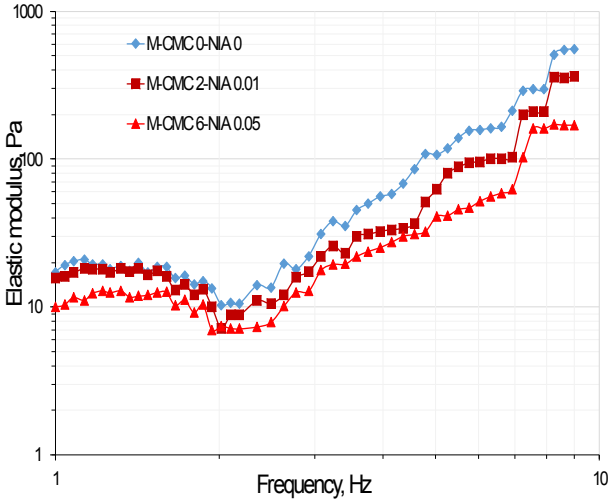

Fig. 9 Elastic modulus of MNFC suspensions containing CMC and surfactant.

Elastic modulus shows similar tendency with viscosity. MNFC suspensions with low CMC and surfactant content (2% and 0.01%) showed lower elastic modulus than pure suspension of MNFC (Fig. 9). The same trend is observed with the amounts 0.05% of the surfactant and 6% of the CMC with an obvious decrease of the elastic modulus. This can be explained by the fact that the CMC disperses the MNFC in the presence of the surfactant and prevents it to forming flocks.

3.4 Results of the Content of Air Bubbles

The pure suspension of MNFC contains a low air content (less than 1%). the addition of CMC from 2% to 6% increases slightly the air content. On the other hand, the addition of the surfactant increases significantly the air content in the MNFC suspensions (almost 3% for 0.05% of the niaproof4 and 6% for 0.05%). When CMC was used as a rheology modifier, air bubbles were generated in MNFC suspensions (Fig. 10). With an increase of CMC addition rate, the amount of Bubble increase. The surfactant generates more air bubbles in the MNFC suspensions than the CMC. The use of both modifiers generates even more air bubbles. This can be explained by the fact that the surfactant is positioned at the water-air interface, its hydrophilic part in the water, and the other part in the air. Therefore, increasing the amount of surfactant increases the air

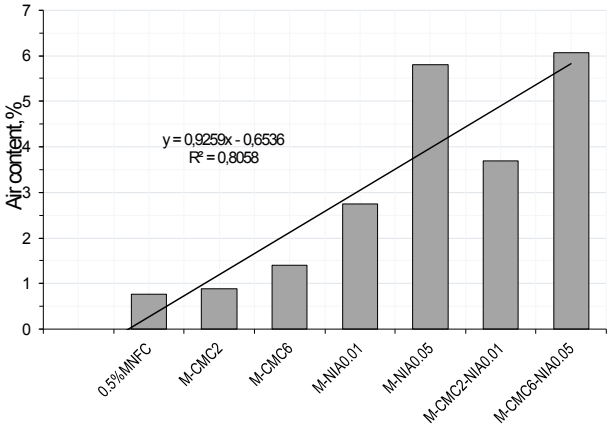

Fig. 10 Bubble content of MNFC suspensions with CMC and surfactant.

bubbles in the MNFC suspensions. We have seen that the CMC has a slight influence on the surface tension of the MNFC suspensions that is clear in this part, which reflects the slight amount of air bubbles in the MNFC suspensions in the presence of the CMC.

4. Conclusion

In this study, the effects of CMC and surfactant addition on rheological properties, dynamic surface tension and content of air bubbles of the MNFC suspensions were investigated. When CMC is added, the dispersibility of the MNFC suspensions is improved: The viscosity and the elastic modulus decrease when the amount of CMC increases, which

shows that the CMC has a good ability to prevent fibril-fibril interactions within the internal structure of the MNFC. In addition, CMC didn't influence the dynamic surface tension of MNFC suspensions. On the contrary, surfactant didn't have effect on viscoelasticity (viscosity and elastic modulus) of MNFC suspensions but it significantly reduces the dynamic surface tension of MNFC suspensions. The addition of the CMC and the surfacant at the same time does not bring new results, the conclusions drawn previously remain valid for the combined effect. On the other side, we found that the surfactant generates more air bubbles in the MNFC suspensions than CMC, which can cause defects on the final paper.

It appears that it is better to use the CMC and the surfactant to control the viscoelasticity and the surface tension of the MNFC suspensions. The disadvantage is that the use of these two modifiers increases the content of air bubbles.

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Determination of Antibiotics in Water Samples from Anil River, in Northeast of Brazil

Rogério Luís Nascimento de Jesus, Djárea Costa Silva, Reyla Andressa Silva Dias, Lanna Karinny Silva, Marta dos Santos Diniz, Jean Carlo Ferreira Goiabeira, Adriana das Mercês Pereira Ferreira, Ozelito Possidônio de Amarante Júnior, and Natilene Mesquita Brito

Federal Institute of Maranhao, Brazil

Abstract: There is a growing concern in monitoring the occurrence of antibiotics in the environment because even in low concentrations they may further increase resistance of pathogenic bacteria. Because the low concentrations in water samples ($ng.L^{-1}$ or lower), it is necessary to incorporate a concentration procedure prior to analysis by a chromatographic technique. This study aims to determine the presence of fluoroquinolones drugs such as levofloxacin (LEV), ciprofloxacin (CIP), enrofloxacin (ENR), sarafloxacin (SAR) and norfloxacin (NOR) in water samples from Anil River, located in Sao Luis, Maranhao, northeast of Brazil, using solid phase extraction as preconcentration procedure and analyses by liquid chromatography. LEV, NOR and CIP were found in concentrations of $ng.L^{-1}$. ENR and SAR were not detected. These results confirm the contamination by domestic wastes and demonstrate the importance of effective actions against contamination in environment by sewage, since they could have compounds such as fluoroquinolones that may cause a strong negative impact to aquatic organisms.

Key words: fluoroquinolones drugs, Anil River, solid phase extraction, liquid chromatography

1. Introduction

The presence of pharmaceuticals in the aquatic system is not a new issue. They can enter in the environment through human and industrial processes wastes [1, 2]. Antibiotics are an important group of these compounds, which have been found especially in water samples [3]. They have been extensively used in human and veterinary applications to treat bacterial infections and/or as growth promoters in animal agriculture and aquaculture industry [4]. There is a growing concern in monitoring the occurrence of antibiotics in the environment because even in low concentrations they may further increase resistance of pathogenic bacteria. In this study, it will be considered a special group of antibiotics: the fluoroquinolones (FQ's). They are commonly used because of your widespread spectrum activity against a number of both Gram-positive and Gram-negative bacteria [3].

Because the low concentrations of pharmaceuticals in water samples ($ng.L^{-1}$ or lower), it is necessary to incorporate a concentration procedure prior to analysis by a chromatographic technique. An extraction method commonly used is the solid phase extraction (SPE) in which the target analytes from aqueous matrix are extracted after passing through a cartridge containing solvent. In order to remove the undesirable compounds extracted with analytes, an organic solvent is used to wash the cartridge. Afterward, a selective solvent is used to extract the compounds that will be used in the chromatographic analysis [5, 6]. The SPE is a practical method, allows automation, has high sensitivity and does not have problem with emulsion formation [7].

This study aims to determine the presence of FQ's drugs such as levofloxacin (LEV), ciprofloxacin (CIP),

Corresponding author: Natilene Mesquita Brito, Dr., areas/interests: environmental chemistry. E-mail: natilene.brito@ifma.edu.br.

enrofloxacin (ENR), sarafloxacin (SAR) and norfloxacin (NOR) in water samples from Anil River, located in Sao Luis, Maranhao, northeast of Brazil, using SPE as preconcentration procedure and analyses by liquid chromatography (LC).

2. Material and Methods

2.1 Chemicals and Reagents

Antibiotic standards of levofloxacin, ciprofloxacin, enrofloxacin, sarafloxacin and norfloxacin in purity of > 98% were purchased from Sigma Aldrich (USA). The chemical structures of these drugs are shown in Fig. 1. Chromatographic grade methanol (MeOH) and acetonitrile (ACN) were purchased from Merck (Germany). Phosphoric acid, sodium phosphate monobasic (NaH_2PO_4) and formic acid were purchased from Isofar (Brasil) and dichloromethane (DCM) was obtained from Proquimios (Brasil). Ultrapure water was obtained using a Milli-Q Direct 8 purification system from Millipore (USA).

Stock solutions of CIP, ENR, SAR and LEV were prepared in methanol and NOR was in acetonitrile. The solutions were prepared in concentrations of 100 $mg.L^{-1}$ and stocked in dark at -20°C. In order to construct the analytical curve, the solutions of standards were mixed in methanol in a concentration range of 10-300 $\mu g.L^{-1}$.

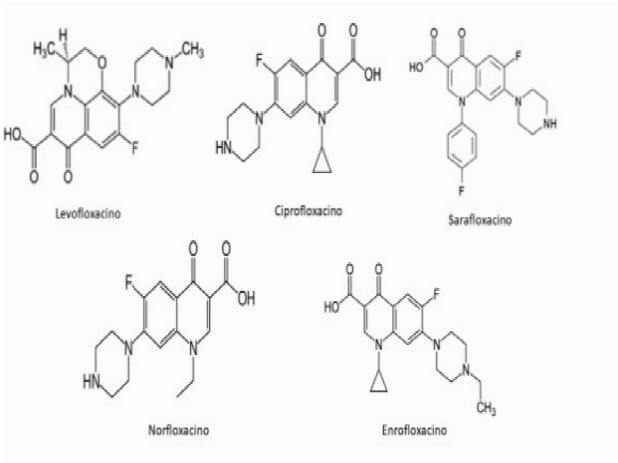

Fig. 1 Chemical structures of LEV, CIP, SAR, NOR and ENR.

2.2 Sample Collection

Water samples from Anil river were collected in a place with coordinates (-2.549270, -44.232179) as shown in Fig. 2. The samples for determination of antibiotics were placed in amber glass bottles of 1L, packed in a box thermal insulation and transported to the laboratory at Federal Institute of Maranhao in order to be stored at 2°C. Additional physicochemical parameters such as water temperature, pH, conductivity, dissolved oxygen, total dissolved solids and total suspended solids were measured in situ at the sampling sites during 36 hours with a break of 1 hour between each measurement.

2.3 Sample Extraction

Water samples were adjusted to pH 3 with phosphoric acid and filtered with a nylon filter (size 0.45μm) prior to extraction procedure. Extraction was performed as follows: HLB Oasis cartridges were conditioned with 2×2.5 mL of DCM + 2× 2.5 mL of MeOH + 3×3 mL of a phosphoric acid solution (pH 3). 200 mL of sample were gently loaded into the cartridges. Afterward, a solution of MeOH 5% adjusted to pH 2.5 with phosphoric acid was used to wash the cartridges. The elution of target analytes was performed with 3×2 mL of formic acid 2% in MeOH.

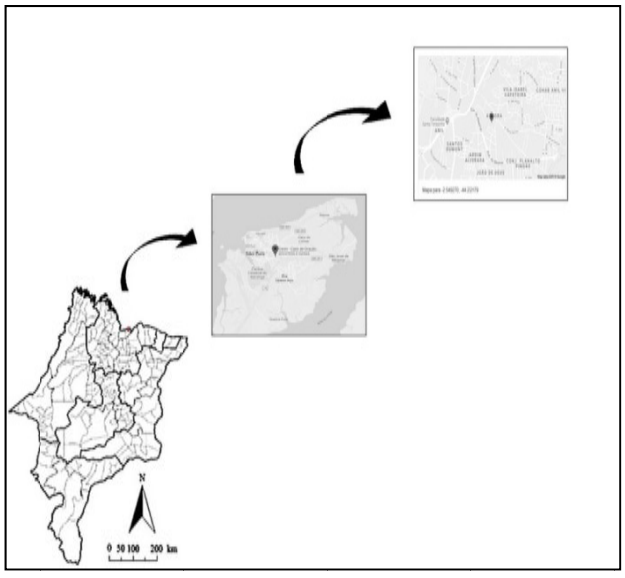

Fig. 2 Samples collection point.

The sample extract was dried with nitrogen and then reconstituted with 1mL of 30% MeOH/70% buffer (0.04 M NaH_2PO_4, pH 3).

2.4 LC analysis

The antibiotics analyses were conducted in gradient mode. Mobile phases A and B are methanol and buffer (0.04 M NaH_2PO_4, pH 3), respectively. The gradient program used is as follows: 0-7.5 min, 20% A; 7.5-9 min, 25% A; 9-25 min, 35% A; 25-28 min, 20% A. The flow rate of mobile phase was kept at 1.2 $mL.min^{-1}$ and temperature column was at 35°C. Injection volume of analytical solution was 10 μL. The monitoring wavelength was 280nm (excitation) and 450nm (emission) for all the target compounds.

2.5 Instruments

The analyses were performed using a LC 20-AT liquid chromatograph system (Shimadzu, Japan), a column oven (CTO-10AS) and a fluorescence detector (RF-20A). Chromatographic separation was carried out using a Luna C18 column (250 mm × 4.6 mm; 5 μm). Relevant data acquisition and processing were accomplished with Shimadzu *LC solution* software. The measurement of pH and temperature on Anil River was performed using the Fisher Scientific Accculmet AP72 multiparameter and for conductivity and total solids the Fisher Scientific Accculmet AP75 multiparameter was used. The analysis of dissolved oxygen was carried out with the Hanna HI 9146 Oximeter.

3. Results and Discussion

3.1 Analytical Curve

Table 1 shows the equations and linear correlation coefficients based on analytical curves. The method used in this study exhibit a good linearity for all compounds in a concentration range of 10-300 $\mu g.L^{-1}$ because the linear correlation coefficients have values higher than 0.99 [12].

Table 1 Equations and linear correlation coefficients based on analytical curves of target analytes.

Fluoroquinolone	Analytical curve equation	R^2
LEV	Y=1725,6 X-4391.5	0.9981
NOR	Y=13560 X-105432	0.9975
CIP	Y=6830 X-48370	0.9997
ENR	Y=22036 X+92211	0.9997
SAR	Y=7358.9 X+8332.2	0.9961

3.2 Physicochemical parameters

Physicochemical parameters analyzed are shown in Table 2. Dissolved oxygen (OD), pH, electrical conductivity (EC), total dissolved solids (TDS), temperature and total suspended solids were measured in accordance with CONAMA 357/2005 and 430/2011 resolutions [8, 9].

The pH values measured are not in accordance with CONAMA 357/2005 resolution, which define a range from 6 to 9. The lowest value obtained was 5.63 and the highest was 6.10.

Oxygen dissolved in water is associated with several variables such as temperature, salinity, human interference and microorganisms activity [10]. The values expected for freshwater class I, II and III have not be less than 6 $mg.L^{-1}$, 5 $mg.L^{-1}$ and 4 $mg.L^{-1}$, respectively [8, 9]. However, some results obtained from Anil River are not in accordance with resolution values, because they varied from 2.44 to 4.11.

Electrical conductivity is a parameter that can be influenced by factors such as ion types and temperature. Since there is no upper limit, it is necessary to observe the variations that are associated with occurrence of industrial wastes. Samples that are highly contaminated by sewage show electrical conductivity values in a range from 100 to 10,000 ($\mu S.cm^{-1}$) [11]. The values obtained from Anil River varied between 249.17 and 608.50, which testify the contamination.

Solids in water can have natural or human origins. For class II freshwater the maximum limit is 500 $mg.L^{-1}$ [8, 9]. The highest value for total dissolved solids obtained in Anil River was 302.83.

Table 2 Physicochemical parameters in Anil River.

Collection Time	pH	OD (mg.L^{-1})	E.C (µS.cm^{-1})	TDS (ppm)	T (ºC)	TSS (mg.L^{-1})
09:00 am-02:00 pm	5.71	3.01	268.67	133.75	28.72	9.90
03:00 pm-08:00 pm	5.95	2.44	295.33	147.33	28.70	7.73
09:00 pm-02:00 am	6.05	3.17	249.17	124.67	28.07	3.20
03:00 am-08:00 am	6.10	3.79	608.50	302.83	28.30	2.53
09:00 am-02:00 pm	5.63	4.11	392.33	196.50	28.92	1.07
03:00 pm-08:00 pm	5.85	3.37	516.50	250.67	29.08	3.00

CONAMA 357/2005 resolution does not define values for water temperature but this parameter affects the solubility and toxicity of many other parameters.

The occurrence of sewage in water may futher increase the temperature. This situation was not observed in Anil River because the average temperature was 28.63°C. The results for total suspended solids (TSS) presented average values from 1.07 to 9.90 contemplated by climatic conditions.

3.3 Occurrence of Fluoroquinolones

The results for FQ's analyses are presented in Table 3. LEV. NOR and CIP were found in concentrations of ng.L^{-1}. ENR and SAR were not detected.

Table 3 Fluoroquinolones in Anil River water.

Collection Time	Fluoroquinolone (ng.L^{-1})				
	LEV	**NOR**	**CIP**	**ENR**	**SAR**
09:00 am-02:00 pm	*	40	48.8	*	*
03:00 pm-08:00 pm	*	10	*	*	*
09:00 pm-02:00 am	*	67.7	112.6	*	*
03:00 am-08:00 am	*	10.6	*	*	*
09:00 am-02:00 pm	21.6	*	11.4	*	*
03:00 pm-08:00 pm	100.6	*	49.9	*	*

* Undetected concentrations

4. Conclusion

The results obtained from analyses in Anil River confirm the contamination by domestic wastes. This is proved by pH. oxygen dissolved and electrical conductivity values and occurrence of levofloxacin. ciprofloxacin and norfloxacin. because these pharmaceuticals are widely used in human applications. The absence of enrofloxacin and sarafloxacin antibiotics probably is due to they are exclusively used in veterinary medicine and these activities are not be so prominent in the collection region. The results demonstrate the importance of effective actions against contamination in environment by sewage. since they could have compounds such as fluoroquinolones that may cause a strong negative impact to aquatic organisms.

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Micro-businesses' Impact on the Peri-urban Districts, Ciudad Juarez and Merida, Mexico, Popular and Solidarity Economy

Garcia Gomez Carmen[1], Peña Barrera Leticia[2], and Bojorquez Morales Gonzalo[2]

1. Faculty of Anthropological Sciences, Autonomous University of Yucatan

2. Institute of Architecture, Design and Art, Autonomous University of Ciudad Juárez

3. Faculty of Architecture and Design, Autonomous University of Baja California

Abstract: This paper analyzes how peri-urban mega projects dwelling inhabitants create microbusiness in two cities, Ciudad Juarez, Chihuahua and Merida, Yucatan on Mexico, looking at effects as a family or neighborhood lifestyle. Is divided in two parts, first conceptualized on set dwellings lacking off primary services and infrastructure, impact in the lifestyle of inhabitants. Second, problematizes into families with salesman tradition, how they in commercial activity looking for an opportunity in self-employment and in this way of think create microbusiness in basic supplies as a solidarity form to improve the economy in the neighborhood. At last, conclusions focus in a new and relevant information about impacts in quality of life in different areas where microbusiness are included, the apportation is in urbanism, with a new approach of research dwellings-microbusiness. This research is supported on mapping survey combined with interview to employers and microbusiness employee. This work belonging to a broad research financed by CONCYT-CONAVI.

Key words: popular economy, family, microbusiness, peri-urban

1. Introduction

The growth of Mexico's cities is the result of the neoliberal economic model adopted since the twentieth century. The consequences are uncontrolled urbanizations that have made cities widespread, less efficient, unlivable and even unsustainable. The model demonstrates the authorities' inability, repeating errors and building cities with fragmented urban spaces with poor housing areas that cause abandonment and disappointment.

The problem is the cities' artificial construction, where the material component of buildings and constructions, or the connecting paved arteries, dominate as a mere insertion of artifacts [1]. The city is not visualized as a living system, with complex networks, and as such, it grows between a set of parts that must engage and work as a unit. It is necessary to provide individuals who use all the satisfiers and maintain natural elements, to achieve a balanced life with quality.

This research is carried out in two cities, one in northern Mexico: Ciudad Juárez, Chihuahua and the other in the south: Mérida, Yucatán (Fig. 1).

Ciudad Juarez is a city bordering the United States of America and the largest city in the state of Chihuahua. It is located at the center of the Chihuahua desert and has an area of 321.2 km^2 which represents 12.97% of the state territory and concentrates 39.1% of the population of the state with 1,391,180 inhabitants [3].

Corresponding author: Garcia Gomez Carmen, Ph.D., Professor; areas/interests: housing, environmental habitability and tourism. E-mail: ggomez@correo.uady.mx.

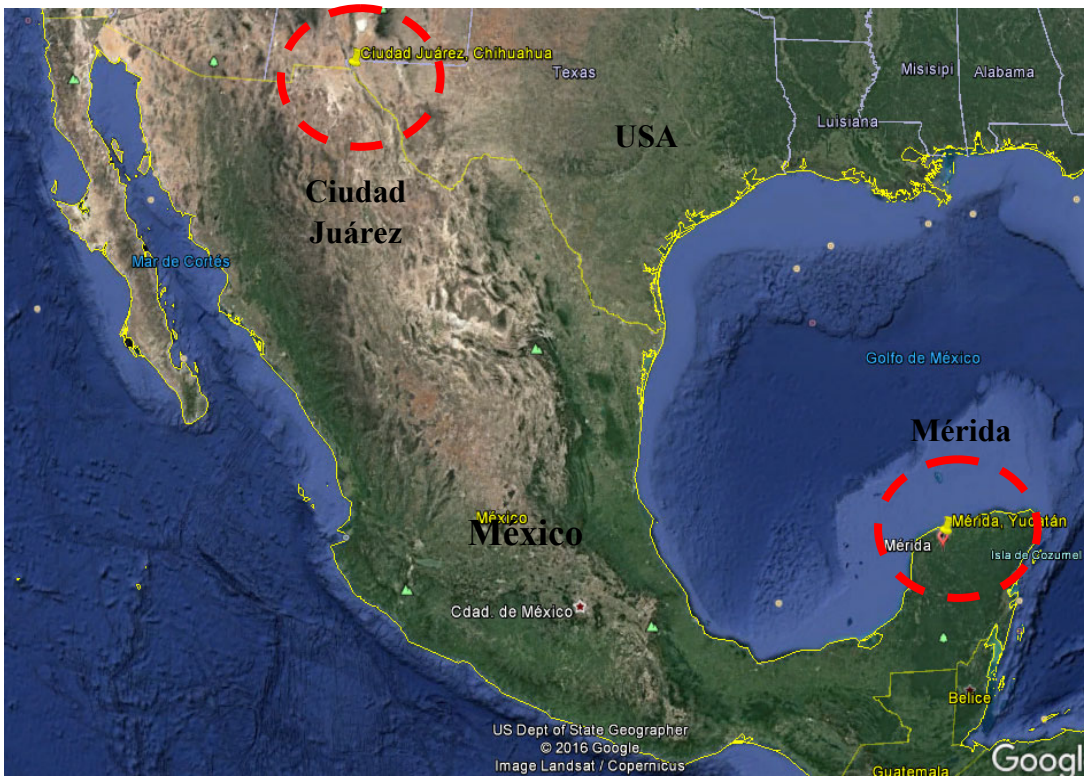

Fig. 1 Location of the cities studied [2].

Ciudad Juarez has an uncontrolled population growth which began in 1960 due to the installation of *maquila*[1] industries that require a lot of low-skilled or operational work force. State workers are not sufficient to fill vacancies, so many people decide to migrate in order to work and settle there.

The job requirements and opportunities were not linked to a socio-economic policy that would facilitate the installation of these new families at the local level. Initially, the people who arrive begin to occupy the city, however, it was quickly insufficient, and the housing developers decide to bring the houses "closer" to the sources of work. Many housing complexes are built; but, instead of solving the housing deficit, they caused an oversupply in the housing market and led to dispersion and low densification of the land. As a result, an expansive and dispersed growth was favored, with disarticulated urban structure, zones lacking development, not consolidated and with a large amount of underutilized spaces [4].

Mérida is the capital of the state and the central city in the southeast region of Mexico for the quantity and quality of equipment, services and trade it has; It has an area of 858.41 square kilometers that represents 2 percent of the state territory and concentrates 46.4 percent of the population of the state with 830.7 thousand inhabitants [3].

Merida, like all cities, is heterogeneous, with developed, urbanized areas where all goods are within reach; mixed spaces where there are infrastructure, services and equipment. However, the extent of these is limited and do not reach all the inhabitants and places with total or partial remnants. The service provision has different degrees of sufficiency that usually occupy the more distant, residual or vulnerable sites.

When the consolidated zones in Mérida became saturated, a phenomenon of polarized expulsion of the

[1] *Maquila* is defined as a factory that imports materials and equipment on a duty-free and tariff-free basis for assembly or manufacturing and then re-exports the assembled product; usually back to the originating country. http://harlingenedc.com/economic-development/international-opportunity/maquiladoras/.

population was caused [5], the sector with less solvency is displaced to the south and southeast areas where rent is economically more accessible and, on the other hand, the population with greater economic resources develop exclusive luxurious areas to the north; This situation generated a social and functional change in the spaces of the city, which manifested itself with an internal migration segregating the new peripheries with popular neighborhoods and massive social and economic housing subdivisions.

The economic dynamics of cities is the pillar that sustains the development of a country; It includes economic growth, income distribution, technological progress, environmental sustainability and, consequently, the society's behavior as a whole. This generates inequalities in several modalities: wealth and poverty, employment and unemployment, concentration and dispersion. These inequalities are set in the level of life, progress or well-being of the communities that constitute a territory. That is to say that the level of development depends largely on the type of activities that are carried out and on the concentration of the population [6].

In the existing economic structure in Mexico, the standard of living or welfare is unequal. Some people need a subsistence employment to live or to complement the low salary that is received. That complementary activity is recognized as a micro-business.

Microbusinesses are small businesses that operate with autonomy and business freedom [7]. They have up to 10 employees including the owner. For this research the houses considered were all those that are used to carry out activities that contribute an additional income to the household, which reduces the surface destined to the daily life of the families and is recognized as a social economy.

Social and solidarity economy is present in times of crisis. It "is a collective action project aimed to counteract the socially negative tendencies of the existing system, with the perspective — actual or potential — of building an alternative economic system" [8, 9].

Although it is recognized worldwide as a viable alternative for the social sector (*ejidatarios*, or communal land holders, collectives, organized workers in cooperatives), small and family-owned companies dedicated to the production, distribution or consumption of goods and services are also considered.

This research falls in this category and aims to analyze the work of members of various family groups in small establishments in Ciudad Juárez and Mérida, Mexico, as well as the impact that their work has on family and neighborhood life and the relationships that occur between them.

2. Method

The research approach is based on four stages: 1) Definition of approach, 2) Multiple case study, 3) Data collection techniques and 4) Data systematization (Fig. 2).

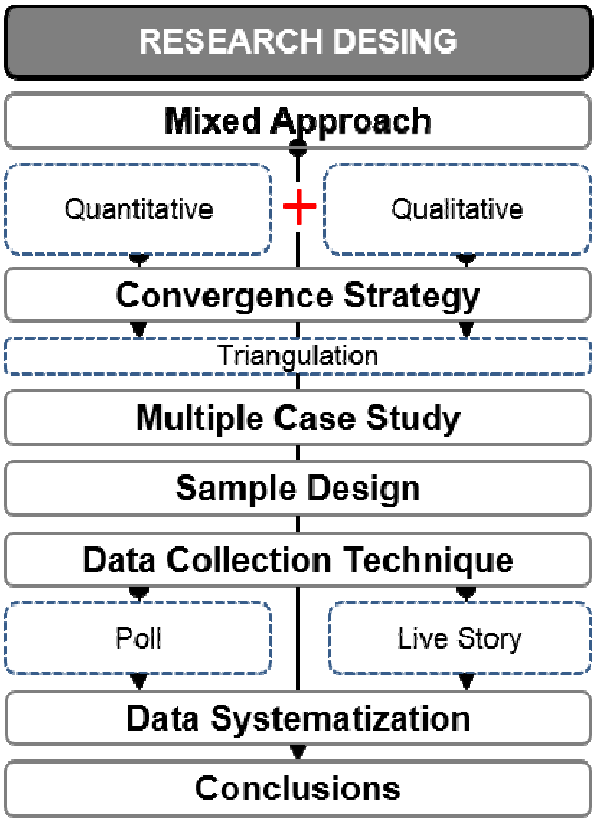

Fig. 2 Investigation method applied.

APPROACH. Methodological aspects guide the research process. This study was carried out using a mixed method approach, which includes quantitative and qualitative research. Quantitative studies aim to explain the social reality seen from an external and objective perspective [10]. The qualitative perspective studies reality in its natural context, trying to make sense of or interpret phenomena according to the meanings they have for the people involved [11].

MULTIPLE CASE STUDY. This research is simultaneously carried out in three cities: Merida, Yucatan, Ciudad Juárez, Chihuahua and Mexicali, Baja California, although only the first two are reported here. The study was in consolidated subdivisions of massive medium interest and economic type housing. It's been at least five years since they have been built and since they were in the periphery of the city.

Three housing complexes were worked on in Ciudad Juarez, located in the southeast of the city: Las Haciendas, Senderos de San Isidro, Finca Bonita Cedros stage 1 and 2. These complexes are far from the city, in peripheral sectors and without culture or supply services nor health or medium and higher level educational equipment. There are many houses that are not occupied. The distance between the food supply sources or convenience stores runs from one to five kilometers, a wide extension of the desert that limits the city, a route that is made up of vacant lots.

In Merida, three subdivisions of the west of the city Villa Magna II, Tixcacal Opichen and Ampliación Tixcacal Opichen were worked on. They are located at the end of the city, far from the center where the public markets and the cheapest grocery markets are located. To get there you must go by bus; the fastest route takes more than an hour. In the housing complex, there are small commercial plazas that have been occupied by convenience stores where food and beverages are more expensive, pharmacy chains and pawn shops.

SAMPLE DESIGN: A census was held in each housing complex through a complete route which was recorded in geo-referenced plans. Afterwards, they were classified by line of business and the criteria for the collection of information were given. The sample definition for the conducting of the survey was based on considering all the unique lines of business. The repeated lines of business were determined by statistical calculation with the parameters of 95% confidence level, 5% accuracy level, and 30% of probability of it occurring.

In Ciudad Juarez, 40% of the establishments that are closed because of crime and risk were eliminated, leaving 55 micro-businesses to work with and Merida's sample with 85 establishments.

DATA COLLECTION TECHNIQUES. The data collection techniques used: survey and life history. Administering surveys is a procedure that explores certain issues and allows subjectivity while obtaining information from a considerable number of people [12]. This research only reports survey results[2].

The aspects considered in the design of the questionnaire, try to identify elements of the economic dynamics at the local level of each city and sector. It is intended to facilitate the analysis and knowledge of the different business lines in a housing sector and, in turn, can be adapted for interpretation according to the different idiosyncrasies that may exist in the cities where the study is conducted, having comparable elements and other badges

The questionnaire is structured in 12 groups of information which is control data, respondent information, business identification, business classification, the business' data, financing and problems, business acceptance, business advice, other businesses' references, observations and comments. A structure was designed that facilitated the collection of data and the corresponding capture in databases.

The questionnaire was based on general information to encourage confidence and allow the interviewer to

[2] The instrument is part of the *Habitabilidad ambiental en la vivienda construida en serie para ciudades de México*, based on benefit indicators, social impacts and quality of life, code 205807, financed by CONAVI-CONACYT, carried out by researchers from the Universities of Yucatan, Ciudad Juarez and Baja California.

approach the participant and be able to, subsequently, obtain the confidential information that could stir distrust or rejection in the beginning.

The considerations for the data collection in the field were:

In Ciudad Juarez, all transportation was by car due to lack of public transportation services; a one to two hours' drive, work in groups of two to four people for safety reasons; monitoring of students who entered the homes via mobile telephones, since it is a risk factor in this type of studies.

In Mérida, public transportation was used, one to two hours' ride; work in groups of three people; there were not any security problems, therefore, all the tours in the neighborhoods were by foot.

In both cities, a collaborative teacher-student environment was fostered. The activities were midweek and weekends, in the morning and evening hours, since most of the service and supplying businesses work in the morning and the prepared food services are in the afternoon and evening.

SYSTEMATIZATION. Systematization is done in two types of computer programs. The statistical software SPSS was used, because it is a versatile tool for data capture. It is possible to have many answers and it allows organizing them in pre-established areas and facilitates working with answers to open questions.

The variables analyzed in the SPSS register a validation table. The variables that were greater than 95% were worked on. In that sense, it is possible to purge the database since there are no invalidated or irrelevant answers for the analysis; and it can concentrate the crossing of three variables, which are recorded in a validation box. Invalid responses and those that did not provide much information for the analysis were eliminated.

The other option used was the Excel program, which allows importing information from the SPSS. The advantage is the quantity and quality of representation of the results' graphs.

3. Results

The micro-businesses found in the housing complex of the two cities can be categorized in three types:

1) Family business: representing the business that is in the residence or within the habitable area or those that have an extension to the original construction of the house.
2) Door to door sales: includes retail sales activities through catalog which occupy space in the house to store the products. Those who supply wholesale products for their own purpose or for other businesses were also considered.
3) Second hand store or flea markets: respond to the uses and customs of the places of study. Although these are ambulant, they are considered because the inhabitants of the housing complexes work there. They are called second hand sales at the border of the country and flea markets on wheels in the rest of the country.

The distance between the housing complexes and the supply sites or the center of the city favors family businesses and/or micro businesses to achieve greater success in their sales in both cities.

However, in Ciudad Juárez, micro-businesses face insecurity and must make payments of contributions and/or permits, which do not correspond to the benefits they should receive from the city. They are vulnerable to assaults, collection of fees, lack of payment from clients and conflicts with neighbors, mediating with a real service they provide and the difficulties of establishing themselves in these sectors. In Merida, the main problem is that some micro-businesses do not have official permits and there are people who pass themselves off as inspectors and extort money from the owners.

The main economic activities in the housing complexes respond to retail supply needs that meet the basic food demands of raw or prepared inputs,

followed by supplies of school supplies, workshops and beautification services.

The proliferation of small businesses such as grocery stores, stationery stores, video rental businesses, mechanic shops, tire repair shops, beauty salons, tailoring shops, among others, promote self-employment, complement the families' income and provide means of subsistence for their owners. Hence, people do not need to travel outside their sector to obtain a service or good.

The different types of microbusinesses identified in Ciudad Juárez offer various services, such as food, workshops and small factories. In Merida, the predominant use is food, services and in a pattern is food, services and workshops (Fig. 3).

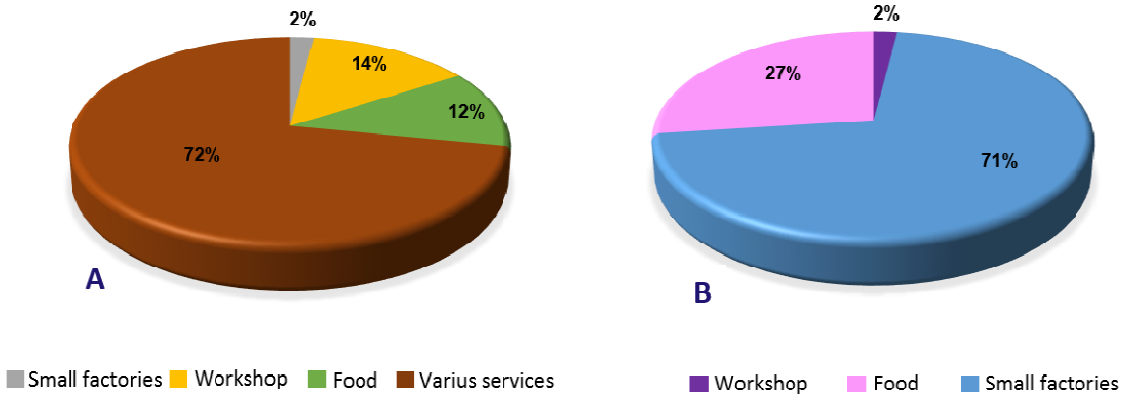

Fig. 3 Types of microbusinesses in Ciudad Juárez (A) and Merida (B).

A factor that contributes to micro-businesses staying open in the housing complexes, is the construction of mechanisms of solidarity and mutual aid, due to the fact that the loan systems they provide facilitate and complement the management of many of their clients' homes; merchandise is delivered with weekly payment of consumptions. This way, the owners guarantee the sale and increase the family income. They feel supported as neighbors as their encountered with eventualities. This situation is recurrent due to the impoverished salary the people receive. In addition, the monthly payment that people must have to finance the house they live in, must be considered.

Something interesting about the analysis was the relationship between age and gender of the people who attend micro-businesses. In Ciudad Juarez, the age with the highest number of employees are between 21 and 25 and 31 and 40 mostly being women (60%). For Mérida, ages range from 31 to 45 years, which reflects the level of unemployment for young adults in the locality; women also predominate (64%).

Some housing complexes have a lesser amount of businesses and business diversity. The most complete housing complexes are Las Haciendas for Ciudad Juárez and Tixcacal Opichen for Mérida.

It was very important to verify to which degree the home was overcrowded, since the business occupies useful space in the house. The house has minimum dimensions and the most sacrificed place for the change were the living room and/or dining room, 56% for Ciudad Juárez and 61% in Mérida. The greatest impact is that its occupants practically live in the bedroom(s) although they use the services (bathroom-kitchen).

Most of the day the owners are at the business, which allows them to establish social relationships with the other residents. They are well- known people among the neighbors and they are sought after when there are difficulties. However, when the other members of the family do not get involved, there are conflicts within the family, which can be a factor of violence or expulsion of the children (Fig. 4).

Fig. 4 Microbusinesses Questionnaire for Finca Bonita Cedros 1 in Ciudad Juarez y Tixcacal Opichen in Mérida.

In this sense, 88% of the inhabitants express the need for more space in their home; therefore, 29% made adjustments to their home with the initial capital. The modifications, for the commercial area, not for the living area, were made to provide greater security.

Another deficient aspect is in reference to the family interaction, given that it is affected by the microbusiness' owner's activities; the social outings and family activities are almost nonexistent. These relationships are sacrificed in order to keep the service open for a long time. To be able to attend an event outside the house, they must close the business or leave it in charge of another person and pay, which, consequently, impacts the income. It is deduced that the people who attend their business, only coexist in the neighborhood environment, due to the presence and relationship they have with their neighbors, positively or negatively.

Another factor is that most of the micro-businesses respond to an economic need, both for the families that offer the service and for the inhabitants who avoid large trips and transportation costs in the acquisition of goods that they cannot generally buy in advance. In this sense, micro-businesses are a socio-economic benefit for their communities and their owners play an influential role in their neighborhoods, either as advisors, as an alternative of solidarity or even as a factor of tolerance.

An alternative trade in Mexico is street vending. In northern Mexico these are the so-called "second-hand markets" because they sell used or second-hand things that are more affordable for inhabitants with incomes below three minimum wages per day (equivalent to nine dollars). In both cases, they mainly offer natural and prepared food, clothing, household items, auto parts, tools, toys household goods, tools, clothes, and various items (Fig. 5).

4. Conclusions

As in most cases, the micro-business is attended by the housewife; she subsidizes her time and dedicates herself to both the micro-business and the housework which implies a double shift without economic compensation. They affirm that it is exhausting to link the two activities and the synergies of family daily life and the economic part in the same space. They comment "... I never leave work", although the role is a form of positioning and power.

Fig. 5 Second-hand market, San Pedro and San Pablo, Ciudad Juarez y Flea market, Tixcacal Opichen in Merida.

Micro-businesses, as distribution channels, still represent a niche of growth opportunity in some housing complexes. They became a unique form of capital gain, an opportunity for work and community support by means of interaction and closer interpersonal coexistence between the owner and his/her customers.

The creation of micro-businesses contributes to the reduction of unemployment, although the income is in many cases the subsistence of the owner and his family, it facilitates the participation of women in the creation and management of their own business and, for the members of the family, it is an option to help the family economy.

The overcrowding caused by micro-businesses within the home is an important subject of socio-economic perspective to be analyzed by INFONAVIT[3]. The current scheme of the housing complexes, with exclusive areas for housing and commercial areas far from it, impacts the quality of life of the inhabitants, affects the interaction and solidarity support models that are found in these sectors, where their residents receive minimal income and are, therefore, more vulnerable.

To reverse this, academics have been insisting on a proposal, which considers mixing the uses in the housing area to locate lots and houses with more space in order to offer alternatives called "home-business". It would be a way to meet the needs of the family but also provide a place designed to offer a service without sacrificing habitability and, at the same time, allow the integration of urban and social activities with the family activities. This model responds to the changes that are observed in the ways the city is inhabited in isolated and segregated places.

It is necessary to implement new urban development actions; those which allow to identify the business modalities in a more effective way, contribute to the subsistence of the families, but also to the construction of viable alternatives that improve the quality of life of the whole sector. Some ideas are presented:

1) Define an alternative security program, either by means of organization and citizen participation or by an arrangement between police and owners coordinated by the authority.

2) Achieve models of cooperative management that facilitate the supply and reduce costs, in which cost-profit has an impact on the economy of the residents.

3) Identify urban models that solve the garbage buildup problems, car concentration, unhealthy or polluted environments, which favor residential quality.

4) Solve the problems that promote some lines of business by identifying opportunities and locations for them.

5) Have financing alternatives for the "home-business" that will solve the overcrowding

[3] *Instituto del Fondo Nacional de la Vivienda para los Trabajadores* is the Mexican tripartite institution where the workers' sector, the business sector and the government participate in the construction of housing for salaried workers and grants credit to pay in 30 years.

problem that many houses face when converting their home into a reduced and confined space [13].

Financing micro-businesses is a topic which has been explored to a small extent, since they are only conceived as PyMES[4] and at the local level they only reach average and average high-level sectors. The importance given to it is merely regulatory and its economic and social benefit is rarely evaluated. It is always believed that creating shopping areas can be an alternative; however, the family micro-business has several observations:

1) Generally, the employees are family members who reside in the house.

2) The space built is the necessary one for the activity or turnaround, if these are for the lack of options for another type of financing reflects the level of local economic development and the little potentiation to the micro-finance schemes.

3) By relying solely on institutional financing and focusing on the housing deficit, in neither case study, do they visualize another form of self-employment, investment or development of new economic offers [13].

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To CONACYT-CONAVI for financing the Project titled Habitabilidad ambiental en la vivienda construida en serie para ciudades de México, con base en indicadores de beneficios, impactos sociales y calidad de vida, code 205807.

To the universities of Ciudad Juárez, Baja California y Yucatan, for the facilities they provide to their researchers.

To all the students who joined the project because without their help this would not have been possible.

[4] Small and medium-sized companies, account for 97% of the total number of companies, in Mexico, which employ 79% of the population and generate income equivalent to 23% of the Producto Interno Bruto (PIB). As it can be seen it is the base of the Mexican economy [14].

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Paulista Avenue, São Paulo, at Ground Level

Adilson Costa Macedo, and Jessica Lorellay Cuscan Guidoti
University São Judas, São Paulo, Brazil

Abstract: Research on the elements that make up the ground floor of Avenida Paulista, an important urban corridor in the city of São Paulo. The article presents the result of the relations between free and occupied space, aiming the identification of types, their description and classification. The site is of high density of occupancy and mix of uses, but. the emphasis is given to the commercial use space. This corridor is old and offers diversity of situations amalgamated by time representing exemplary types of blocks, lots and buildings. Urban Morphology procedures are used to analyze the relationships between the ground floor spaces of the buildings, with the free space of the lots; lots with the blocks and the public promenade. It is concluded by a list of types, classified according to the characteristics of people's access. The characteristics of the internal circulation of buildings are identified, considering as the ground floor the spaces through which people move, from the external space and after entering the buildings. The result is a type classification.

Key words: walkability, commercial enclosure, people spaces

1. Introduction

This work aims to study the ground floor occupation of Paulista Avenue buildings, considering the predominant commercial use and the interaction of internal and external spaces. Refers to the piano nobile of buildings and the street, where life becomes more intense apart from strictly functional requirements.

The result is the knowledge and classification of existing types, generating subsidies for the new projects program. Researching the types and shape of the city is the main objective of CARG, City Architecture Research Group, of São Judas University, which includes the authors of the monograph. Currently the corridor is explored as an urban element. Element that is defined by the sum of the box of the street, plus the width of eventual artifact that accompanies it (central bed, water course, infrastructure line), plus the border of lots with their buildings.

Corresponding author: Adilson Costa Macedo, Ph.D., research area/interests: urban morphology, sustainable urbanism. E-mail: ac.macedo@terra.com.br.

To contextualize the analysis of Paulista Avenue and make it complete, the blocks between the avenue and the two parallel roads on each side are considered. This is because there are owners with lots facing only the avenue, others with front to one or two cross streets and others cutting the court up the parallel path. Note that for the lot belonging to the aisle it is necessary that its front is aligned with the avenue. In the corridors generated by an arterial route the first parallel street has the role of alleviating traffic and facilitating conversions to the left, crossing the main road. From there distribute the flows destined for the distribution routes and local streets [1].

2. The Paulista Avenue

The Avenue due to the variety of open spaces that it presents at the level of its sidewalks and the ground floor of the buildings, where thousands of people walk daily, provides an instigating subject for research into the nature of urban elements and architecture. In São Paulo, the avenue is reference as much as the quality of the way space, as of the blocks, lots and buildings. It ranges from the built type occupying an entire block, such as lots with access by two or three streets, as well

as the half-block buildings located on lots of a single facade.

The long corridor from which Paulista Avenue occupies a stretch runs through the city from the south quadrant to the west, lying on a spike line. Cutting several districts, the route was subdivided into segments — avenues — that gives it different names. Among them, Paulista Avenue names the chosen section for the study.

The corridor, which is the dividing line between the Tietê River and the Pinheiros River, crosses the city from West to South and is 8,125 miles long. The section of Paulista Avenue is 1,70 miles and equals twenty percent of the total of the corridor. The elevation of the Paulista Corridor ranges from 2625 feet in the extreme west to 2591 in the South, marking the highest points of the expanded center of the city (space between the two rivers). Due to the elevated dimensions of the spigot, several transmission towers were installed in the roofs of the buildings and in some of them were constructed helipads. The towers, and the back and forth of helicopters, give an unusual image to the skyline of this part of the city.

Fig. 1 View from the center of the city to the spigot (source: Wikimedia, Google Earth Pro 15.05.2017).

As a research object, commercial use spaces will be considered, highlighted from the mixed-use set. The following topics will be the subject of specific observations throughout the text:

• Corridor dimensions and site seating. It will be called the Paulista Corridor, the segment of the corridor corresponding to this Avenue.

• Observations on the segmentation of the Paulista Corridor in smaller parts to characterize each type of urban element to be studied.

• Configuration of the blocks and their installment in lots.

• Criteria for drawing with resources from Urban Morphology, with attention to the projection of buildings (figure-ground) and the design of free areas.

• Classification of types relating to commercial premises.

3. Analysis Procedures

The way of listing the observations on the spaces is organized by a list of patterns in the sense that the results transcend the object of study itself. Establish new types and invent spaces, to consolidate procedures based on the study of corridors and subareas as a method of urban analysis [2].

It studies the form of spaces where people's access is free in an urban corridor. The work process used is efficient for the analysis of the relationships between spaces with a view to a classification of types. It can be considered in the field of Urban Morphology because the study focuses on the physical configuration of spaces in the light of the transformations that occurred in time. From the explanations coming from disciplines that study other aspects of the city it is understood that the society has advanced demanding new uses of the space. It reached the occupation expressed by the types that are observed today in this Avenue. Thus, to determine the patterns that function as articulating elements of the spaces at ground level and of free access to pedestrians in this corridor, we proceeded as follows:

• Understand the evolution of the urban form, based on different authors.

• Prepare a map on the 1: 10,000 scale, showing the avenue and the first row of blocks that flank it.

• Locate each batch with mixed-use building, office work, using Google Street View.

• Visit the place to know and photograph each property selected and correct any distortion of what was seen in the office.

• Organize individual records of each property (123 copies).

• Organize the types identified by a diagram — icon — representing each type, photo of an example, summary description and quantity of each type (six types).

• Present the six types through examples, with schematic plan of each showing the relation with the access ways and the passages through the building, plus the image of the building.

• Write the commentary on the experience of this typological practice.

4. Evolution of Urban Form

The Paulista Avenue since the beginning of the 20th century has undergone constant changes. From an open avenue to cross a rural area of the late nineteenth century, it accompanied the peculiar development of areas that transform from rural to urban. Farms are subdivided into smaller rural parcels and then fragmented into lots. Fractionation that depends on the entrepreneur's perception of the market at each moment in history [3].

The understanding of society at the beginning of the twentieth century was that the position in high, prominent position in the city, could be the place for the palaces of those who were made millionaires by the coffee production. Thus, the slope opposite the Avenue was divided into large lots, marked by the reticular system of the blocks, resulting from orthogonal paths drawn with spacing of one hundred to two hundred meters. Serving very well the coffee-time bourgeoisie, which was the driving force behind the economy of São Paulo (and Brazil). Since the mid-twentieth century, large lots of houses have begun to give way to buildings; not only those of Avenida Paulista. A conglomeration of tall buildings, except for the subdivision of the garden neighborhoods, would characterize the urban landscape of the expanded center of the city of São Paulo, Fig. 2 [4].

The spill-like relief, water divider, is present due to its slope to both sides, generally with more accentuated slopes to the North side and milder to the South. Characteristic exemplified by the illustrative cut of this situation, near the confluence of the Avenida Paulista with Rua Augusta, Fig. 3.

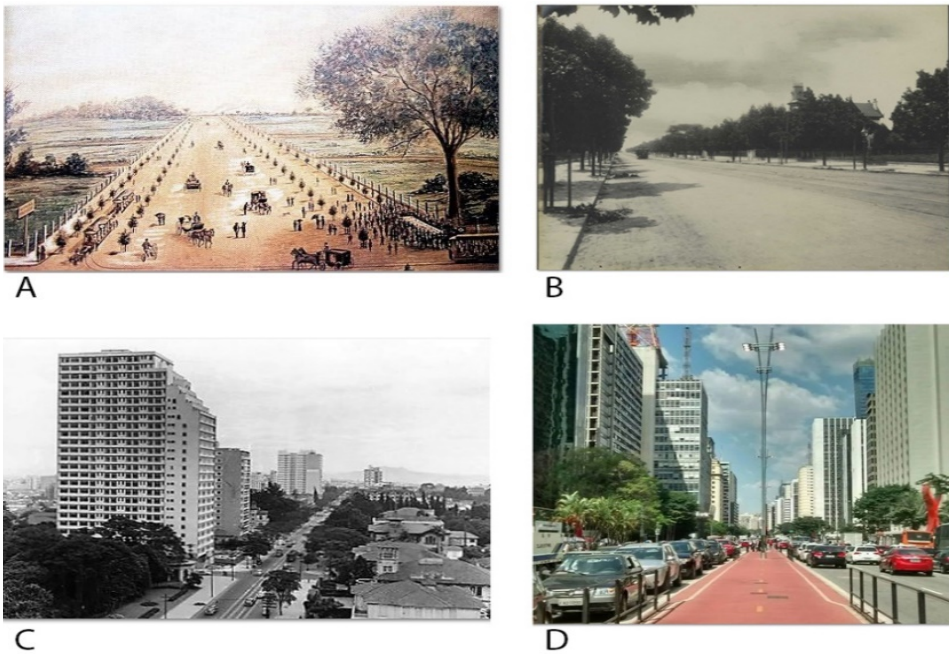


Fig. 2 A: 1891, B: 1906, C: 1957, D: 2017 (Source: Watercolor J. Martin, public domain, Eletropaulo archive, authors).

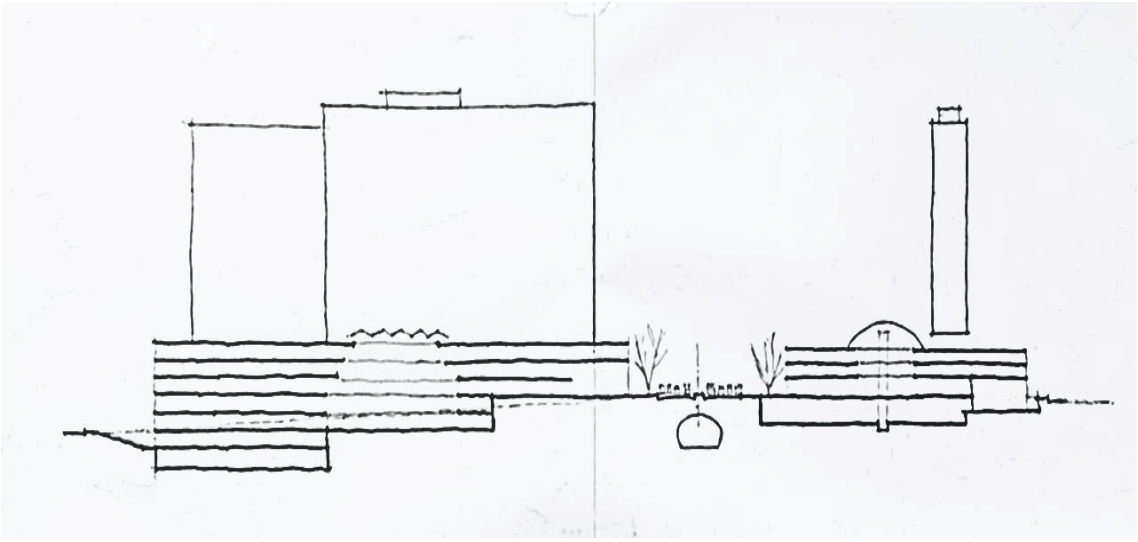


Fig. 3 Cross section of Avenida Paulista.

5. Urban Elements in Paulista Corridor

Studying the corridor implies considering the entire length occupied by the blocks that accompany the path that gives it origin. In the case of the Paulista Corridor, from the beginning of its numbering, indicated by the letter A (Osvaldo Cruz Square) to the letter B (Minas Gerais Street). It can be observed in the aerial photo the system of orthodontic routes to Paulista that forms a network of routes responsible for the center-neighborhood connection. Some of these connections have a large extension and others terminate before, but all can be classified as routes that direct the flow of vehicles to the neighborhoods. From the viewpoint of a corridor located in the highest reaches of the city, this route plays an important role. It includes the movement of people along the sidewalks and the route of the cyclists, being of interest the stops of buses and especially the ones for the Metro, Fig. 4 [5].

For an ease visualization of the corridor site plan, without reducing greatly the scale, the drawing was segmented into two sections, indicated by the number 1 and 2, Fig. 4.

Paulista Avenue is understood as an open space in the last decade of the nineteenth century and today it is a place of the city, an appropriate space for people,

Fig. 4 A: Praça Osvaldo Cruz; B: Rua Minas Gerais.

where one lives, works and lives. Where the street is used for recreation every weekend and every now and then happens big events (protests, carnival, gay parade ...). The Avenue has a special meaning for the city's residents and broad national recognition as the city's postcard [6].

As a working procedure two corridor plants are presented:

- The first showing the free access spaces in the corridor, related to the study purpose documented by the manuscript. Rolling ranges are not included, despite the pedestrian opening at the weekend. It is only the use of the spaces in the working days, Fig. 5.
- The second shows the projection of the buildings (figure-ground), which emphasizes the space committed to the buildings on the ground floor, in contrast to the exterior spaces, Fig. 6.

The process of checking the information to organize Figs. 5 and 6 was accompanied by field visits and study of bibliographical material, such as projects that were published in architecture magazines. Research to identify types that relate the public access passages inside the lots and the buildings.

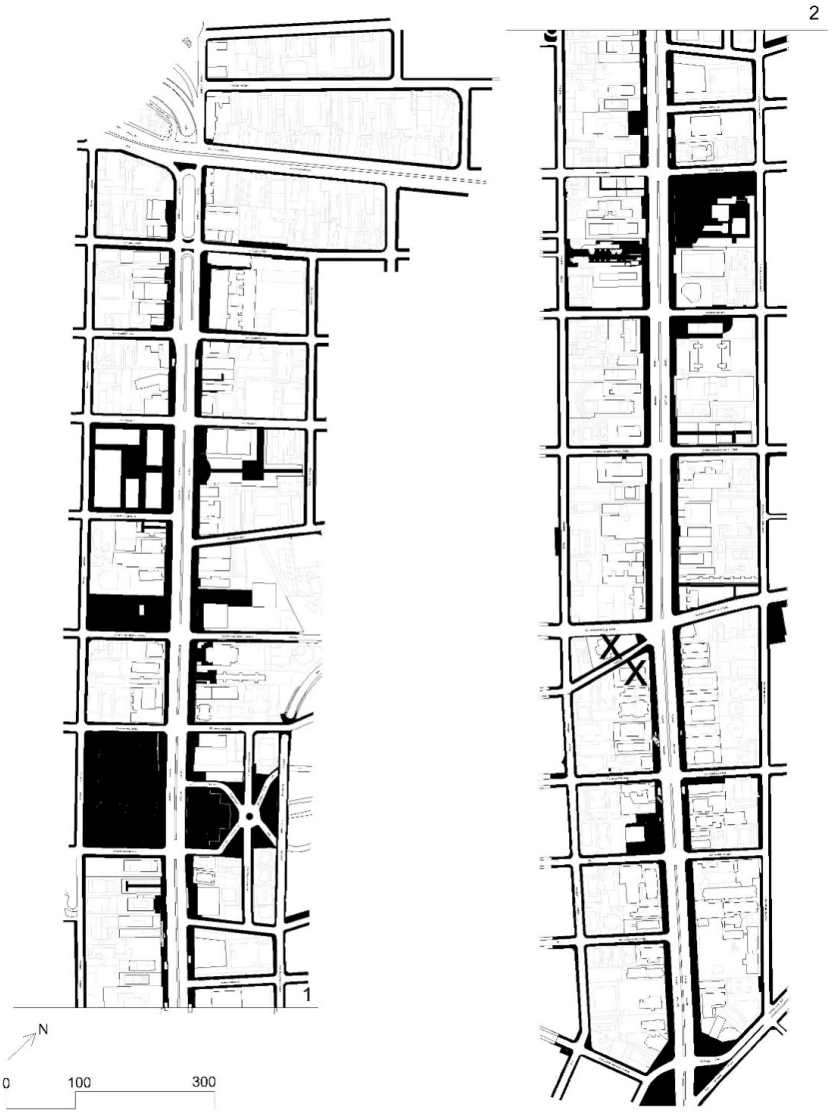


Fig. 5 Free access spaces downstairs from corridor.

Fig. 6 Projection of buildings.

6. Building Typology

The predominant type of spaces on the ground floor of the properties located in the Paulista Corridor is mainly intended to house commercial activities and services, even when residential floors are used on the upper floors. There are rare cases of the entire property being occupied by residential units. In Paulista there are several corporate type buildings, where a company occupies the whole property, being the ground floor as a reception floor and access control to the interior of the building. The administrative buildings of the banking institutions are differentiated, where the ground floor is occupied by a public service agency. In this case, despite the relative control of access, the agency was considered as a store and was thus mapped for analysis purposes.

There are buildings where the daily movement of people is intense and do not fall into the types listed above. They are unique character buildings such as the museum, school, church, and listed goods [7]. In Paulista, these types are complementary to the set of tall buildings and reinforce the diversity of the urban landscape. Not only for the differentiation of built size, but also for the periods in which they are visited. They suggest a proper classification of types, which will not be studied now.

As for the free access of the ground floor were determined certain situations, depending on the relation of the property with the court and the corridor. For some types, significant by the permeability (free passage of people through the ground floor)

illustrations are presented by photograph emphasizing the relations of the accesses to the lot and to the building. We describe in the manuscript only the types that are characteristic of a situation perceptible in a first general overview, if perhaps they act types to be added or variants of a certain type to be considered.

6.1 Type 1: Building Located on Ground of Half A Block, with the Front Facing the Corridor

This is the most frequent case, where the front door is facing the avenue and the basement (ground floor and mezzanine), recessed on the front slope in the side currencies of the lot. The elevator hall turns into the street. There may be shops facing the Avenida or the case of a gallery with entrance and exit on Avenida. Through the gallery you can access the elevator hall. This type allows for windows and direct access to stores that have direct contact with the sidewalk. Also, on the Avenue there is access of vehicles to the garage, Fig. 7.

The Christina Building has a single gallery and represents the type that can have two or more galleries interconnected by forming a loop near the bottom of the lot. The usual type has small stores for the retail trade. There is a reception atrium that distributes the circulation to the galleries interconnected to the background. The hall of elevators is located with direct access by the Avenue and it emphasizes the importance of the great building in the urban context, Fig. 8.

Fig. 7 Avenida Paulista 1471, Edifício Christina.

Fig. 8 Commercial gallery, small shops.

6.2 Type 2: Lot of Half Block, between Two Parallel Streets Linked through A Pedestrian Gallery

In this type the shops have access through the internal gallery and the ones situated at the ends are facing the sidewalks. Access to the elevator hall can be direct on the sidewalks or inside the gallery of shops.

6.3 Type 3: Corner Lot, Gallery with Access by Two Perpendicular Streets

In this type the wings of stores of the gallery have access by two streets that form an angle near ninety degrees. The elevator halls are in the gallery, next to the two entrances or in one of them, depending on the size of the vertical volume. There is possibility of access from the sidewalk to the gallery of shops and direct access to the elevator hall, Fig. 10.

Fig. 9 Gallery interconnecting parallel streets.

Fig. 10 Gallery with longitudinal circulation without exit and access by side street.

6.4 Type 4: Narrow Corner Plot with Currencies for Three Streets, Gallery with Three Accesses.

It happens in relatively narrow terrain, with the possibility of opening accesses and windows for the three sidewalks. The width of the lot induces free movement of people to favor the location of as many stores as possible. In the example the trapezoidal terrain allowed the implantation of patio with vegetation, Fig. 11.

In this type of situation, the width of the lot favors the implantation of commercial center in the ground floor, with the mezzanines that it judges convenient. Overlapping the set may appear one or more towers. In the following example there are two towers.

Fig. 11 Gallery with direct access to three streets.

6.5 Type 6: Wide Terraced Corner, Access By Three Streets, A Single Vertical Block Recessed Leaving Lateral Free Space And Internal Shopping Center.

The representative examples of types 5 and 6 (Figs. 12 and 13) are buildings in lots located on the same side of Paulista Avenue, being favored by the slope of the ground for the implantation of the garage, with entrance through the street parallel to the bottom. This facilitates the entrance of services and parking, Fig. 13.

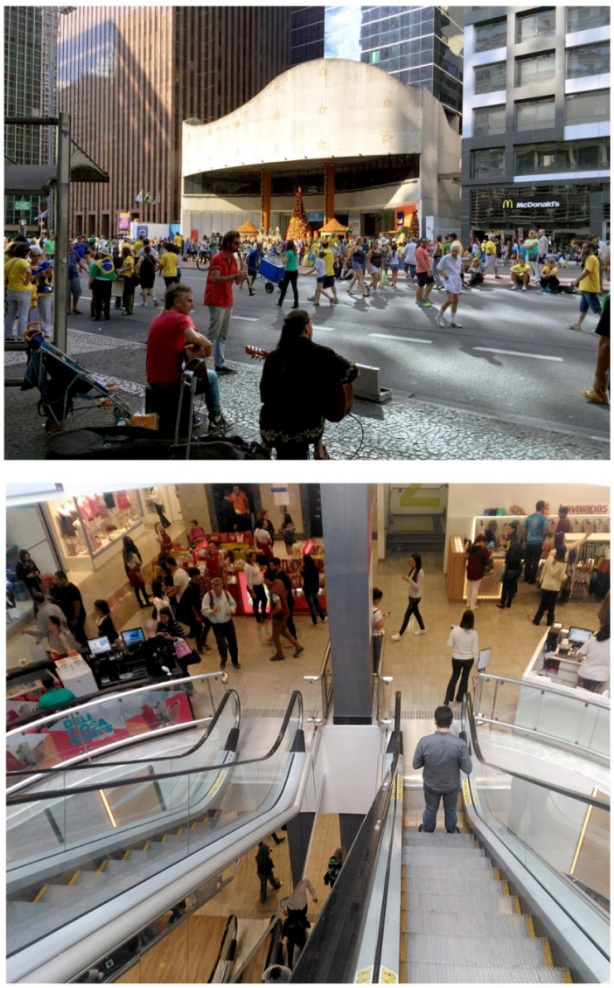


Fig. 12 Lot facing three streets, like a shopping center.

6.6 Type 7: Single Lot Occupying An Entire Block.

In this case the free access of people is made by four entrances, relative to four streets.

The only example of this type in Paulista is an enterprise with access galleries through the four tracks that form the block, the Conjunto Nacional. Its galleries are a benchmark of success for the mobility of people at the ground level, in the city of São Paulo, Fig. 14.

In this case the free access of people is made by four entrances, related to a block, the ground floor being dependent on the cut of the ground due to the existence of lots of third parties. It is a case in which the solution of the architectural project will depend on the implementation strategy of the enterprise. Such as the site plan leaving on the ground free access between different towers or the implantation of a single low rise building on the ground floor and one or more isolated towers above. The only example of this type on Avenida Paulista is the enterprise that occupies the whole block with a low rise building, having the main entrances through galleries. Above there is a tower

designed as a monolitic artefact. This building is called Conjunto Nacional, a benchmark of success in the city with respect to mobility of people, at ground level of a whole block.

Fig. 13 Wide corner lot, access by three streets.

Fig. 14 Lot occupying an entire block, four streets access.

7. Typology: An Overview

The following table summarizes the patterns studied, represented by diagrams of building types, explained using four columns:

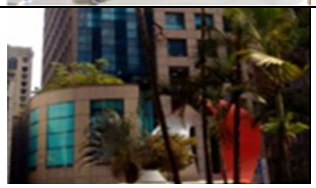
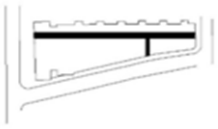
Column 1 shows the number of each type;

Column 2 indicates the diagram that outlines each one of the seven patterns;

Column 3 states the pictures to remember each type;

Column 4 a short comment on the characteristics of each pattern, Table 1.

Table 1 Typology index.

Type	Diagram	Image	Comment
1			Half-Block Lot Driveway Entrance Trough The Avenue
2			Straight Gallery Between Two Paralel Sidewalks An Easy Way for People Crossing
3			Gallery Linking Ortogonal Streets Vertical Circulations Near to the Streets
4			Gallery Going Straight To Paralel Streets With Lateral Doorway Patio Facing the Street
5			Atrium Facing the Avenue and Doorways Open to Two Different Streets Garage Entrance Trough the Paralel Street
6			Large Scale Building Tower with Shopping Prescinct in the Ground Floor
7			Commercial Gallery Occupying the Entire Block An Unique Tower Building

8. Final Assumptions

It is shown a by-product of the research that has been carried out by the GPAC/USJT on the urban elements, based on concepts of Urban Morphology. From the geography of the larger area to the site of analysis; passing through the study of the street, block, lot and building, the project is sought in the way that best meets the will expressed by society [8].

He holds himself for other moments, together with professionals specialized in social, economic, and technical study, accurate in such important specialties, integrate and form interdisciplinary teams. To analyze, plan and design the built space, with the desire that they become the environment of people for sustainability. After all, the common goal is for academic research to reflect and assist the work of professionals in urban design.

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Environmental and Health Percept about a Contaminated Water Channel in Guadalajara, México

Arellano Avelar María Azucena[1], Martha Georgina Orozco Medina[2], Figueroa Montaño Arturo[3], and Davydova Belitskaya Valentina[4]

1. Environmental Monitoring Laboratory, Department of Water and Energy Studies, Tonala's University Center, University of Guadalajara, México

2. Department of Environmental Sciences, Division of Biological and Environmental Sciences, University Center of Biological and Agricultural Sciences, University of Guadalajara, México

3. Department of Physics, University Center of Exact Sciences and Ingeniering, University of Guadalajara, México

4. Department of Environmental Sciences, Division of Biological and Environmental Sciences, University Center of Biological and Agricultural Sciences, University of Guadalajara, México

Abstract: The results of an environmental perception study about a contaminated water channel in Guadalajara Jalisco, Mexico are presented. The percept and opinions of residents were collected by direct interview to a random sample of 370 adults out of a total of 8,900 dwellings with a statistical reliability of 95% and 5% error. The main results highlight discomfort due to the presence of sewage and its association with displeasing odor with 39.3%, in addition to the presence of mosquitoes with 17.6%. Sewage and visual pollution are evident at points P3, P6 and P8, due to the presence of discharges of wastewater and solid waste to which the population is exposed. The most frequently reported signs and symptoms are irritation to organs of the respiratory system and headache with a statistically significant association ($P \leq 0.0000$). The association of signs and symptoms was determined with the chi-square test with the use of a contingency table. The perception of environmental quality is assessed as very bad (90% of interviewee), which coincides with direct observation.

Key words: environmental percept, health percept, water contamination, environmental quality

1. Introduction

The state of the environment is crucial when studding people wellness, although there are a large number of factors conditioning relationships between wellness and illness processes. A particular science that relates societal and environmental factors is Environmental Health. It takes into account that humans interact with the environment constantly, and these interactions affect quality of life, years of healthy life lived, and health disparities [1].

The World Health Organization (WHO) defines environment, as it relates to health, as "all the physical, chemical, and biological factors external to a person, and all the related behaviors" [1]. Thus Environmental Health consists of preventing or controlling disease, injury, and disability related to the interactions between people and their environment [2].

In most parts of the world's urban scenarios, environmental problems are usual and range from poor air quality, water sanitation, solid waste, and poverty. These issues demand concrete measures to lesser the negative effects on quality of life [3].

A useful tool to assess the condition of the environment and how it relates to health is perception

Corresponding author: Martha Georgina Orozco Medina, Ph.D.; research areas/interests: salud ambient. E-mail: martha.orozco@academicos.udg.mx.

survey, since citizens express their opinions and feelings about the problem they are facing and yield sound information to design programs, or attention proposals to tackle the complication [4]. Surveys of public opinion are instruments that support research projects, although might be subject to error, but are not necessarily related to a poor selection of samples or representativeness [5]. In the design of public opinion surveys, the researcher must define variables as accurately as possible to avoid bias or misleading information [6]. Such considerations were taken into account when designing the questionnaire of this project.

Perception surveys and public opinion studies are relatively recent in social research, but they have reached a solid position in modern societies. Such tools are increasingly present in the public agenda, constituting an essential resource to guide the decisions of governmental and non-governmental organizations.

Conducting a perception study allows us to know how people perceive the environment and how the status of it connects their mental state, as enjoyment of beautiful landscape, anger or fearing of a spoiling water course [7]. Vargas and Gallegos, 2005 mentions that optimal surroundings are beneficial to health and welfare. Louv (2010) [8] comments that relationship with nature influences moods such as depression in children, and Kratekin (2011) [9] states that positive results from environmental intervention generate confidence.

According to Luengo (2002) [10], evaluation of physical surroundings should monitor qualitative variables such as breathable air, the appropriate proportion of green spaces in terms of expansion, availability and management, personal safety and the quality of services. Risk evaluation concerning toxic substances should be appraised for legislative measures of the use of chemicals. In Latin-American countries such approach is far from being put into practice, as it is the case of pesticides and agro-chemicals which are posing important health problems in the population of rural communities that live nearby shores of contaminated bodies of water.

Particularly in Guadalajara city the natural course subject of this study, is the remaining of what used to be a generous stream emerging from the upland of the Colomos Forest to down land in the Santiago River. Due to intensive urbanize practice that occurs in the city, besides the lack of comprehensive environmental management policies, the flow has not received proper attention in correspondence with their importance of environmental value [11, 12].

In order to analyze the percept regarding environmental conditions along the course of the channel, nearby population was questioned about environmental problems in the area, the frequency of signs and symptoms of health, and how they relate the presence of this issue to the quality of surroundings. The willing of residents to get involved in actions to improve present environmental conditions was addressed as well.

2. Method

From the origin of the natural course in the Colomos Forest to the convergence with the San Juan de Dios River there were established eight sites of measurement (Fig. 1). The water course covers a length of 8.7 km and runs along the municipalities of Zapopan and Guadalajara in the northern part of the metropolis [13]. Inland the watershed of 30.89 km^2 there are 50 communities of 31,109 inhabitants settled in 8,900 homes that get the benefits or negative effects from surrounding environment [14]. An influence area of 200 m both sides of channel course was defined using a geographic information system (Arc Gis) as it was described by Sánchez et al. (2006) [15].

In order to know dweller's percept about the presence of environmental problems, the frequency of signs and symptoms of health, and how they relate these issues to the quality of surroundings; besides willingness of respondents to be involved in actions to improve current conditions, there was defined a

random sample of 370 homes to be directly interviewed. This number was estimated by a sample size calculator for a 95% confidence level, 5% confidence interval and a population of 8,900 families [16].

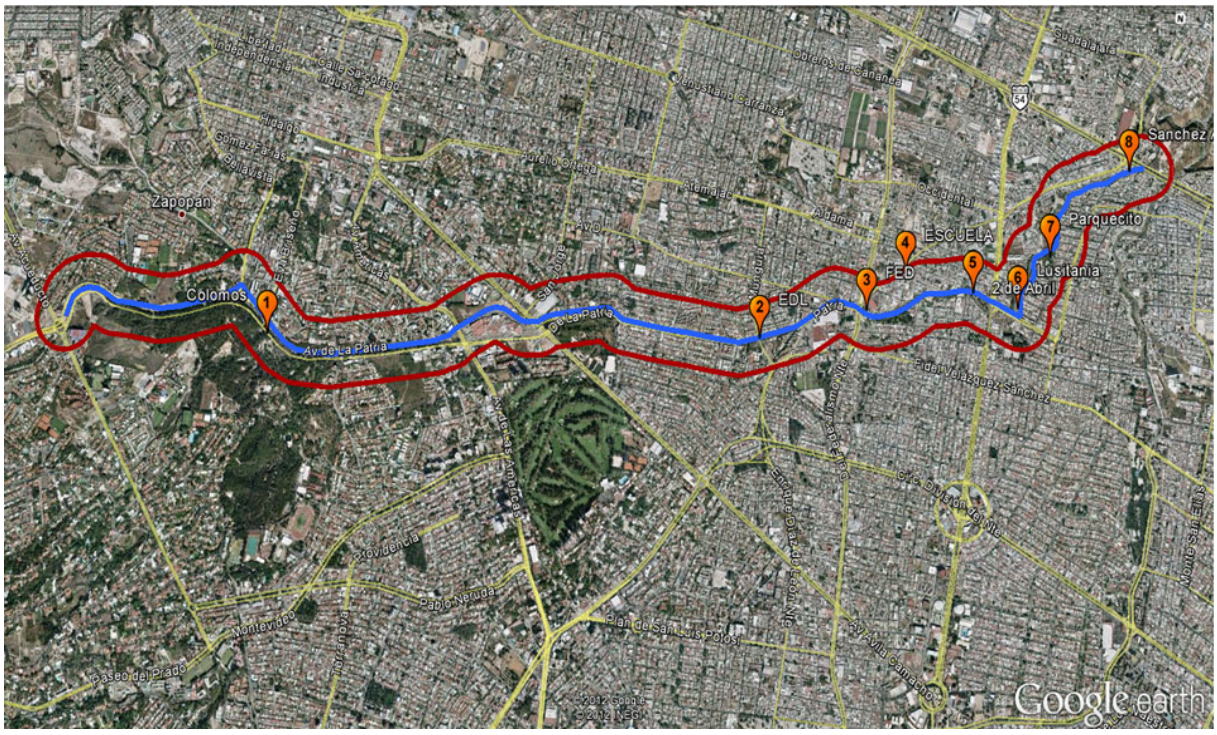

Fig. 1 Location of sampling sites. Blue line corresponds to water course and the red one to border line of influence.

Even though water pollution was visible, a pilot study was conducted in order to have a quantitative reference as a water quality index (WQI). Resulted WQI was 14.23 which refer to excess contamination within a range of 0-20. According to this range water is not suitable for farming, fishing, agriculture, recreational use or domestic use [17]. The WQI groups the most representative polluting parameters in a unified value, thus being an instrument that allows identifying the deterioration or improvement of quality in a body of water.

Survey information was analyzed by the statistical software StatGraphics Centurion XV. Particularly the Chi-square test was performed to test the null hypothesis "There is not association between the frequency of signs and symptoms and the environmental status at the different sampling sites".

3. Results

The results of the study show a gradual deterioration from the origin of the channel in the "Colomos Forest" (Fig. 2(a) and (b)) to its confluence with the "San Juan de Dios River" (Fig. 2(c) and (d)). The main problem that affects the channel has to do with sewage discharge, thus altering its physicochemical properties and the generation of displeasing odor. Physicochemical characteristics of water from the pilot study referred a WQI of 14.23 within a range of 0-20. At this value contaminants in the water are overloaded and the use of the resource for farming, fishing, agriculture, recreational use or domestic use should be avoided. In addition, visual pollution due to solid waste dumping is visible as well.

3.1 Survey Results

Fig. 3 summarizes results of sociodemographic data from the 370 questionnaires, as well as identified environmental problems by interviewee. It can be seen that 62.4% of the data corresponded to women and 37.6% to men. Regarding occupation, a proportion of 30%

identified themselves as housekeepers, although a similar figure of 29% did not give an answer (Fig. 3a). About schooling there is almost a homogeneous steady decrease among different educational levels, except for elementary to secondary (Fig. 3b). In relation to the time of residence in the area, most people have been there between 2 and 10 years and secondly from 11 to 21 years (Fig. 3c).

Fig. 2 Environmental conditions of stream bank from its origin in "Colomos Forest" (a), to its convergence with "San Juan de Dios River" (c), and its final discharge in "Santiago River" (d).

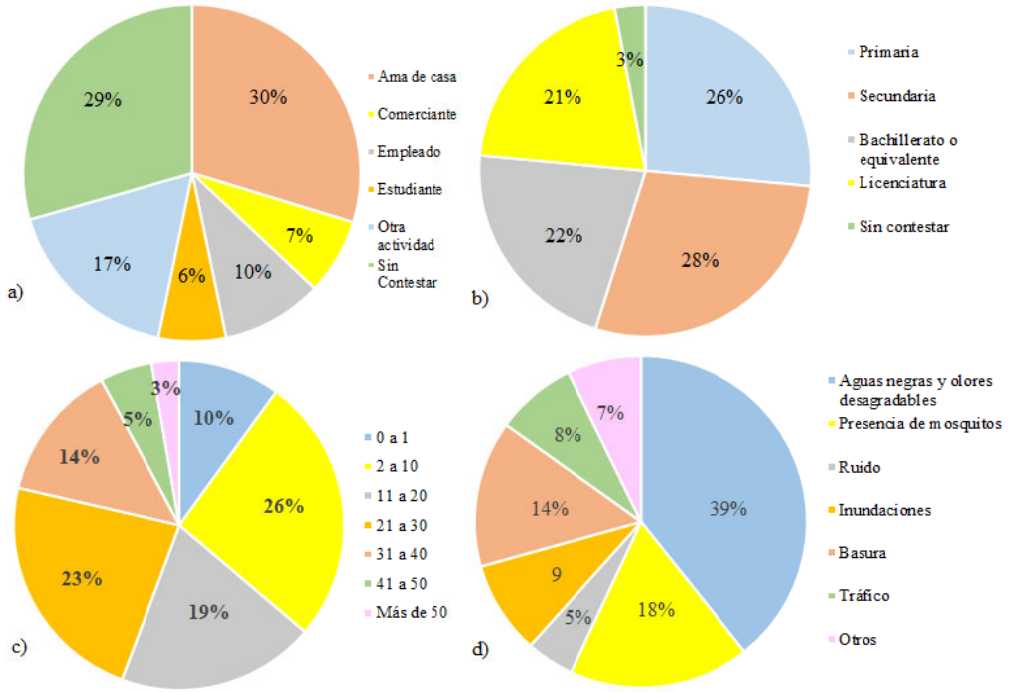

Fig. 3 Occupation (a), Education (b), years of residence (c) and identified environmental problems (d).

The most common environmental problems reported by responders were sewage and associated displeasing odor. Secondly, the presence of mosquitoes, followed by solid waste of domestic origin, and in less proportion waste products from commercial activities and services occurring in the area (Fig. 3d). Less identified problems corresponded to noise pollution and other events such as smog, animal pests, insecurity and vandalism; in addition to the problems of traffic and flooding (Fig. 3d).

The most polluted sites along the water course match waste water discharge from a nearby slaughterhouse, in addition to a local market and automotive services that generate chemicals like mineral oil, solvents and other toxic substances (Fig. 4(a): P3, P6 and P8). The presence of bad smell in the area is frequent during spring when average temperature is warm enough to enhance bacteria growth, and consequently displeasing odor due to spoiling of organic matter.

In general terms, the quality of the environment was qualified as very bad by interviewee (Fig. 4(b)). This is because the benefits they can get from a natural stream like landscape beauty, microclimate regulator or water supply, are limited by the unhealthy state of water (Fig. 4(c)). Besides 84.6 of participants have good knowledge of how the quality of surroundings where they live has an impact on their health and wellbeing.

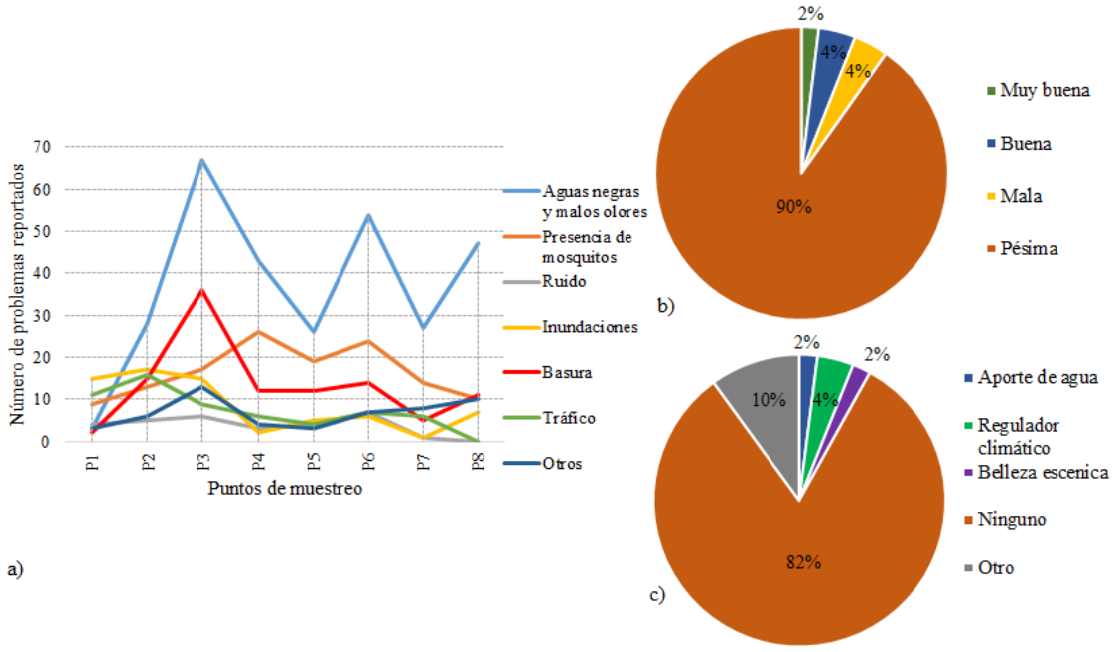

Fig. 4 Assessment of environmental quality: a) Main problems, b) Environmental quality, c) Benefits of living nearby the channel.

Signs and symptoms most frequently reported were those related to organs of the respiratory system, such as throat irritation, nasal congestion, coughing and respiratory problems; in addition to headache which normally follows the saturation of smell sensors because of the persistence of displeasing odor.

In order to test possible association between occurrence of signs and symptoms and the state of environmental quality at each of the study points, the results of reported frequencies were analyzed through a contingency table by mean of the chi-square test. In this technique the null hypothesis that "there is no association between the presence of signs and symptoms and the environmental conditions at each of the study sites" was tested and produced the results pointed in Table 1.

The chi-square value of 155.86 and P = 0.0000, gives relevant information to reject the tested hypothesis with

Table 1 Statistical test of independence.

Independence test	Statistical value	Degrees of freedom	P value
Chi-square	155.856	70	0.0000

a statistical confidence of 95%. It can be affirmed that prevailing environmental conditions at each point of study are statistical associated with the signs and symptoms of local population.

Column totals (Table 2) show the most commonly reported signs and symptoms. Larger numbers correspond to affections of organs of the respiratory system (throat irritation, congested nose, coughing, respiratory problems) and headache. Row totals account for accumulated signs and symptoms at each sampling site and higher values in descending order were recorded at P3, P6, P4 and P8 as it is shown in Fig. 4a for the most common environmental problems identified by interviewee.

Table 2 Contingency table showing the association among environmental conditions and the presence of signs and symptoms, (Chi-square 155.86, P < 0.0000).

	Sings and Symptoms											
Sampling Sites	Headache	Stress	Nausea	Malaise	Diarrhea	Respiratory problems	Congested nose	Throat irritation	Coughing	Alergy	None	Row total
P1	1	2	1	1	1	18	21	20	16	2	2	85
	0.09%	0.17%	0.09%	0.09%	0.09%	1.53%	1.79%	1.70%	1.36%	0.17%	0.17%	7.23%
P2	15	10	2	4	9	6	14	12	17	6	13	108
	1.28%	0.85%	0.17%	0.34%	0.77%	0.51%	1.19%	1.02%	1.45%	0.51%	1.11%	9.19%
P3	37	22	23	23	34	23	35	35	23	12	4	271
	3.15%	1.87%	1.96%	1.96%	2.89%	1.96%	2.98%	2.98%	1.96%	1.02%	0.34%	23.06%
P4	22	12	9	14	14	21	23	33	31	6	2	187
	1.87%	1.02%	0.77%	1.19%	1.19%	1.79%	1.96%	2.81%	2.64%	0.51%	0.17%	15.91%
P5	8	3	8	1	4	10	13	13	8	9	1	78
	0.68%	0.26%	0.68%	0.09%	0.34%	0.85%	1.11%	1.11%	0.68%	0.77%	0.09%	6.64%
P6	25	13	16	8	9	22	27	31	23	9	9	192
	2.13%	1.11%	1.36%	0.68%	0.77%	1.87%	2.30%	2.64%	1.96%	0.77%	0.77%	16.34%
P7	12	4	4	3	9	8	9	22	16	6	3	96
	1.02%	0.34%	0.34%	0.26%	0.77%	0.68%	0.77%	1.87%	1.36%	0.51%	0.26%	8.17%
P8	27	12	13	9	15	13	18	20	20	9	2	158
	2.30%	1.02%	1.11%	0.77%	1.28%	1.11%	1.53%	1.70%	1.70%	0.77%	0.17%	13.45%
Columm Total	147	78	76	63	95	121	160	186	154	59	36	1175
	12.51%	6.64%	6.47%	5.36%	8.09%	10.30%	13.62%	15.83%	13.11%	5.02%	3.06%	100.00%

Finally results of the survey concerning the willingness of local residents to engage in actions to improve identified impacts were good. Participants demand government to leader a remedial project focused on environmental education, inspection and regulation of sewage discharges and cleaning campaigns. As the most significant measure to finish eminent health hazards for local residents, they propose to route the stream through culverts and on top of it built a linear park for leisure. By this action the surrounding can be sanitized both in terms of displeasing odor and landscape improvement.

Findings of this study complement those made by Fernanadez et al. (2016) [7] in relation to contamination of a well number of natural courses in Latinamerica, where population growth and the high

demand for goods and services, besides lack of environmental management programs that take into account the voice of local inhabitants; are the driving forces for the deterioration of these elements of nature.

The approach of environmental problems is complex, but if the feelings and opinions of affected people are heard and take into account when designing management programs and policies to tackle the problem, the chance of success will be more significant [18, 19]. Similar arguments are made by Vergel et al. (2016) [20] when stating that it is of great importance the involvement of citizens when building the community, and not only the esthetics should be present but relationships among social dimension and nature, life quality, public spaces and security issues must complement it.

Jiménez et al. (2015) [21] discusses relevance of subjective evaluations when assessing sanitary risks of a polluted zone through social perception and refers this approach of research as a significant tool to confirm people's feelings and opinions. In this sense it is important to take into consideration that health and environmental quality are close together and if we want to advance in better health it is also essential to consider comprehensive environmental policy to improve environmental quality in critical areas, such as the one identified in this study.

4. Conclusions

Most relevant problems referred by interviewee were related to the presence of sewage and displeasing odor with a 39.3% as well as the presence of mosquitoes 17.6%. Environmental quality was qualifies as very bad by 90% of participants. Regarding the perception of noise as a problem, it was blurred due to the importance to other pollutants.

The methodology applied in this project is a basic information tool to enhance responsible action by social, public and private sectors, about the impacts and deleterious consequences of environmental problems on health that occur at critical areas of environmental interest. This project also provides information to identify environmental health conditions along the course of channel as it was produced by the perception and opinion of the population. Results of perception studies support intervention actions and facilitate the implementation of sound public policies.

It is necessary to generate a framework solution to promote sanitation of surrounding that improve health of inhabitants, as well as social issues like security, that allows local dwellers of the channel bank to live with dignity and position Guadalajara city on the top rank of urban sustainability. In order to approach this level citizen should take action in reporting and demanding authorities to solve environmental arising pressures due to the contamination of the cannel. Part of this level of consciousness can be reached by environmental education programs by which people can get knowledge of the importance of their participation to improve the environmental status in the area.

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Inferential Sensor of Residual Moisture Content and Separation Efficiency Applied to Pilot-Scale Vibrating Screen

Mateus Sousa Freitas, Vinicius Pimenta Barbosa, Fernando Superbi Guerreiro, Anderson Lima de Menezes, Rubens Gedraite, and Carlos Henrique Ataíde

Chemical Engineering Faculty, Federal University of Uberlandia, Brazil

Abstract: Vibrating screening is still one of the main operations considering solid-solid and solid-liquid separation processes. Although it is an equipment of simple design and execution, the full description of a screening unit operation may be difficult to predict, considering that several operational variables can influence it. Therefore, the main objective of this work was to develop an inferential sensor to be used with an optimized control system in order to automate and improve the sieving process. Semi-empirical models were identified considering a pilot-scale vibrating screen by using a suspension of phosphate rock concentrate (with a density of 3.25 g/cm^3 and average particle size of 95 μm), water, and xanthan gum. The experiments for obtaining the models followed a factorial design 3^k and relate moisture content of retained solids and separation efficiency to g-force and solids concentration in the feed. The vibrating model was obtained by the disturbance in the rotation of the vibration motors and relates the g-force with rotation of these motors. The combination of the models was studied through simulation. The behavior of moisture content and separation efficiency was evaluated and an operation optimization was performed. For the studied range, the system worked properly, leading to g force to the best possible value, depending on operating conditions of the vibrating screen.

Key words: wet screening, inferential sensor, process control

1. Introduction

The drilling of oil and gas wells makes use of drilling fluids while the drill bit penetrates to the required depth. The advancement and the drill rotational movement breaks the rocky formation, creating small pieces of rock, called drill cuttings. Finally, the drilling fluid carries solid material along the annular region between the duct and the shaft wall, to remove it from the well and preventing the buildup of this material on the perforated region [1].

The size of the transported solid particles between 1 and 1,500 micrometers and its composition is the same as the perforated rocky formation. The presence of solid alter various properties of the drilling fluid which, in turn, affect the drilling time, the drill life, the recirculation pump and other mechanical equipment involved in the operation. For the reuse of this fluid and compliance with environmental constraints that prevent the disposal of solids contaminated, the separation of these materials is necessary [2-4].

The vibrating screens are the first devices that come into contact with the drilling fluid, being responsible for removing coarse solids, generally larger than 74 micrometers[3, 5]. The vibration obtained with vibrating motors introduces ascending and descendants forces in the material on the screen, which favors the separation. The upward movement of the sieve screen pushes the fluid in downward direction by inertia, causing it to drain by passing

Corresponding author: Rubens Gedraite, Ph.D., Chemical Engineer; research areas/interests: process automation. E-mail: rgedraite@ufu.br.

through the open area of the sieve screen by moving the solid up. When the screen cloth moves down, the solids have a tendency to be driven forward [3, 6, 7] The passing fluid (underflow) containing solid material with dimensions generally smaller than the screen opening of the sieve, which can be separated in other process steps [3, 8, 9].

Accordingly to Golovanevskiy et al. (2011) [7], the vibration phenomena in a granular bulk material represents a problem, due to the fact that material behavior depends on vibrating parameters, material properties and sieve feed system. The scientifically screening and its sub-processes are currently still not satisfactorily understood, often complicating the design and optimization of screening processes in both small scale laboratory and industrial applications [10].

The main variables that influence the performance of the vibrating screen operation are: magnitude of the acceleration of material on the screen (typically represented by the dimensionless number g-force), the sieve screen tilt, feed flow and characteristics of the screening cloth and solid fed [11-14].

Finally, seeking to reduce the loss of material and extend the life of the vibrating screen, some control strategies have been proposed [12, 15, 16]. However, these do not consider the use of process models identified able to infer the value of a particular property of interest in real time as shown by Itävuo et al. (2012) [17] for the case of the cone type mills. Liao and Dexter (2005) [18] also use a similar strategy to infer the operating temperature of a boiler and propose an alternative control strategy from these estimated data.

Makinde et al. (2015) [19] presented a study of vibrating screen development trends and the nature of the evolution through the years. According these authors, the survey considers a model that was developed to show the distinct novelties and technical features that have evolved in vibrating screen production trends in the mining machinery industries.

In contrast, for the control of vibratory sieving operation these ideas are still in the initial deployment phase. To contribute in this area, it was decided to study the residual moisture content of the behavior and the efficiency of separation in real time, considering the employment of identified mathematical model associated with the sieve control strategy that identifies the best operating point for the vibrating screen from the knowledge of its dynamic behavior.. The difficulty related with the measurement of the residual moisture of the retained material by traditional sensors is a problem that could be solved using a inferential sensor as proposed in this paper.

2. Materials and Methods

2.1 The Lab Scale Screen

A schematic diagram of the experimental unit used is shown in Fig. 1.

The main component of this unit is the vibrating screen with 1.65 m long, 0.81 m wide and 1.0 m high, equipped with two rotating vibrators and one screen

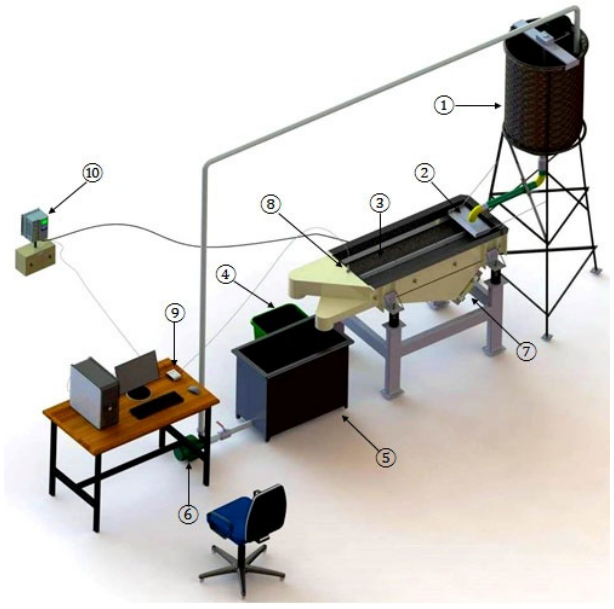

Fig. 1 Experimental unit used to perform the tests: (1) 500 L stired feed tank; (2) rail for the feed of the suspension; (3) screen surface; (4) tank to collect the retained material; (5) tank to collect the material that passes through the screen cloth; (6) centrifugal pump; (7) rotating vibrators; (8) accelerometer; (9) data acquisition board and (10) frequency inverter.

cloth, which is exchanged when necessary. The vibrating screen is linked to three tanks: a 500 L stirred feed tank that keep the suspension under constant mechanical agitation; a 200 L tank to collect the material that passes through the screen cloth and a 80 L tank to collect the retained material.

The vibrating screen was equipped with two 0.75 hp counter-rotating vibrating motors which produce rotation movements in opposite directions. This configuration ensures adequate vibration, providing a linear motion to the simulating drilling fluid discharged on the screen. A WEG model CFW700 frequency inverter adjusts the rotation of the vibrators. To perform the operation, the screen cloth was mounted and the suspension of phosphate rock concentrate stored in the feed tank was fed to the screen. The suspension was kept under constant agitation. The screening was started opening the valve installed at the tank base to allow flow of the suspension to be discharged onto a rail in order to enable a more uniform distribution on the screening surface. The g-force control was needed, since the value of the controlled variable decreases as the suspension is being fed onto the screen [12, 14].

2.2 Sensors and Controls

The experimental unit was equipped with a PCB model 646B00 piezoelectric accelerometer (Fig. 2A), responsible for sending a signal in the range 4 to 20 mAcc to a computer through National Instruments model USB-6008 data acquisition board (Fig. 2B). The signal magnitude is given in g-force in a range from 0 to 10 grms. The data acquisition, monitoring of experimental unit and g-force control was configured in the data base of LabVIEW® (Fig. 3). The current signal created by the accelerometer was collected and conditioned in a range from 1 to 5 V. The acquisition system collected 1000 data per second. The data collected mean for each time interval of 1 second was calculated and transformed to g-force. It was also possible to select a rotation value for vibrators

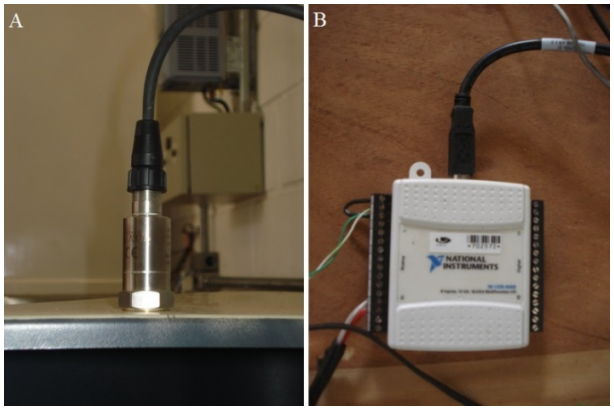

Fig. 2 (A) PCB model 646B00 piezoelectric accelerometer and (B) National Instruments model USB-6008 data acquisition board.

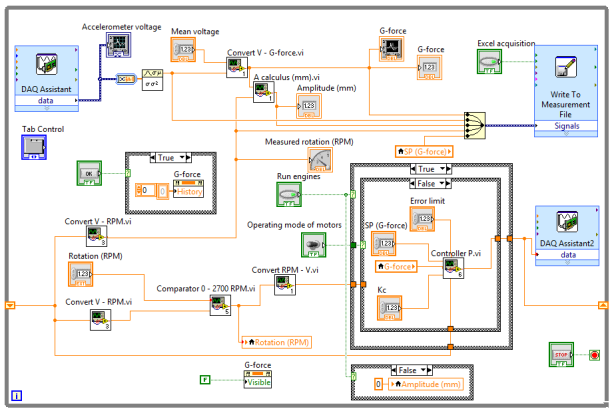

Fig. 3 G-force Controller Block diagram in LabVIEW®.

operation through a signal sent to the frequency inverter. For the experiments, it was necessary to establish a predetermined g-force (set point).

The g-force decreases as the suspension fills the basket and the total system mass increases, a proportional control algorithm was configured to compensate this disturbance. The collected data were exported to an Excel Spreadsheet. Experimental data used in this work was conducted by Guerreiro et al. (2016) [14]. The experiments were performed in batches considering a 3^k factorial design, in triplicate, for the variables (F_g) and volumetric concentration of particulate material in the feed (C_V).

3. Results

3.1 Inferential Models of a Dewatering Screening

The temporal behavior of the g-force value applied

to the vibrating screen was evaluated using an identified model that relates the operating frequency of the vibration motors with the g-force applied to the material on the screen. This work was based on dynamic response analysis of the g-force to start the rotation frequency of the vibrators. The initial portion of the transient variation of g-force was studied, corresponding to the acceleration imposed on the oscillatory motion applied to the screen by the fact that it allows greater sensitivity in response to the system analysis. A first order plus dead time (FOPDT) transfer function was identified relating the g-force with the engine vibration, as presented at (1) and the simulation diagram developed in MATLAB/Simulink® is presented at Fig. 4.

To increase the performance of process systems, there is a need for differentiation between variables that can be measured easily and the variables linked to the efficiency of the equipment, many of which can not be measured quickly, or simply cannot be measured [20-22].

The identified models for the moisture content of retained solids and the prototype separation efficiency at a 175 mesh screen were developed and are presented in Eqs. (2) and (3). The evaluated responses were: moisture content of the retained material (M) and separation efficiency of the retained material (η). Besides, the independent variables chosen were: the volumetric concentration of particulate material in the feed (C_V) and the g-force promoted by the screen (F_g). Each experiment was carried out in triplicate and one third of the outputs were used to validate the model. One barrel (159 L) of suspension containing phosphate rock concentrate diluted in water was prepared. Its particle density determined by helium gas pycnometry was 3.25 g/cm^3. The moisture content was determined from the samples collected, followed by oven-drying at 105°C for 24 h and the separation efficiency was evaluated from feed and fluid passing PSD analysis [11]. Eqs. (2) and (3) were evaluated from the experimental outputs and a full multiple regression to fit a second order model was executed [17, 23].

$$G_{screen}(s) = \frac{\left(\frac{1.9}{1490}\right)e^{-9s}}{3s+1} \quad (1)$$

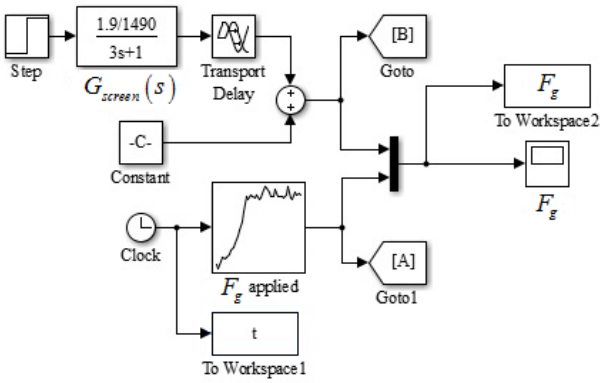

Fig. 4 Simulation diagram for g-force.

$$M(\%) = 30.833 - 8.847C_V + 1.238C_V^2 - 1.721F_g - 0.026F_g^2 + 1.090C_VF_g \quad (2)$$

$$\eta(\%) = 78.096 + 0.937C_V + 0.538C_V^2 + 4.593F_g - 0.682F_g^2 - 1.732C_VF_g \quad (3)$$

The optimal operation point for the studied experimental facility combines both low moisture content and high separation efficiency and take into consideration an auxiliary variable (Z), that is the objective function, subjected to the constraints1.00 ≥ F_g ≥ 3.50 and 1.0% ≥ C_V ≥ 3.0%, and defined by Eqs. (4) and (5):

$$Z(\%) = \eta(\%) - M(\%) \quad (4)$$

$$Z(\%) = 47.263 + 9.784C_V - 0.700C_V^2 + 6.676F_g - 0.657F_g^2 - 2.821C_VF_g \quad (5)$$

The optimal Z value, obtained from the experiments was 67.87 for a g-force of 1.00 and a solids concentration of 3.0%. Based on the identified models, it was proposed a control strategy that allows real-time optimization of the system considering disturbances in the concentration of solids in the feed stream and in the g-force applied to the screen. This system identifies the best g-force value to be applied depending on the solid concentration in the feed. Fig. 5 depicts the corresponding block diagram. This kind of technology

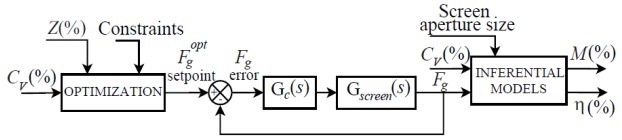

Fig. 5 Block diagram of the proposed inferencial control system.

can contribute to minimize the operator intervention in order to maximize screening performance [16].

The proposed control strategy defines a g-force set point that is required to provide a higher efficiency and also produce a retained solids stream with lower moisture content for a given solids concentration in the feed. This set point is compared with the measured g-force value, and the controller acts to compensate this difference. Considering Eqs. (2) and (3), it is possible to infer the screening efficiency and moisture content in real time operation. Similarly, a FOPDT(First Order Plus Dead Time) dynamic model was used in the simulation of the control system to represent the behavior of the sieve vibration. Also it was used a PID controller tuned with MATLAB PID Tuner®, considering a fast response time and a smooth answer for the equipment during transient behavior.

3.2 Model Validation

The model validation was realized applying the methodology proposed by Fair (1986) [24], considering that any experiment related to a high residual (also called an outlier) was removed from the regression. This procedure was executed until there were no more outliers, and at least two experiments of each experimental condition were kept for the analysis. In the sequence, a new regression was executed considering the mean values in each experimental condition with determination of R^2 after removing all outliers. The non-significant estimators were eliminated by the F-fisher statistical test at a 5% significance level.

The validation data set were compared with the results provided by the identified models considering the root mean square error (RMSE) and mean absolute error (MAE) criteria [24, 25]. Error values tending to zero indicate the validity of the equations. For g-force, varying between 1.00 and 3.50 and the volumetric concentration of solids fed varying between 1.0 and 3.0%, all calculated errors are smaller than 3%. For moisture content model, Eq. (2), the values of RMSE and MAE are 0.51 and 0.44. Similarly, for efficiency model in Eq. (3), the values of RMSE and MAE are 2.70 and 2.42. Eq. (3) higher errors occurs due to greater number of analyzes need to obtain efficiency values. Efficiency analysis involves measuring the flow, the concentration and the PSD of all screening stream [14].

The graphics presented in Fig. 6 and Fig. 7 depicts the behavior predicted by the models proposed on Eqs. (2) and (3), respectively. Considering Fig. 6, for volumetric concentration of solids in the feed equals to 1.0%, as the g-force values increase, the moisture content of the retained solids decreases. This occurs because for 1.0%, less solids are competing for the openings in the screen than for 2 and 3%, improving the fluid passage through the screen with increase in g-force, even though the residence time effect is lower due to a higher transport velocity. On the other hand, for 2.0% and 3.0% volumetric concentration of solids, the moisture content increases as the g-force values increase. This effect can explain by the fact of for 2.0 and 3.0%, there is more particulate material onto screen, which results in a smaller area available for liquid flow through the screen and, in addition, the resistance caused by the slurry concentration affect the liquid passage through the screen. Thus, the process is disadvantaged by increasing the g-force, since the residence time effect becomes a more significant variable. It is also possible to observe that, for each value considered for the g-force, the increase in the volumetric concentration of solids results in a decreasing in the moisture content. These results demonstrate the difficulty of relating the variables involved in the vibratory sieving process and the difficulty associated by the phenomenological description and simulation of process.

The inferential sensor is an appropriate choice to measure the values of variables that cannot be measured directly in the process or that are difficult to measure. In the case of this study, both separation efficiency and residual moisture are variables that are difficult to measure in real time, so the justification is to use the inferential sensor [26].

Considering Fig. 7, it is found that there is a trend of decreasing in the separation efficiency concerning the increase of the g-force values, except for C_V = 1.0%. Under the conditions used in the experiments, the g-force applied to the screen represents the driving force in the solid-liquid separation, and the volumetric concentration of the suspension fed to the equipment represents the resistance of the separation process. In this condition, the increase in the g-force value suggests that the particulate solid material will be subject to a more intense vibration which could increase the separation process. However, there is a tendency to promote higher conveyance of the solid material on the screen and this tends to neutralize or inhibit the most favorable effect of vibration applied to the screen [12].

The relationship between objective function, g-force and volumetric concentration of solids is depicted in Fig. 8. For C_V = 1.0%, the objective function value increases with increasing g-force. However, for higher volumetric concentrations of solids, an increase in g-force promotes decreases Z under the conditions used in the experiments. Similarly, for lower g-force values, an increase in volumetric concentration of solids increases the objective function value. However, for higher g-force, an increase in concentration causes

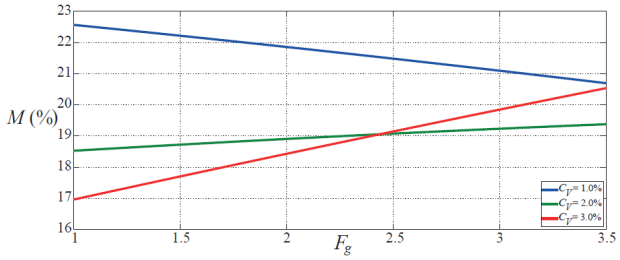

Fig. 6 Relationship between moisture content of the retained solids and g-force.

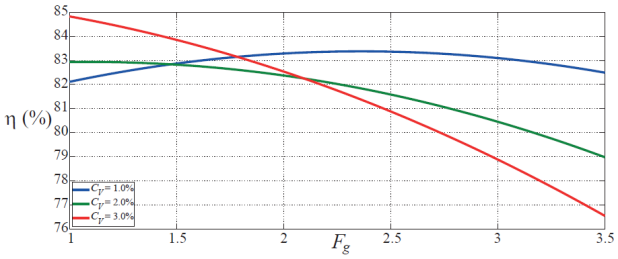

Fig. 7 Relationship between efficiency and g-force.

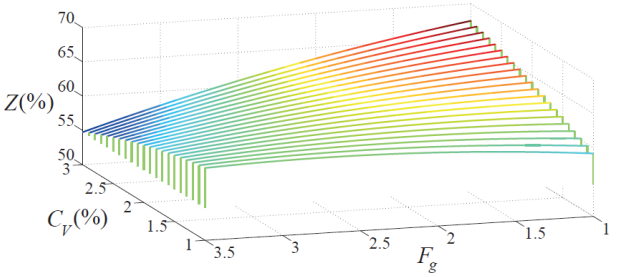

Fig. 8 Relationship between objective function and g-force and concentration.

a decrease in the Z values. The maximum point Z obtained was 67.87 for a g-force of 1.00 and a solids concentration of 3.0%. However, if a disturbance occurs in the volumetric concentration of particulate material in the feed stream, a new value of g-force may be required to maintain the objective function at highest value. This observation was used to calibrate the control system presented in Fig. 5. Eq. (6) was evaluated considering the maximum value of the objective function for each constant concentration from the annulment of Eq. (5) partial derivative with respect to g-force and it represents the best operating g-force (F_g^{opt}) for each concentration value [27].

$$F_g^{opt} = \begin{cases} 5.081 - 2.148C_V, & 1.0\% \le C_V < 1.9\% \\ 1.00, & 1.9\% \le C_V \le 3.0\% \end{cases} \quad (6)$$

3.3 Control Simulations and Applications

Continuous monitoring of certain industrial processes is often difficult and, in some cases, impossible due to the lack of adequate equipment. In some scenarios, virtual sensors become adequate solutions for the online monitoring of these types of processes [28].

The proposed identified inferential models for the estimation of the moisture content of the retained solids and screening separation efficiency can be applied to an industrial control system considering the necessity to find the best value of g-force, according to concentration of solids in the feed stream. In addition to that, the identified FOPDT dynamic model was used to represent the behavior of the g-force on the screen over time.

The screening startup simulation of the optimized control system for different volumetric concentrations of solids in the feed is shown in Fig. 9. The control system identifies the optimal value of the frequency to be applied to the vibration motors and it is able to keep the g-force in the best value identified. Based on Eq. (6), the best operating value of g-force at 1.0% solids concentration is 2.93. Similarly, at 2.0 and 3.0% concentrations, the best g-force is 1.00. The exponential term of the FOPDT dynamic model in Eq. (3) represents the dead time concerning the beginning of the screen startup, experimentally observed. The dead time is followed by a rapid increase in g-force value, simulating the vibration motors operation start up. The response depicted in Fig. 9 shows that the control system is stable and robust as well, it is able to recognize the best g-force regardless the solids concentration. The static inferential models, showed by Eqs. (2) and (3), were not used to predict the moisture content and separation efficiency in screening startup because g-force value is lower than equations range.

It was also simulated disturbances in the solids concentration in the feed. These disturbances are shown as variations of step type. The temporal behavior of the concentration values, g-force, moisture content of retained solids, separation efficiency, and objective function are shown in Fig. 10. This simulation starts with the system running with a solids concentration of 1.0% and it pursuits a different set point. At a concentration of 1.0%, the optimum operating g-force is 2.93. Note that to achieve this value, the moisture decreases, efficiency and objective

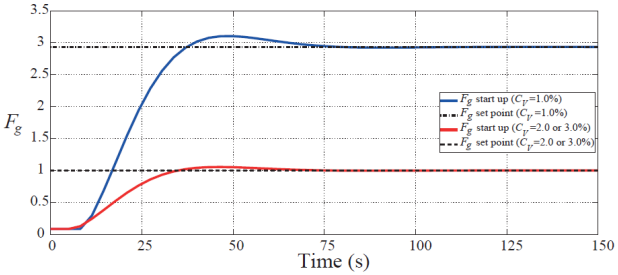

Fig. 9 Screening startup simulation.

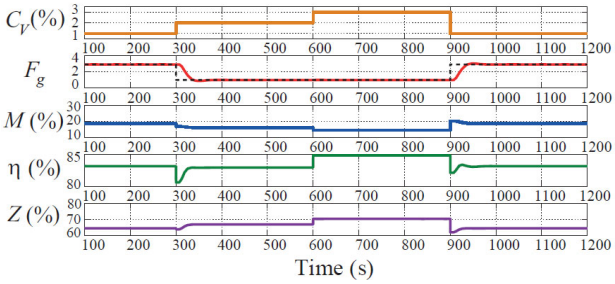

Fig. 10 System Response Simulation to step disturbances in concentration.

function increase as it was expected. A step from 1.0 to 2.0% occurs at 300 seconds in the concentration. At this point, the system identifies that the set point of the previous g-force is not the best and it looks for a new value. The efficiency tends to decrease after the disturbance, although the new set point and the controller action raise the efficiency to a higher level. As seen in Fig. 8 and Fig. 10, for C_V = 2.0%, the optimal g-force is 1.00. Once again at 600 seconds, a step disturbance occurs in concentration from 2.0 to 3.0%. In this case, the system identifies the best operating g-force value is still 1.00, and the set point is not changed. Finally, at 900 seconds a new step disturbance occurs in the concentration from 3.0 to 1.0% and the system returns to operate with 2.933 g-force. The results presented in Fig. 10 starts at 100 seconds because it is not possible to estimate moisture content and separation efficiency for g-force lower than 1.00.

Likewise developed by Dorry and Dufilho (2012) [16], the proposed controller is also able to detect the best g-force from the screening feed data. The acting process in a controlled manner dispenses the operator intervention for choosing the best set point and

prevents excessive loss of fluid from the separated solids.

4. Conclusions

It was possible to propose and simulate optimal control strategy based on identified models. This system was able to identify the best operating point that allows greater separation efficiency and lower moisture content in the retained solids. In addition, the proposed control strategy was able to drive and hold the g-force variable in the most appropriate operation condition.

A hybrid model was built with dynamic and static identified equations. Hence, a control strategy based on this model presented a smooth behavior, maintaining constant the g-force value in the presence of a disturbance. The importance of the inferential system is due to the fact that there is no efficient way to measure the concentration of the retained solids in real time, since the sieve operates with the solids distributed on the screen. The use of static models as inferential sensors for moisture content and separation efficiency can be assumed to be adequate.

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Synergy between Scientific Research and Public Authorities for Future Urban Planning Forecast

Rita Valenti[1], Sebastiano Giuliano[2], and Emanuela Paternò[1]

1. Special Educational Structure of Architecture, DICAR, University of Catania, Italy

2. Faculty of Engineering and Architecture, University of Enna KORE, Italy

Abstract: The study evaluates the management of urban centres where the consolidated city tends to be a synthesis of the evolution of all the confirmative events which, together, show strengths and weaknesses of the actions carried out on the territory.

The research assessed a shared and scientifically oriented management of the urban areas of Ortygia and Floridia, respectively the urban centre and a town on the outskirts of Syracuse. A synergy between Research Centres and Public Administrations was previously established so to direct the investigative approach towards the urban planning programmes according to a sustainable development. The research used new technologies based on interactive IT systems as a crucial factor of knowledge targeted on further graded explorations and analyses through an active relational connection with the available objectives and resources.

The purpose was to detect and protect valuable fragments and typological features of the old urban fabric through the implementation of an informative and morphometric database of the architectural elements of the town. The expected goal is to steer the management and the future transformations of the urban planning towards interventions directed to the protection and enhancement of fragments of "minor" architecture.

Key words: urban survey, historical centre, urban planning, urban sustainability, city protection

1. Introduction: Shared Knowledge on the Governance of the Territory

The management of urban centres is associated with the deep knowledge of the city which, with its own story, tells its past and with its own urban planning shows its strengths and weaknesses. Only with a joint and scientifically oriented management it is possible to direct the future planning of the territory towards a sustainable development.

"The world is not there, it is regained through form; and art is not a reproduction of impression, it is human experience to create and translate sense perception, giving a form to it (...) Knowledge is not the iconic image of the actually given object, it is the pictorial presence of the absent" as Cassirer wrote in the Introduction to the first volume of "Philosophy of symbolic forms" (1923) [1].

The present research referred to the concept of knowledge in anthropological terms transferring it into the built-up, complex and dynamic areas of eastern Sicily which, though sharing the same history which makes this territory particularly vulnerable, because of the earthquake which struck the area in 1693, have different characteristics and potentialities. In this area, where the presence-absence of geographical vulnerability, detectable in the urban and architectural forms of the reconstruction, determines an essential relationship with the past. Knowledge is not only concerned with the perceptible image of the city, it must be gradually expanded and symbiotically include objectives and available financial resources which only local administrations can define and allocate.

This approach to the governance of the territory involved collaboration with Research Centres and

Corresponding author: Rita Valenti, Associate Professor; research areas/interests: special educational structure of architecture. E-mail: r.valenti@unict.it.

Public Administrations. In particular, an Agreement Protocol was signed between the University of Catania, through the Laboratory of Representation of S.D.S in Syracuse, and the municipalities of Syracuse and Floridia.

In the first case, investigations were conducted towards the "analysis of urban fabric, based on an accurate survey of the ancient part of the town, implementing new technologies and interactive information systems, to provide knowledge and aiming at subsequent sectorial and in-depth studies" in the ancient part of Ortygia (Fig. 1).

Fig. 1 45 degree view of urban scenery of Ortygia.

In the second case, within the workshop Urban Centre 0.2-Floridia and its transformations, investigations aimed at the analysis of the distinctive characteristics of the most famous façades and architectural buildings covering the perimeter of the historical centre.

In both cases, the research experimented new technologies based on interactive information systems as a fundamental instrument of knowledge.

Representation, main instrument for the definition and dissemination of culture, has had a crucial role in the course of the research adjusting its tools and techniques to the requirements of the investigation.[1]

[1] Since Cavallari Murat's studies in 1960s [2] and more recently Docci's and Maestri's researches [3], there has been a cultural debate about the contents and purposes of urban survey, about the use of a graphical symbolic or mimetic language [4], about the development of 3D data acquisition instruments and the suitability of 3D modelling. Analysis and multidisciplinary

The conducted research has its roots in the discipline itself and applies innovative approaches based on the direct collaboration between the administration and the Technical Commission. The aim of the study is twofold: firstly to implement an easy instrument of interpretation according to the specific requirements of the site, the island of Ortygia, ancient centre of Syracuse, and then to experiment the dissemination of cultural elements.

The main purpose was to achieve an active collaboration between Public Administrations and the University in order to establish a hierarchy of interests and methodologies based on the sharing of research results, easy to consult and recognize.

Thoroughly organized knowledge, through visualization, meets the needs of improving the management services offered by administrations according to available resources.[2]

2. Material and Methods: Urban Identity and Varying Readability Levels

The methodological approach focused on the implementation of a knowledge and perception management system to be shared with local institutions. Distinguishing features of each single case study were taken into consideration, starting from the assumption that historical identity must be protected in view of a sustainable development.

The identified components of the two urban systems have been aggregated in order to define urban environment according to what stated on the Agreement Protocols. In detail, the collected data acquired from an accurate surveying campaign of the two different researched urban areas were processed according to the objectives set by the single administrations.

In the case of Ortygia [6] the main purpose was to provide an objective, flexible, implementable, expressive and easy to read instrument for the governance of the site; a representative system able to combine analytical knowledge derived from thematic survey with synthetic knowledge, necessary for any allowed practical determination.

As it is known, governance of architectural heritage is undertaken by a spatio-temporal decision-making system identified in urban planning which local administrations implement with difficulty when information about the built-in environment is not based on an organic and updated system. In order to overcome these obstacles, the information system was implemented through a critical selection of the needs underlined by public administrations, real direct end-users, and also active operators in the starting phase of the project.

The conducted study generated new cultural approaches to the management of the Urban Implementation Plan through the development of an ad hoc surveying method according to the site complexity (Fig. 2). The applied methodology used the traditional surveying technology for the acquisition of formal and metric data on the urban level, supported by modern technology which allows a faster and more detailed acquisition of information.

The research focused on two aspects: the first connected with the critical understanding of “samples of blocks” to be surveyed, the second relating to the methods of data representation.

As for the first aspect, the surveyed blocks could basically represent all the possible situations that Ortygia can have from the aggregative and morphological point of view (structure of housing units, intersections of properties, superfetation, etc.).

The second aspect, survey reading, focused on the expressive power of survey products, on the simple and immediate consultation of complete parts according to

descriptions are much needed especially with the use of H.B.I.M as a system which starts with the collection of elements constructed from visual or geometrical data [5].

[2] The political and administrative practice of application highlights the need to give rise to data-sharing policies and to the control of land transformations. The issue is specifically technical and social at the same time. Design methods call for the involvement and training of specialists on the one hand and on data-sharing and terms of choice transparency and clarity on the other.

the difficulty faced in the real cases. Graphical language was adapted to the research methodology. A synthetic framework of information interrelated with the different scales of representation was organized in consideration of all the characteristics of the urban fabric and the contents to draw attention to.

Fig. 2 Ortigia: laser scanner survey of piazza dei Mergulensi.

3D representations were associated to traditional tables and 2D representations through point clouds which convert formal data into a perceptible way, particularly suitable for non-specialists. Therefore, the research results can be easily transmitted even to the end-user of the governance politics of the territory, the citizens.

The study case of Floridia, in accordance with the Agreement Protocol, dealt with the cultural analysis of the urban fabric oriented towards knowledge dissemination from a visual point of view, easily readable and at the same time able to raise awareness about "the city as Cultural Heritage" in relation to sustainable development and personal commitment to sustainability-related issues.

This was a scientifically ideal opportunity to experiment on site different digital surveying methods focusing on 3D modelling and engaging students of architecture in learning and research experiences.

The approach to survey was traditional, but carried out with modern technology, and adapted to the specific characteristics which distinguish the context. The research was conducted on different levels of assumptions in order to establish relations with the specific urban context.

The final step of the research methodology starts a process of data modelling using visualization software (Fig. 3).

2.1 Investigating Historical Context

The present socio-cultural situation is particularly positive to adopt different approaches and suitable strategies to achieve qualitative objectives for the interrelations between research organizations and Public Administrations.

The management and governance of all the political processes of a city are built into the long-term technical and collaborative communication.

It is extremely important to establish a close and symbiotic connection between intentions and strategic objectives, framing the question in a single organic and pragmatic structure.

The objective underlies an innovative strategy by which all the researches discussed in University Conventions provide, as previously said, an opportunity for the promotion of transformation and requalification processes of the territory [6].

It is a matter of fact that the single interpretation of a historical urban centre should be supported by appropriate knowledge processes and thematic insights. This process is often hindered by the intrinsic nature of

the investigated object or, on most occasions, by a lack of financial resources to support research.

Specifically, the Laboratory of Representation of the University of Catania has already encountered similar difficulties during the research of the case studies, regarding in particular the historical buildings in Ortygia and the historical areas in the nearby town of Floridia (Fig. 4).

Fig. 3 Ortigia: 3d model of Via del Consiglio Reginale.

Fig. 4 Ortygia orthophotos.

Technological innovation is driving survey towards a series of new standards which allow data to be implemented on historical areas of towns: 3D laser scanning technology, mobile mapping systems, 3D Lasers Scanning with Drones, etc.

Anyway, if on the one hand technological innovation makes data collection process easy even in large and dense urban areas; on the other, financial difficulties do not allow public administrations the implementation of high-innovative technology for the management of

historical centres.

The conducted research had the objective to experimentally implement surveying methodology in historical centres, applying a single data collection system, easily enlargeable and consultable by public administrations and by the technicians operating in the territory. A system able to support the gradual process of information implementation deriving from the historical survey plans and from the modern range and image-based survey technology.

2.2 Didactic and Low-Cost Technologies for the Territory

The goal of the research was to develop a best practice model regarding survey techniques of the city and of its architectural remains widespread all over the urban area. The widely used digital survey techniques had a crucial role in raising awareness about the safeguard and protection of the city, especially on a detail level scale. The documentation of architectural fragments is in fact a fundamental action expressed through the cataloguing and protection of architectural buildings and remains of particular value.

The detection methodology has been developed both in relation to direct and digital survey methodologies. In particular, the digital ones were tested to develop, with the help of laser scanning technology, a 3D morphometric support of the urban area where to implement detail data, coming from direct survey and from image-based surveying technology.

This methodological approach generated an informative three-dimensional database, always updatable and modifiable. In particular, laser scanning survey was carried out on sensitive areas. According to this methodological approach, the data collected by the laser scanner survey sensors formed a point cloud of the investigated site. The 3D dataset was of fundamental importance for the acquisition of useful morphometric information of the urban features and also for the testing of the surveying data collected with different surveying technologies.

The obtained result by this field operation can be usefully exploited in order to insert any other information into the generated model using low cost surveying techniques such as image-based technologies. Low cost technologies, in a period characterised by great difficulties in fundraising activities for the protection of smaller urban centres, are a point of strength for local administrations for the documentation of their own territory. Thereby, once acquired morphometric data of the urban area through laser scanning technology, public administrations can implement the general model without any large investment in new expensive technology.

Thus, thanks to the image-based technology, the generation of a three-dimensional model describing the formal and material characteristics of the urban area and of its single piece of architecture becomes an activity affordable to everyone. Compared to range-based and image-based techniques, image-based methods do not require sophisticated instruments except for a camera, a personal Computer and the specific image-based software. It is important to say that even if image-based software can be intuitive, the method is not fully automated as it could be otherwise expected. It is necessary to refer to a competent surveyor in order to obtain good morphometric results (Fig. 5) [7].

The conducted research allowed the testing of an operational methodology for the survey of an urban area with the effective collaboration between the University and the local administration with the common objective of documenting the architecture patrimony by our territory. The challenge was to make teaching-research methodology and public interest converge into an single open-air laboratory. Thereby, the students could experience first-hand physical aspects and operational problems connected with the surveying of the city. Moreover, the research and teaching methodology provided the local administration with a precise and always implementable morphometric database able to

orientate and manage the future transformations of the city area.

3. Results and Discussion: The Case Studies

3.1 Experimentation in Ortygia

Experimentation in Ortygia started in 2014 with the objective to update the whole survey framework.

The last systematic survey of the historical centre goes back to the 1998 detailed plan, whose chronology lasts ten years because of the complexity of the applied field, when ground floor and first floor buildings in Ortygia were surveyed.

However a 10-year-old survey, even if systematic and accurate, becomes obsolete thinking about all the continuous transformations of historical centres, living organisms in constant evolution, characterized by more or less legal actions such as annexes, elevations, demolitions.

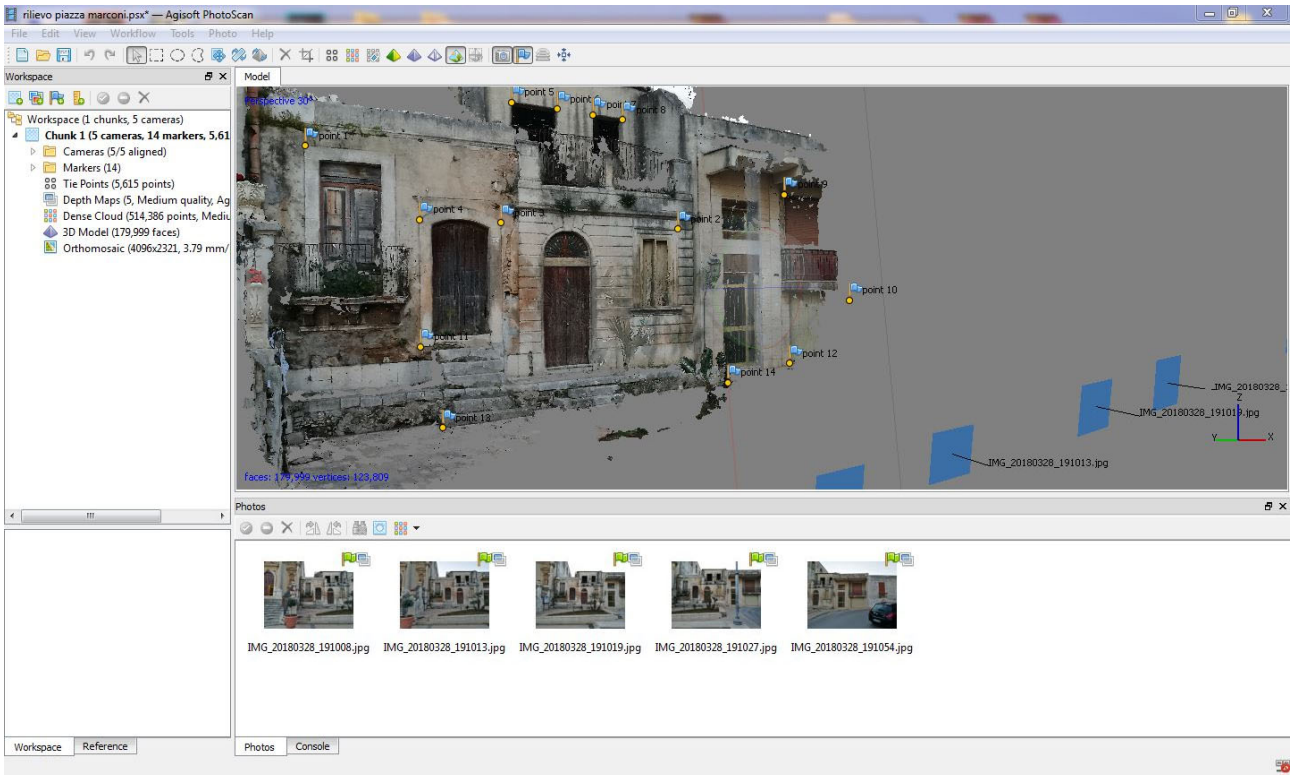

Fig. 5 Positioning of the rooms with respect to the detected area with image-based techniques (Agisoft Photoscan software).

Implementing the information model in the historical area was crucial for the decision-making process in terms of protection and safeguard and in terms of local tourism and economy.

Survey updating was carried out choosing to implement 1998 survey plans. Therefore, the survey campaign conducted at the time of the old Detailed Plan represented the morphometric base where new data regarding the urban transformations (demolitions, elevations, etc.) (Fig. 6) were implemented.

Data about the eave height of buildings, the numbering of the above ground floors and of any possible superfetation were extremely important in order to explore the development of urban areas during "the two unsurveyed decades". It was possible, then , to detect the piano nobile of two-storey buildings transformed, in a more or less legal way, into separate floors.

The superimposition of modern cadastral maps with the old Detailed Plan maps, not only completed the background with the missing data but also integrated maps with information strictly connected with the building plans and their diachronic evolution, focusing on the annexes to main different structures, the

demolitions of the few block transformed into parking areas and the modifications made in the private buildings such as the courtyards and the interior vaulted ceilings (Fig. 7).

LOCALIZZAZIONE	ISOLATO	UNITA' EDILIZIE	ALTEZZA ALLA GRONDA	NUMERO PIANI	ATTIVITA' COMMERCIALI	COPERTURA	DATA RILEVAMENTO	DEGRADO FUNZIONALE PIANO TERRA	ACCESSO
VIA DEI TINTORI	48	36			8		30/12/2013		SI
		A	15,40 m	4	4	falde (altro)		SI	
		35	13,70 m	4	1	piana (altro)		NO	
		36	9,90 m	2 T1	1	falde (bing)		NO	
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Fig. 6 Form of Ortigia's urban survey.

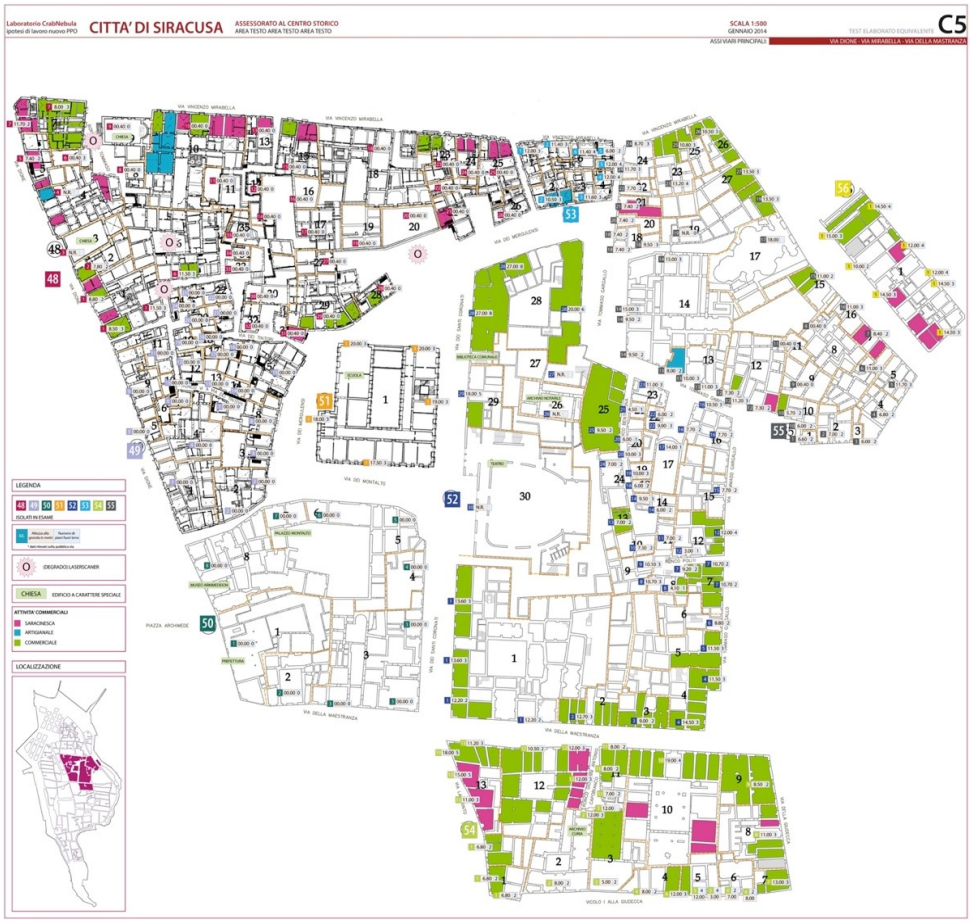

Fig. 7 Ortygia, Area of Spirduta. Implementation of urban data.

An endemic analysis of these areas is crucial. Areas which are often connected to specific historical and architectural characteristics which connote the island as a whole.

The morphometric updating of these areas was carried out with 3D laser scanning technology. The Laboratory of Representation of the University of Catania has conducted a large surveying campaign of urban fabric of the town, of its monumental precincts and smaller areas characterized by degradation and obsolescence.

Laser surveying of these areas has formed a 3D point cloud, texturized with RGB data deriving from camera parameters. The obtained models not only are able to diachronically fix morphological and architectural data in terms of cultural dissemination, they also provide a starting point for the functional rehabilitation of the single buildings.

The acquired data were inserted into interactive multidimensional maps structured as thematic layers providing information about the eave heights of buildings, the number of floors above the ground and possible superfetation, the superimposition of the new cadastral maps onto the old ones, the performed activities on the ground floors and the urban areas surveyed with Laser Scanning technology.

Data dissemination was released in pdf format in order to share information with all the technicians who operate in the development of the territory. Surveying documents were structured according to a multilevel pdf file containing all the updated information of the survey campaign divided into different semantic layers. Finally, precise hypertext links to detailed tables about single blocks or 3D point cloud viewers are made immediately accessible.

3.2 Comparing Digital Methodologies: The Case Study of Floridia

One of the main objectives of the conducted research was to experiment new "forms" of communications of cultural contents regarding urban space, historical urban space in particular, able to highlight the specific characteristics of the cultural heritage it consists of.

The study started from the idea that the communication of the built-up environment is better if it centres on a representation which implements innovative technologies which stimulate visual sensation. These were the starting points from which procedures able to create 3D digital models were experimented and applied in order to make the understanding of architecture easier. The area of intervention is Floridia, a small historical centre in the Val di Noto area. Through a careful analysis of the territory it was possible to detect a rich architectural heritage which, though almost unknown, deserves to be promoted.

The present study, in particular, investigated the architectural elements which, on a small and large scale, are typical features of the place.

Temporal reference was set on a case-by-case basis according to the applied experimentation directed to the approach assessment about the plastic characteristics of the investigated objects, their spatial positions, based on different scale relations and used materials, sometimes badly degraded [8].

The advancement of digital surveying and 3D modelling technology allows 3D data acquisition aiming at the documentation, archiving and digital representation of architectural sites with a strong cultural value.

The applied methodology which aims at the digital rendering of architectural heritage exploits, as previously said, surveying technology in all its different applications depending on the selected instruments in each specific case.

Surveying has always represented a means of knowledge dissemination. It is also an instrument to investigate, understand and get to know forms and historical events directly from the investigated architectural object [9].

Surveying and 3D modelling are distinguished technologies used according to their characteristics and

performances and their selection depends on the requirements of the final digital model, on the geometric and physical parameters of the object, on the environmental conditions affecting surveying operations, on the available budget and, above all, on experience [10].

It is therefore useful to mention some significant cases representing the different approaches adopted according to the different contexts.

The first case deals with Piazza Umberto I and Piazza del Popolo, right in the centre of the town, their big dimensions suggested an approach based on active sensors (range-based methods). This methodology is employed in (terrestrial and aerial) laser scanners which have the ability to acquire a great amount of 3D data which are then passed as a point cloud. In the examined case the Leica Scan Station C10 was used and it was necessary to conduct different scans from several different station points in order to have a complete 3D model able to represent all the details of the specific urban area. In the data post-processing phase each single scan was automatically connected with the help of a network of targets placed during the surveying campaign.

Using this innovative technology was particularly useful for the visualization of survey data which allows the interpretation, archiving and consultation of the investigated objects (Fig. 8).

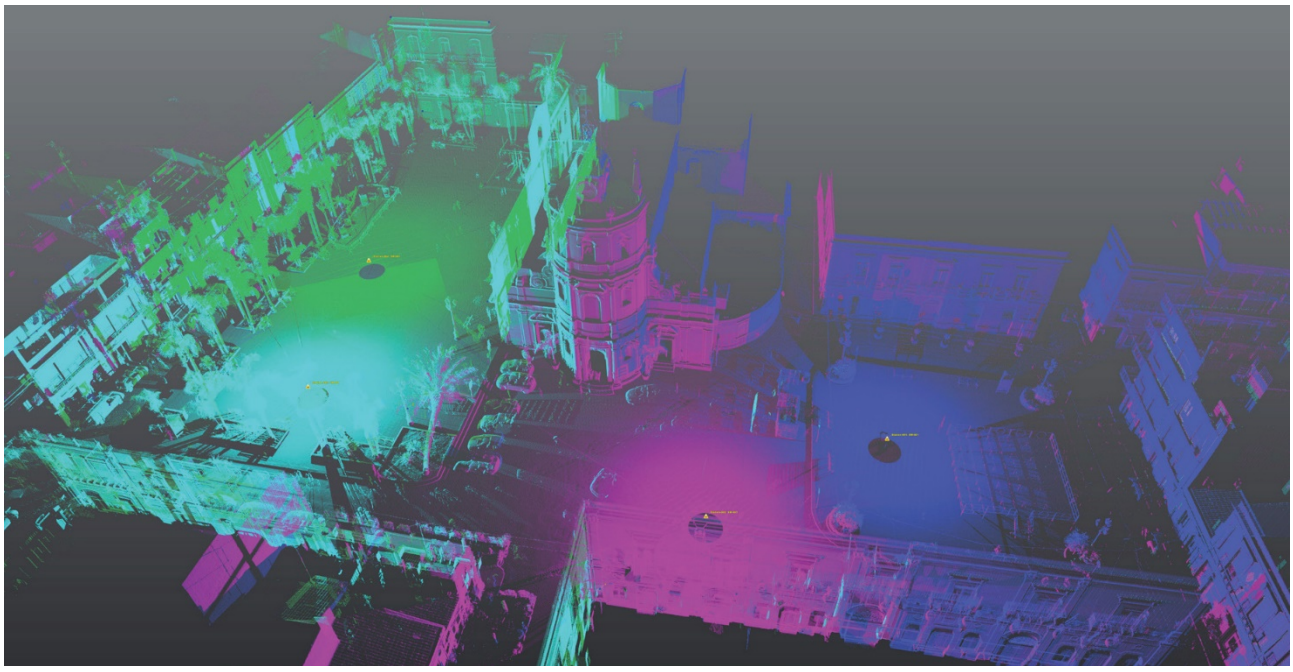

Fig. 8 Floridia, Piazza Umberto I and Piazza del Popolo: survey with laser scanning technology.

The second case deals with the Cathedral dedicated to St. Bartholomew the apostle situated between the two previously mentioned squares. The adopted methodology for its survey was based on passive sensors (image-based methods). Among the technologies, able to recover the environment as it was at the moment of the survey, digital photogrammetry or "photo-modelling" is the best known. This method requires the use of easily affordable instruments such as digital cameras which through a set of digital photos, allow the generation of a texturized 3D model.

Photogrammetric processing includes three independent phases: acquisition of 3D spatial coordinates, 3D imaging process, visual rendering [11].

Agisoft PhotoScan was implemented to perform the process. It works through the identification of homologous points, characteristics in the photos, and determining the relative orientation of the different images and consequently the spatial position of the

object points.

The obtained discontinuous model is then converted into a continuous model through the production of triangular meshes. To such polygonal model, colour shade is associated from the point RGB values of the point cloud (Fig. 9).

The third case study deals with the civic buildings situated along one of the main roads of the town, via Roma. They are, mainly, small Liberty style terraced houses whose linear geometry suggested an indirect intervention which again implemented range-based methods. This time, though, a total station was used to collect data easily detectable on the investigated buildings. This surveying technique generated 2D rendering of the buildings. Starting from 2D drawings it is also possible to represent 3D images through the creation of NURBS mathematical models which can describe any geometric shape from mathematical equations (Fig. 10).

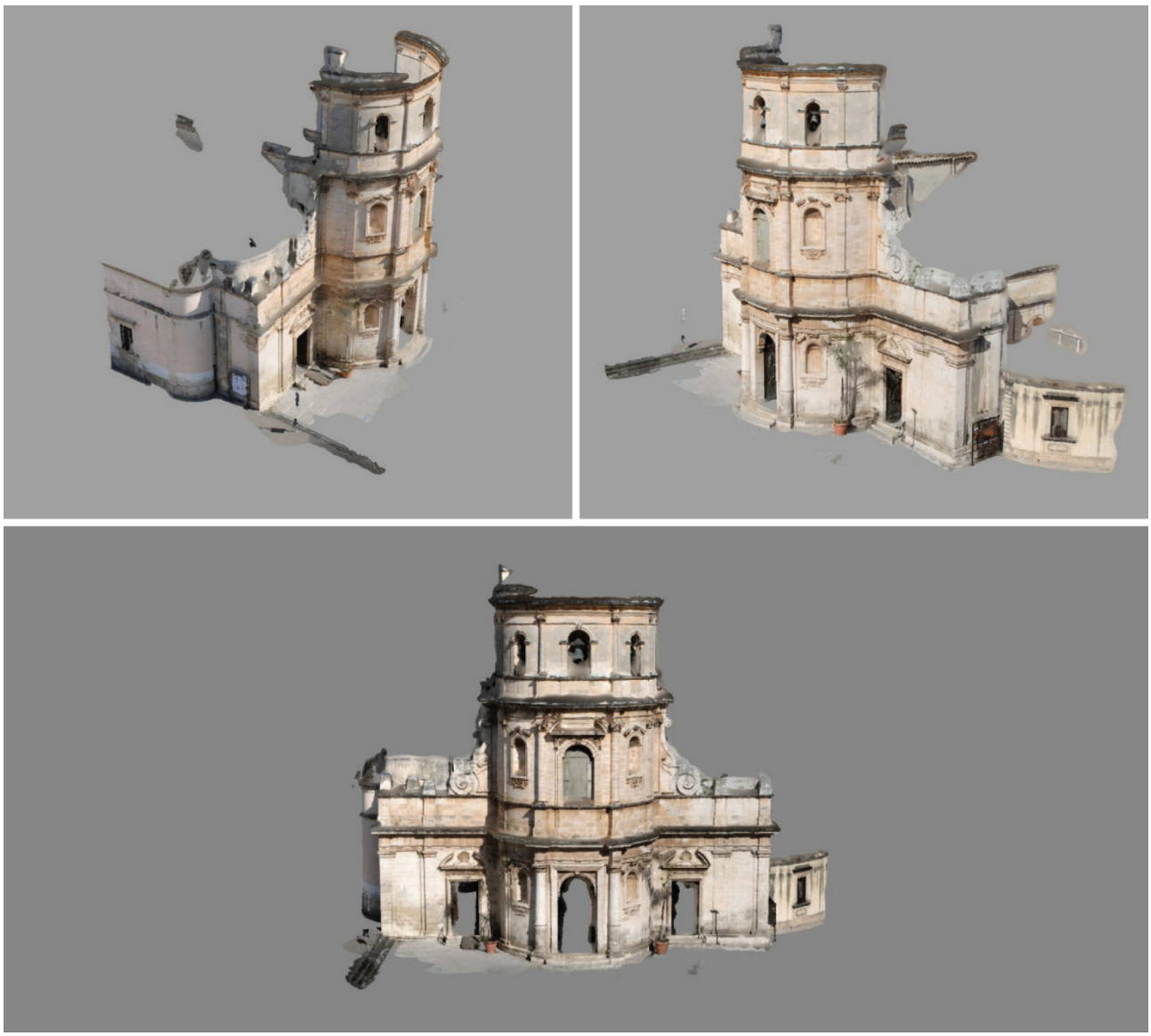

Fig. 9 Floridia, chiesa Madre: photo-modelling.

Fig. 10 Floridia, civic buildings: survey reading and 3D modelling.

In the present research, once more, architectural surveying had a crucial role for the investigation and knowledge dissemination, even when different technology systems were compared. 3D digital representation can also support public administration in the creation of a technological system able to involve different categories of users, as it was in the specific case.

4. Conclusion

Administrative Institutions, undoubtedly, play an important role in the representation of the growing dynamics of their territory and, at the moment, the use of technologically advanced systems for the dissemination and processing of data represents a positive contribution in terms of sustainability. In the current evolution of urban space, priority must be given to the correct interpretation of the historical urban context supported by an appropriate level of knowledge deriving from a new assessment which makes use of all the technological innovations accessible since the current estimate, no longer effective, even if still useful and detailed in the case of Ortygia, is definitely obsolete and doesn't take into account data about the transformations occurred over the last twenty years (Capri, 2015).

In particular, the conducted study about Floridia represented an important element in the local area for the governance of a widespread architectural heritage set against a background of modern buildings aiming at the material and immaterial protection of the local history. The applied analysis resulting from the selection of case studies combined detailed knowledge of cultural heritage and synthetic knowledge to use for any subsequent solution.

The scientific value of this information system is represented by the potential of the methodological approach for the dissemination, out of the academic circles, of consultable, immediately implementable digital documentation, which can be properly defined "smart", about architectural heritage in its whole and not only monumental, of our historical centres.

Actually, the conducted research assessed the methodological approach which implements instrumental survey and its subsequent visualization using dedicated software for the management of an operation protocol for public administrations.

The results of the present research which in the first case study dealt with the development of an instrument able to support decision-making and in the second one involved spatio-temporal knowledge of the urban context, have in turn gave rise to a double critical reflection.

On the one hand, research centres, even if financial resources are poor, continue their studies about the development of innovative strategies for the sustainability of historical urban areas, on the other, the limited amount of time available to decision-makers doesn't encourage frequent relations with researchers so that the agreed decision though promote cultural dissemination, they still run the risk of being ineffective.

The obtained results are giving rise to other similar experiences in contexts similar in dimensions but with different characteristics. The intention is to replicate the methodological approach to the urban surveying technique used in the course of the present research to disseminate the idea of a digital archive, at public administrations' service, simple and smart at the same time.

Author Contributions

The study is the result of the full collaboration of all the authors. However, Rita Valenti wrote the sections titled "Introduction. Shared knowledge on the governance of the territory", "Materials and Methods. Urban identity and varying readability levels", Conclusions. Sebastiano Giuliano wrote the sections titled "Investigating historical context", "Low cost technologies for the protection of smaller centres", "Experimentation in Ortygia" and Emanuela Paternò wrote the sections titled "Comparing digital methodologies: the case study of Floridia". Translated by Melania Grancagnolo. The research team involved in the surveying activities for the case study of Ortygia includes Roberta Conti, Massimo D'Aiello, Sebastiano Giuliano, Giusy Maniscalco, Giacinto Taibi (team coordinator), Rita Valenti (team coordinator).

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Similarity Solution of Heat and Mass Transfer for the Falling Film Flow on a Porous Medium in Presence of Heat Generation or Absorption

Md. Hasanuzzaman[1], and Akio Miyara[2,3]

1. Graduate School of Science and Engineering, Saga University, Saga-shi, 840-8502, Japan

2. Department of Mechanical Engineering, Saga University, Saga-shi, 840-8502, Japan

3. Kyushu University, International Institute for Carbon-Neutral Energy Research, Fukuoka-shi, 819-0395, Japan

Abstract: In this research work, similarity solution of heat and mass transfer for the falling film flow on a porous medium in presence of heat generation or absorption has been modeled by Darcy-Brinkman equations and solved by using similarity technique. Heat generation, thermal radiation and chemical reaction effects are considered. By using appropriate transformations, the governing nonlinear partial equations are transformed into coupled nonlinear ordinary differential equations. Graphs are decorated to explore the influence of physical parameters on the non-dimensional velocity, temperature and concentration distributions. The local Nusselt number and the local Sherwood number are computed and analyzed numerically.

Key words: similarity solution, heat generation, absorption, falling film, porous medium

1. Introduction

There are many applications in heat pumps, chillers and air-conditioners which is the gas absorption process taking place on a falling liquid film has received much attention. In these absorption machines, the refrigerant vapor from evaporator is absorbed by a falling film of an absorbent solution in an absorber, and then the absorbent solution is regenerated by releasing the refrigerant vapor in a regenerator (boiler). Since these absorption machines are driven mainly by low-grade energy, heat (Jones and Hawkins,1986), rather than by high-grade energy, electricity, their application is especially interesting in areas where the electric power supply is limited. The performance of the absorption machine is controlled by the heat and mass transfer rates of the absorption process. Therefore, it is important to study the means of enhancing the heat and mass transfer rates of an absorption process. The absorption process for an absorption process taking place on a falling film flow in a porous medium which is considered by Yang and Jou [2]. The application of porous media in a falling film absorption process is mainly to enhance the wetting conditions which is also discussed by Yang and Jou [3].

Gebhart and Pera [4] and Chen and Yuh [5] treated the vaporizing liquid film as the boundary condition for the gas stream and Shembharkar and Pai [6] and Baumann and Thiele [7] assumed the temperature distribution across the film to be linear. Recently, researches with more rigorous treatments of the equations governing the liquid film and liquid–gas interface have been published. Yan and Lin [8] studied the evaporative cooling of liquid film through interfacial heat and mass transfer in a vertical channel. A. Miyara [9] investigated the flow dynamics and heat transfer characteristics of wavy liquid films. Leu et al.

Corresponding author: Md. Hasanuzzaman, Master of Philosophy; research areas/interests: thermal engineering. E-mail: hasan82_kuet@yahoo.com.

[10] analyzed the liquid film evaporation flow along a vertical isothermal plate covered with a thin liquid-saturated porous layer.

Khader and Megahed [11] are presented a numerical technique which is the implicit finite difference method to the search for the numerical solutions for the given equations. Their technique reduces the problem to a system of algebraic equations. Recently, M. Hasanuzzaman and A. Miyara [12] have been studied a possible similarity solution of unsteady natural convection laminar boundary layer flow of viscous incompressible fluid caused by a heated (or cooled) axi-symmetric slender body of finite axial length immersed vertically in a viscous incompressible fluid. The basic theme of the present study is to investigate the effect of heat generation or absorption, thermal radiation and chemical reaction on the velocity, temperature and concentration fields in the thin liquid film on a porous medium. Mathematical modelling is developed under the considerations of heat generation or absorption, thermal radiation and chemical reaction stratification effects. The effects of various emerging parameters on velocity, temperature as well as concentration fields are presented graphically. The local Nusselt number and the local Sherwood numbers are computed and analyzed both numerically and graphically.

2. Governing Equations

The physical model and coordinate system are shown in Fig. 1. Two-dimensional wavy film on a vertical wall is considered. With the usual boundary layer approximations, the gas flow is assumed as laminar and steady.

The two-dimensional laminar continuity equation, momentum equation, energy equation and mass balance equations are the governing equations.

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0 \tag{1}$$

$$u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}=\nu\frac{\partial^2 u}{\partial y^2}-\frac{\nu}{K}u+g \tag{2}$$

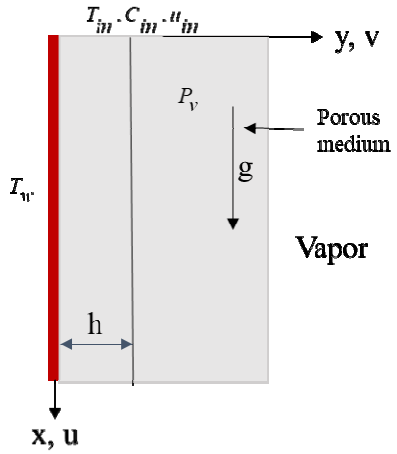

Fig. 1 Physical model and coordinate system.

$$u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}=\alpha\frac{\partial^2 T}{\partial y^2}+\frac{Q_0}{\rho C_p}(T-T_s)-\frac{1}{\rho C_p}\frac{\partial q_r}{\partial y} \tag{3}$$

$$u\frac{\partial C}{\partial x}+v\frac{\partial C}{\partial y}=D\frac{\partial^2 C}{\partial y^2}-Kr'C \tag{4}$$

where u and v are the velocity components along the x and y directions, respectively. ρ is the fluid density, T is the temperature and C is the concentration of the fluid, υ is the kinematic viscosity, h is the thickness of porous médium, K is the permeability of the porous medium, g is the gravitational acceleration, α is the thermal diffusivity, $Q_0(T\text{-}T_S)$ are heat generated or absorbed per unit volume (Q_0 is constant), q_r is the radiation heat flux, D is the mass diffusivity and Kr' is the chemical reaction rate of species concentration.

3. Boundary Conditions

Subject to the following boundary conditions are:

$$u=0,\quad v=0,\quad T=T_w(x) \text{ and } \frac{\partial C}{\partial y} \quad \text{at } y=0 \tag{5}$$

$$\frac{\partial u}{\partial y}=0,\ T=T_S \text{ and } \quad C=C_S \text{ at } y\to h \tag{6}$$

where T_w is the wall temperature, T_S and C_S are the surface temperature concentration, respectively.

According to Rossel and approximation [13], the radiation heat flux q_r is given by

$$q_r=-\frac{4\sigma^*}{3k^*}\frac{\partial T^4}{\partial y} \tag{7}$$

Where σ^* is termed as Stafan-Boltzman constant and k^* is as the mean absorption coefficient, Following Raptis (1998) [13], we assume that the temperature difference within the flow is small such that may be expressed as a linear function of the temperature. Expanding T^4 in a Taylor series about T_0 and neglecting higher order terms, we have:

$$T^4 \cong 4T_0^3 T - 3T_0^4 \quad (8)$$

In this paper, we used the relation between the velocity components as well as the stream functions which are given by:

$$u = \frac{\partial \psi(x,y)}{\partial y},\ v = -\frac{\partial \psi(x,y)}{\partial x} \quad (9)$$

4. Similarity Transforms

The similarity transformations which are given by:

$$\eta = \frac{y}{h},\ \psi = \sqrt{\nu}\, x f(\eta),\ \theta = \frac{T-T_S}{T_w-T_S}, \phi = C - C_\infty \quad (10)$$

Using the Eqs. (5)-(10), the problems defined in Eqs. (1)-(4) are then transformed into the following set of ordinary differential equations:

$$f'''(\eta) + \gamma\{f(\eta)f''(\eta) - f'^2(\eta) - Daf'(\eta) + Fr\} = 0 \quad (11)$$

$$\theta''(\eta) + \frac{Pr}{1+N_R}[f(\eta)\theta'(\eta) + \Delta\,\theta(\eta) - f'(\eta)\theta(\eta)] = 0 \quad (12)$$

$$\phi''(\eta) + Sc\left[f(\eta)\phi'(\eta) - f'(\eta)\phi(\eta) - Kr_x\left(Nc + \phi(\eta)\right)\right] = 0 \quad (13)$$

with the boundary conditions

$$f(0) = 0,\ f'(0) = 0, \theta(0) = 1,\ \phi'(0) = 0 \quad (14)$$

$$f''(1) = 0,\ \theta(1) = 0,\ \phi(1) = 0 \quad (15)$$

where primes denote differentiation with respect to η, $Da = \upsilon/K$ is the Darcy number, $\gamma = h/\sqrt{\upsilon}$ is the dimensionless film thickness, $Fr = \rho^2 g h^3/\mu^2$ is the Froude number, $\Pr = \upsilon/\alpha$ is the Prandtl number, $R = 16\sigma^* T_0^3/k^* k$ is the radiation parameter, $\Delta = \frac{Q_0}{\rho C_P}$ is heat generation/absorption coefficients, $Sc = \upsilon/D$ is the Schmidt number, $Kr_x = Kr'/a$ is the local chemical reaction.

5. Flow Parameters

The physical quantities of interest the local Nusselt number Nu_x and the local Sherwood number Sh_x which are given by

$$Nu_x = \frac{1}{h}\theta'(0),\ Sh_x = \frac{1}{h}\phi'(0) \quad (16)$$

6. Results and Discussion

By using the similarity solution technique in MATLAB, the set of ordinary differential Eqs. (11)-(13) with the boundary conditions (14)-(15) are solved numerically. Here the velocity, temperature and concentration are determined as a function of coordinate η. We have adopted a numerical procedure based on MATLAB for getting the solution of the differential Eqs. (11)-(13) with the boundary conditions (14)-(15). The fundamental parameters that governed the flow are the dimensionless film thickness, Froude number, Darcy number, Prandtl number, thermal radiation parameter, heat generation/absorption parameter, Schmidt number and chemical reaction parameter. According to study their effects, a MATLAB programe is written to enumerate and produce the graphs for the velocity, temperature and concentration for different values of these parameters. Few delegate results are given in Figs. 2-9.

Figs. 2(a), (b) and (c) are shown the effect of the Froude number Fr on the velocity, temperature and concentration profiles. From Fig. 2(a), it is observed that in all cases the velocity is started at 0 (zero) and then the velocity increase with the increase of η. After $\eta = 0.5$ again the velocity decrease with the increase in the similarity variable η. Also, the velocity increases with the increase of the Froude number Fr along the similarity variable η. The dimensionless temperature profiles shown as in Fig. 2(b) for different values of Froude number Fr. It is clearly seen that the temperature at any point decreases with the increase in Fr. The concentration increases with increase in Froude number Fr along the similarity variable η which as shown in Fig. 2(c). This is due to fact that

influence of the gravitation force enhancing the velocity and concentration as well as reduce the temperature of the fluid.

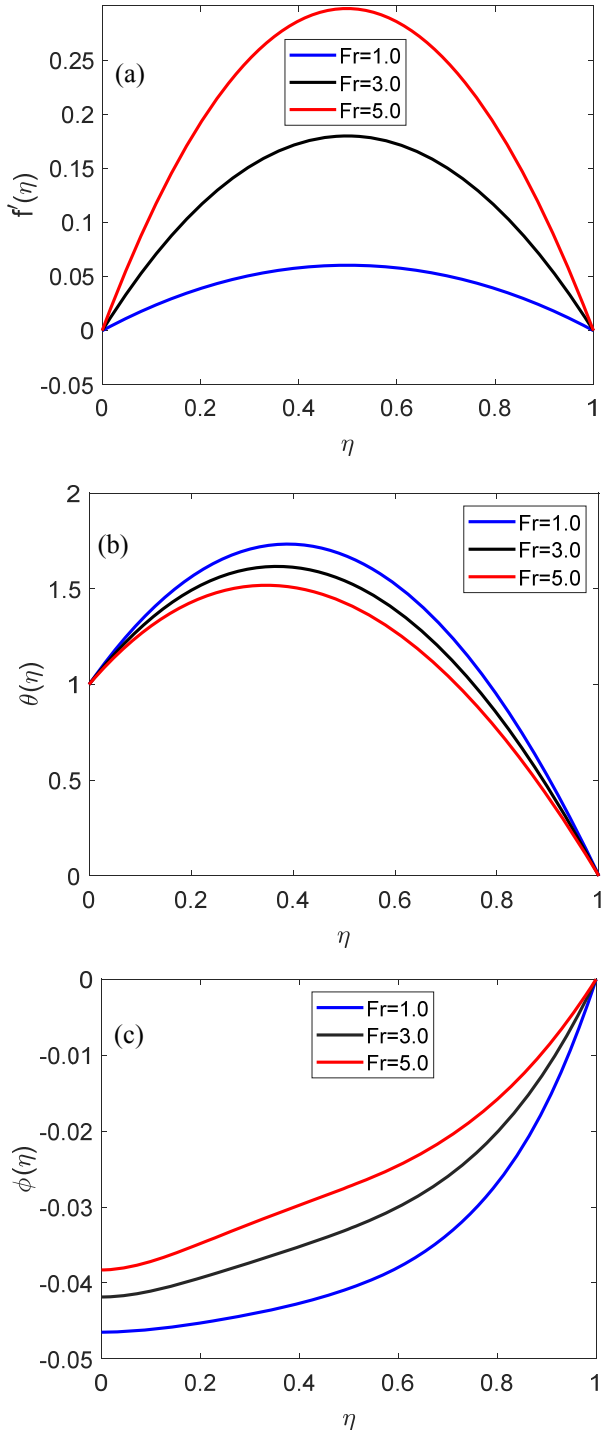

Fig. 2 (a) Velocity, (b) Temperature and (c) Concentration profiles for different values of *Fr* with fixed values of Pr = 10, R = 1, Da = 0.6, Sc = 50, γ = 0.5 and Kr_x = 0.5.

Figs. 3(a), (b) and (c) demonstrates the effect of the dimensionless film thickness γ on the velocity, temperature and concentration profiles, respectively. It is clearly observed from Fig. 3(a) that the fluid increases with the increase in dimensionless film thickness γ along the similarity variable η.

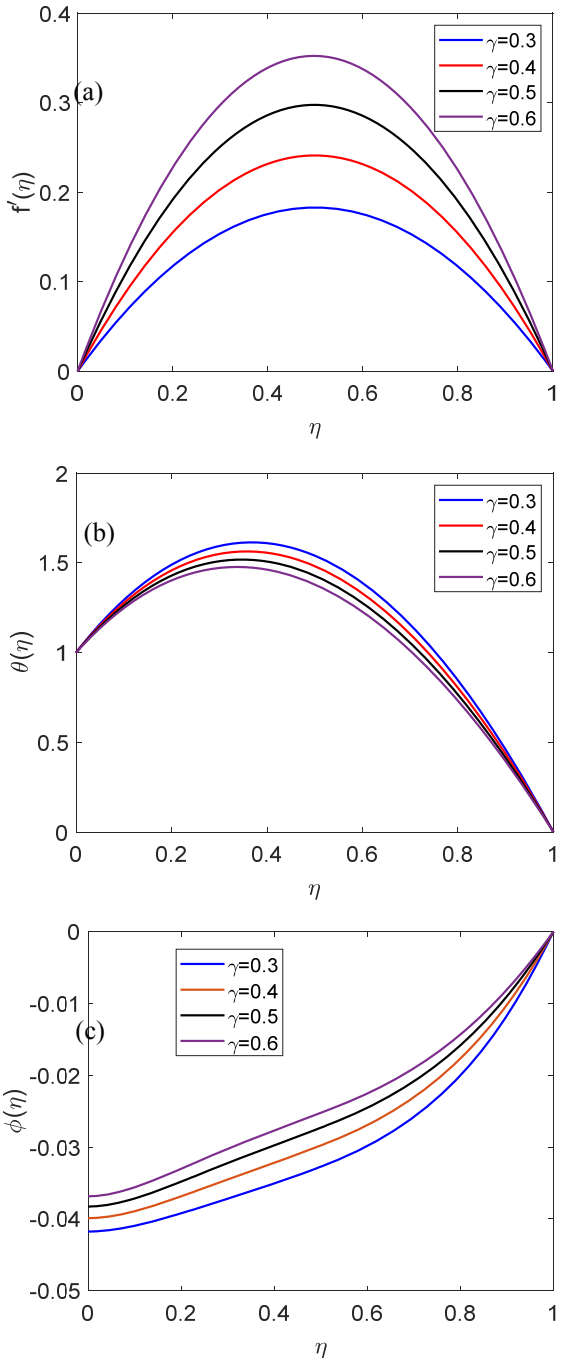

Fig. 3 (a) Velocity, (b) Temperature and (c) Concentration profiles for different values of γ with fixed values of Pr = 10, R = 1, Da = 0.6, Sc = 50, *Fr* = 0.5 and Kr_x = 0.5.

Temperature of the fluid decreases with the increase in $\boldsymbol{\gamma}$ along the similarity variable η which is shown in Fig. 3(b). Also, the concentration behavior is opposite for increasing dimensionless film thickness $\boldsymbol{\gamma}$. With an increase of dimensionless film thickness $\boldsymbol{\gamma}$ the concentration increases along the similarity variable η.

The influence of the Darcy number *Da* on the velocity profile is shown in Fig. 4. The results show that the velocity decreases as the Darcy parameter increases. This is because that the porous medium produces a resistive type of force which causes a reduction in the fluid velocity.

Fig. 5 illustrates the effect of the Prandtl number *Pr* on the temperature profiles. It is observed that the temperature increases with the increase of the Prandtl number. This is due to fact that a fluid with large Prandtl number possesses large heat capacity, and hence augments the heat transfer.

The effect of the radiation parameter R on the dimensionless temperature is shown in Fig. 6. It is observed that with an increase in the radiation parameter the temperature decreases along the similarity variable η. This is because the increase in the radiation parameter implies higher surface heat flux and there-by decreasing the temperature of the fluid.

Fig. 7 represents the effect of heat generation ($\Delta > 0$) and a heat absorption generation ($\Delta < 0$) on the temperature profile. It is clearly observed that with an

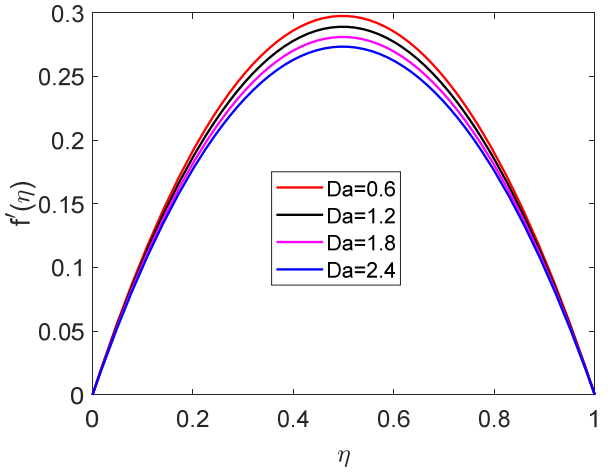

Fig. 4 Velocity profiles for different values of Darcy number *Da* with fixed values of Pr = 10, R = 1, γ = 0.5, Sc = 50, *Fr* = 0.5 and Kr_x = 0.5.

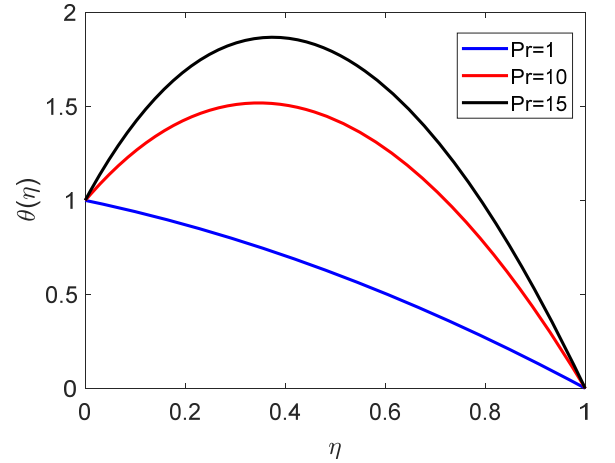

Fig. 5 Temperature profiles for different values of Prandtl number *Pr* with fixed values of *Da* = 10, *R* = 1, γ = 0.5, *Sc* = 50, *Fr* = 0.5 and Kr_x = 0.5.

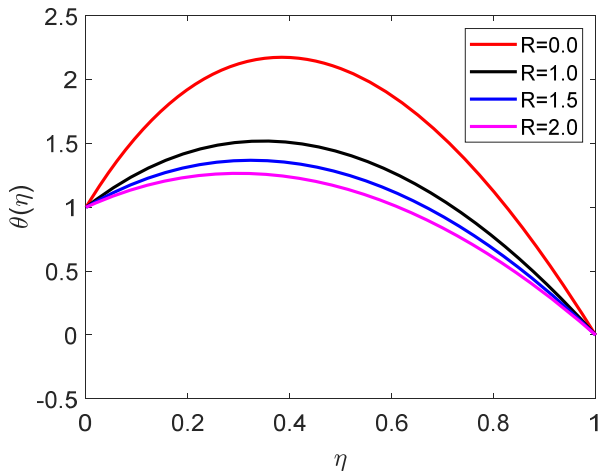

Fig. 6 Temperature profiles for different values of radiation parameter *R* with fixed values of *Da* = 10, *Pr* = 10, γ = 0.5, *Sc* = 50, *Fr* = 0.5 and Kr_x = 0.5.

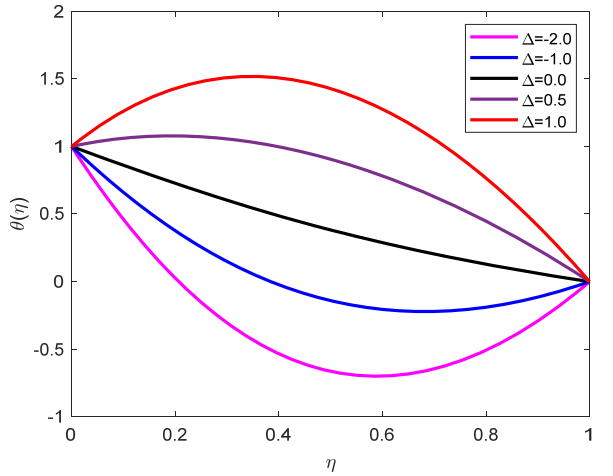

Fig. 7 Temperature profiles for different values of heat generation and absorption with fixed values of *Da* = 10, *R* = 1, γ = 0.5, *Sc* = 50, *Fr* = 0.5 and Kr_x = 0.5.

increase the heat generation the temperature increases. This increase in the fluid temperature causes more induced flow towards the plate through the thermal buoyancy effect. For the case of absorption, the temperature decreases with an increase the absorption.

The variation of the dimensionless concentration against the similarity variable η for various values of the Schmidt number Sc are displayed in Fig. 8. It is seen that the increase of the Schmidt number leads to decrease in the concentration. Schmidt number is inversely proportional to the diffusion coefficient. Hence with an increase in Schmidt number corresponding to a smaller diffusion coefficient. Such smaller diffusion coefficient creates a reduction in the concentration.

The influence of the chemical reaction rate constant Kr_x on the concentration profile within the boundary layer is given in Fig. 9. An increase in the chemical reaction effects increases the concentration within the thermal boundary layer region. This is because increasing the chemical reaction rate causes a thickening of the mass transfer boundary layer.

Fig. 10 is shown the variation of local Nusselt number Nu_x versus thickness of porous medium h for selected values of heat generation and absorption Δ. With an increase the heat generation parameter the local Nusselt number decrease within the boundary along h. Also, increases the absorption the local

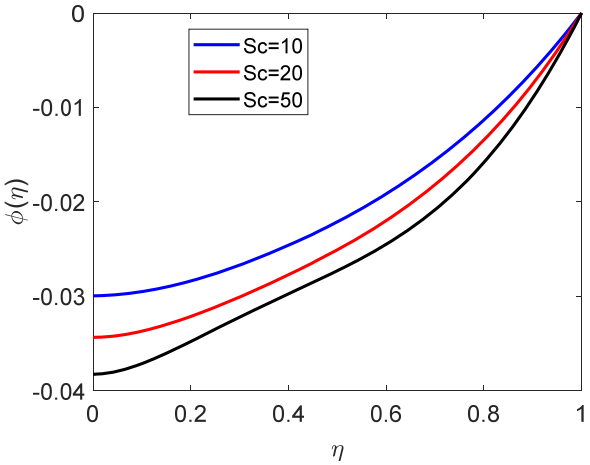

Fig. 8 Concentration profiles for different values of Schmidt number *Sc* with fixed values of Pr = 10, R = 1, Da = 0.6, γ = 0.5, *Fr* = 0.5 and Kr_x = 0.5.

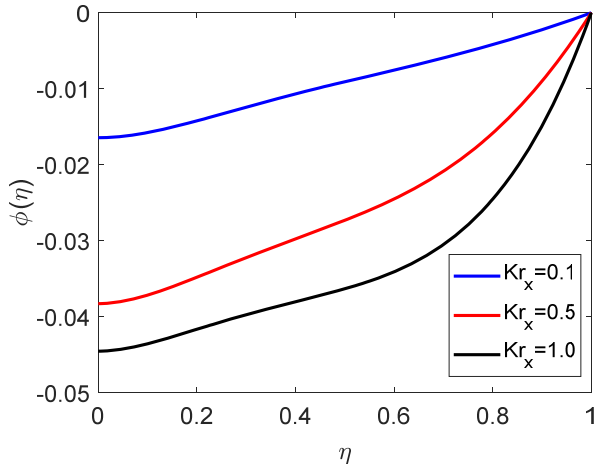

Fig. 9 Concentration profiles for different values of chemical reaction parameter Kr_x with fixed values of Pr = 10, R = 1, Da = 0.6, γ = 0.5, *Fr* = 0.5 and *Sc* =50.

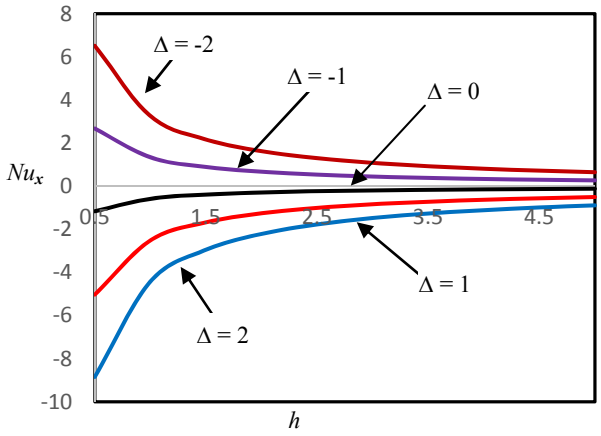

Fig. 10 Variation of local Nussult number Nu_x with *h* for various heat generation and absorption parameter Δ.

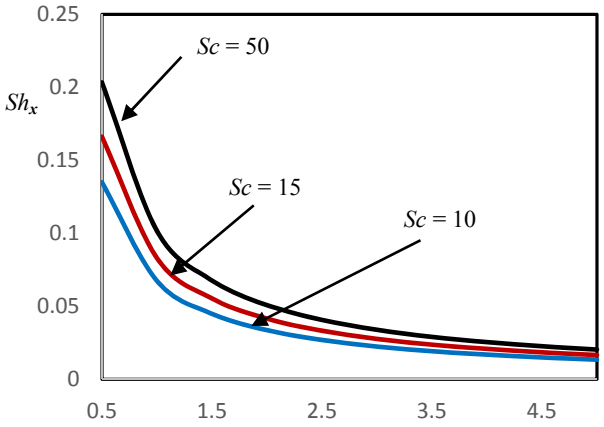

Fig. 11 Variation of local Sherwood number Sh_x with *h* for various Schmidt number *Sc*.

Nusselt number increase along h. The Schmidt number $Sc = \upsilon/D$ indicates the relative extent of the concentration field. The local Sherwood number Sh_x increases with the increase the Schmidt number Sc along h. This is because, for increasing Schmidt number, larger mass flow rate is achieved which is shown in Fig. 11.

7. Conclusions

Influence of triple stratification in the falling film flow on a porous medium with heat generation and absorption, thermal radiation and chemical reaction are examined. The velocity and concentration increase as well as temperature decreases with an increase in Froude number. This is due to fact that influence of the gravitation force enhancing the velocity and concentration as well as reduce the temperature of the fluid. With an increase the heat generation the temperature increases. This increase in the fluid temperature causes more induced flow towards the plate through the thermal buoyancy effect. For the case of absorption, the temperature decreases with an increase the absorption. The increase in the radiation parameter implies higher surface heat flux and there-by decreasing the temperature of the fluid. An increase in the chemical reaction effects increases the concentration within the thermal boundary layer region. This is because increasing the chemical reaction rate causes a thickening of the mass transfer boundary layer. In addition, for the absorption and Schmidt number increase, larger heat transfer rate and mass flow rate are achieved.

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The Agile Scrum Method, Evolution and Application in Project Management

Juan Ignacio Martínez[1,2,3], and Miguel Comino López[4,5,6]

1. National University of Luján, Argentine

2. National University of Rosario, Argentine

3. Valuation Consultants Dumrauf & Asociados (La Lucila, Bs. As.), Argentine

4. Catholic University of Murcia, Spain

5. University of León, Spain

6. University of Oviedo, Spain

Abstract: This paper addresses how companies are evolving in project management through the use of agile methods, such as Kanban and Scrum. For several years, companies used the fundamentals of project management from the Project Management Institute. Different industries were working with other standards: Agile, BIM, IPMA ICB, Lean, Open PM2, Prince2. The agile approach revolutionized the way teams work and enabled the adaptation of the project management processes.

Key words: agile, knowledge, methods, processes

1. Introduction

In its beginnings, project management applied the best practices of the PMI (2017) [1]. Projects evolve and thus increase their complexity. To solve this problem, some professionals applied the PMI methodology as if it were the only standard in the profession [1].

At the same time, industries were working on better project management, with: Prince2 (1975) [3]; BIM (Building Information Modelling, 1984); Scrum (1986); LEED (Leadership in Energy & Environmental Design, 1993); Agile (2001); Lean Construction (2002); IPD (Integrated Project Delivery, 2007).

Much has been said about agile methods, which is the management of continuous workflows, which can also be aided by visual techniques like Kanban that permit the visualization of the tasks and their evolution [2].

Recently, the Project Management Institute [1] has incorporated the Agile Practice Guide, created in partnership with Agile Alliance, one of the many organizations that spread these practices to software companies [3]. Some professionals and organizations try to apply them in other industries (Johnson, 2018).

The following questions arise: ¿do organizations apply maturity models before using a project management method? Are the projects aligned with the strategy of the company? Will IT technicians and operative personnel be able to use both to manage projects? Ultimately, a method that had success in one industry will not necessarily be successful in other.

Do these methods and standards aid in the direction of initiatives inside the constraints of each endeavor, so that they are done on time?

Corresponding author: Juan Ignacio Martínez, MA.; research areas/interests: project management and finance. E-mail: jim_finanzas@yahoo.com.ar.

The information gathered from the interactions between teams nourish the project through a negative feedback loop.

It is for this reason that previously established registry mechanisms are needed to have a competitive advantage in the management of knowledge [4]: a) directives: set of rules or practice standards; b) work routines: set of tasks or protocols; c) autonomous work teams: employees capable of solving problems [4].

Knowledge is a variable that needs capable people in charge, so that the strategy, the plans and the project can move forward.

Thus the behavioral, technical and contextual competencies are the foundation of any project [5]. Discussing the project direction without training the personnel which will work on it would not be the correct approach [5]).

In the end, standards must be applied by employees with a level of competency such that enables them to learn from the management of knowledge. The application of agile methods helps teams work in short iterations, or *sprints*. Sprints make tasks more manageable and easier to understand. The Scrum approach makes for a continuous workflow, achieving incremental, functional developments in a product [1, 2, 6].

2. Learned Lessons, Processes and Resources

Advancements in projects have induced the creation of the appendixes X4 and X5 to the best practices of the Project Management Institute [1]. Additionally, a book of agile methods complementing the good practices was released [3].

In section 4 "Project Integration Management", the item 4.4 "Manage Project Knowledge" was added (see PMBOK Guide 2017, manage project knowledge, data flow diagram, graphic 4-9, p. 99).

We are of the opinion that an area of research denominated "learned lessons" should be created since a negative feedback of information is necessary in different areas of a project, e.g., cost and resource management; this would increase the knowledge of personnel and initiatives. The lessons learned should be applied gradually, since the beginning until the end of a project, by: a) the project manager; b) the team; c) sponsor; d) others interested, until reaching the high managers.

It is a common practice to use the lessons learned only at the end of the project. In consequence, no activity is changed and nothing is learned by the teams in the process. Therefore, support processes (TICs) have an important role in the storage and divulgation of learned lessons.

In his article, Comino López (2018) claims that learned lessons can be defined as: "The knowledge acquired from the experiences derived from the realization of one or many processes in the life cycle of a project". The registry of these lessons is one of the most important aspects of project management for any organization. The failures and successes of projects are archived, to be used as reference for future initiatives, and through this way the organization can continually learn and improve [7].

Perhaps the biggest mistakes in project management are information overload and the loss of focus, which are some of the causes of inefficiency.

The lessons learned must be useful in changing current processes, otherwise the organization will continue facing the same problems.

Improvement initiatives are influenced by: a) a quality framework; b) a problem solving model. In consequence, the quality frameworks are the final results that should be obtained from the processes and the personnel involved. In relation to the problem solving models, these define the action plan, which must be adjusted to the initiative, e.g., ISO 21.500 which orients the processes related to the direction and management of projects [8].

Resources, and teams in particular, must be guided by a leading Project Manager Professional (PMP) that achieves cohesion between its members, dynamism

and cooperation. They must be eager to learn from lessons.

According to authors Katzenbach & Smith (1993) "Teams are a group of people organized around a common objective, with cooperation taking a priority over competition" [9]. Thus 3 basic elements are established:

- Competency: the team members must possess the technical know-how or skills needed to solve the problems they face on a daily basis.
- Responsibility: teams execute the assigned tasks.
- Commitment: the common goals, the cohesive element that justifies the existence of the team.

When we refer to projects, the most important organization structure is the horizontal project management, so that resources are applied in an orderly fashion.

Macroprocesses are reduced to processes and subprocesses for optimal performance, and they have a responsible project manager in charge of applying the resources used to manage the valuable initiatives of the organization. This stage must be manageable and controllable [8].

3. From Predictive to Evolutive Management

As we mentioned earlier in this paper, project management has evolved over time. We know that several different methodologies have been created and applied in different industries, from construction to software projects, etc.

What is better, predictive or evolutive management? The truth is that, while different in their conceptual bases, both are being incorporated to traditional projects managed by the PMI best practices [1].

The adaptation of agile methods with the PMI best practices must be done with caution.

Predictive management, which has been used for many years, employs sequential engineering and process-based production [2]. In other words, its scope is gradual along the project's course, which depends on the quality of the processes employed [2].

Evolutive management employs concurring engineering in overlapping phases. The production of deliverables is done in sprints. Production speed is expressed in terms of work per week, day or month [2, 3].

The authors Alaimo & Solis (2015) define Scrum as [1]: "A framework where people can face complex, adaptative problems, while delivering products with value added", therefore, the Scrum is an agile method [2].

It is based in the 12 principles behind the Agile Manifesto and it considers the following [2]:

- Product functions are developed incrementally.
- The focus is on quality over tacit knowledge of people.
- Development phases are overlapped, rather than in sequence.

The Agile Manifesto considers:

- People and their interactions over processes and tools.
- Working software over exhaustive documentation.
- Collaboration with the client over contractual negotiations.
- Adaptation to change over planification.

Scrum enables coordinated teams to work in short cycles. The sprint is analyzed retrospectively to see its strengths and weaknesses. In some aspects it is superior to the traditional methods [2].

The Lean Manufacturing method is a management model focused on the creation of a continuous work flow that can deliver maximum value to clients. To ensure this flow, team members may be called from execution to planification phases anytime, facilitating integration and saving time during the different work sequences [8].

In consequence, Scrum, Agile and Lean employ superior methods over predictive management, regarding team integration, work flow, etc.

Nowadays, the adoption of agile methods is still in an embryonic stage. However, it continues to evolve and is being applied with success in different organizations and projects. According to the latest PMI report (PM Network, Volume 31, Number 7, 2017).

It considers the following:

- 94% consider agile methods as appropriate.
- Remaining organizations use agile methods in: a) marketing 54%; b) client support 53%; c) sales 52%.
- Why do organizations employ agile methods? 88% report they enhance their ability to manage changing priorities and project visibility.
- Only 30% of organizations have used the methods outside of software development, and only 6% have implemented them to the whole organization.
- What are the barriers of implementation? a) 43% security problems; b) 43% restrictions; c) 42% tool integration; d) 41% internal knowledge and skills; e) 37% organization culture.
- What is required to implement agile methods? a) 52% internal coaching; b) 48% executive sponsorship; c) 41 % coherent processes; d) 36% implementation of a common tool; e) 36% agile consultants.

4. Are Agile Methods for All Organizations, Projects or Phases?

The answer is no. Fewell (2018), the founder of the PMI Agile Community of Practice, expresses in his article: "The fact that the PMI is now conscious of agile methods does not mean they must be used for everything" [10].

The author made part of the team that worked on the Agile Practice Guide and the PMI-ACP certification. We can add that agile methods demand great adaptability from the organization's culture, the work teams and the project. In other words, various methods can coexist in a same project, depending on the target efficiency and efficacy [3].

During the investigation, we observed that the foundations of these methods could not be assembled, and could be complementary depending on the project they are applied.

Engineer Zender (2017) has fractured the paradigm that the Scrum method is solely for IT projects, and that therefore it would not be possible to apply it in other projects [11].

The aforementioned professional intervened in the construction of an iconic shopping center in the city of Piura, Perú.

When questioned about the use of the Scrum method, he answered: "There have been no reports nor precedents in our country about the application of Scrum in construction projects, until now" [11].

Zender was convinced that Scrum would tackle complex, adaptative problems, with maximum results [11].

The decision to apply Scrum was agreed upon by the team, the engineer and the property owners. The different shopping spaces were bestowed in short cycles, given the need to begin shopping activities as soon as possible [11].

It was observed that the typical cascade like programming would not be the most appropiate. The feeling of uncertainty would affect the final product, in spite of the short time frames.

Scrum, Lean Manufacturing and Kanban boards were used in this project. The following results were observed:

- The application of Scrum in the building industry is different to the IT industry.
- The best work dynamic will depend on accumulated experience, team member disposition, high management support and client understanding. Therefore, project information is more readily visualized with Kanban boards.

5. Case Study — Pipe Welding in a Thermoelectric Company

Thermoelectric company Vuelta de Obligado S.A.

was built by DF Duro Felguera S.A. Inc. (Gijón, Asturias, Spain). It is located in the village of Timbúes, 8 km away from the city of San Lorenzo, 6 km away from the city of Puerto General San Martin, and 40 km from Rosario, Argentine. It is a vital part of the industrial region of Rosario.

The objective of the company is to generate 50% of the power demand of the province, which is also equal to 4-5% of the power generated inside Argentine.

Having a net power generation over 800 MW will permit the surge of new industries in the area.

5.1 The Problem

Power generation in this industry requires the use of interconnected pipelines. Proper pipe function essentially depends on the way they are connected.

The pipes are auxiliary elements of the system, which transport water, vapor and other liquids. For the organization of this project, Scrum and Agile methods were used.

The fabrication of the pipes continues to be done through the traditional method. Raw materials are first received, stored and classified. Later, the process of assembly and manual welding is done by specialized personnel.

The welding workshop is in charge of the following activities:

- Storage.
- Pipe cutting.
- Assembly.
- Welding.
- Cleaning.
- X-Ray control.
- First inspection.
- Paint.
- Final inspection.
- Delivery.

Problems found were increased cost and time waste in the delivery process.

- Manual welding.
- Manual inspection.
- Time waste by the quality inspector.
- Data errors in spreadsheets.
- Initial inspection (client and fabricator).
- Painting.
- Final inspection (client).
- Product delivery.

The final product, after being painted, is stored until the arrival of the inspector. An excess of stored pipes can be costly, since the work to find and separate them according to their serial number is increased.

The time wasted affects subsequent tasks dependent, e.g., transportation, which demands permits and customs clearance. The consequence is a final delay in the delivery process.

5.2 Scrum and Kanban: A Solution?

Is the application of Scrum and Kanban a solution to this problem? The answer is yes. In this particular activity, the welding of pipes requires the application of Scrum with sprints to prevent delays. Kanban helps in the visualization of tasks.

By applying both techniques, it is possible to:

- Eliminate short unproductive time.
- Build quality pipes.
- Share knowledge among welding and inspection teams.
- Optimize the cycles.

5.2.1 First Steps

The application of Kanban was organized in:

- Initial tasks.
- Running tasks.
- Revised and controlled tasks.
- Finished and delivered tasks.

By using Kanban boards, the welding process was properly organized and delayed tasks were eliminated (Figs. 1-6).

5.2.2 From Manual Control to App Development

The interactions achieved by the teams helped solved these problems. The manual processes were time wasting and error-producing. In consequence, it

prevented the acquisition of new information from the lessons learned.

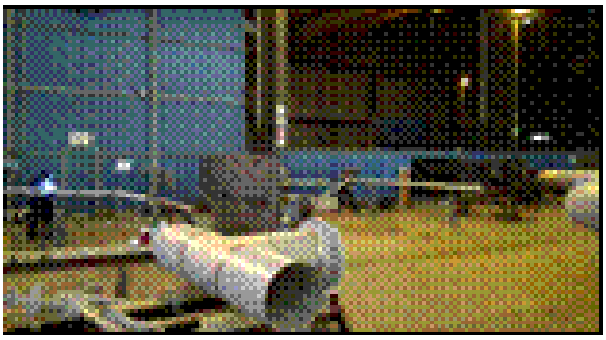

Fig. 1 Cutting.

Fig. 2 Assembly

Fig. 3 Cleaning

Fig. 4 Welding

Fig. 5 Control.

Fig. 6 Storage.

Traditionally, isometric plans were used which identified each welding and the worker in charge of the pipe. This information was written down on a spreadsheet before being uploaded to the office system. This is the current process, which lacks automatization.

A software currently in testing was developed to improve the process. It consists of the installation of a general server which connects remote terminals such as PCs, tablets and smartphones, depending on connection type and user properties. Construction data collected can thus be uploaded instantly to the server.

Through this way, higher work performance and human resource optimization can be achieved; unproductive tasks and operator error can also be eliminated through Lean Manufacturing. The above results in higher productivity, cost reduction and information gathering for better decisions.

The following data is uploaded to the application:

- Date and welding number.
- Isometric number.
- Worker assigned.

The variables are updated in real time and sent to an SQL database in the main server of the administrative office. The data is then replicated by a program designed for this specific task, with the advantage of precision, error elimination and time reduction in the transfer of data from the workshop to the office (Fig. 7).

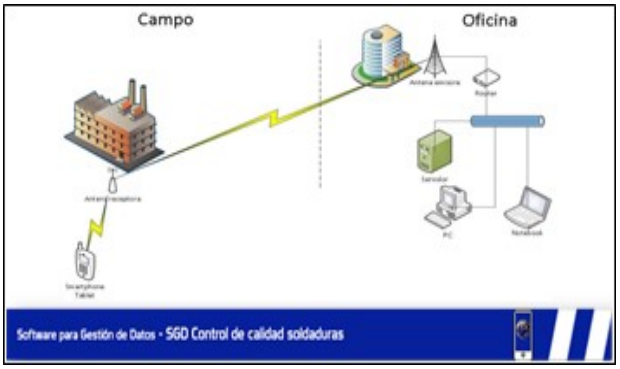

Fig. 7 Online data gathering model.

6. Conclusions

Traditional methods will have to coexist with evolutive ones and any other method the project manager chooses to use, considering that their application will be in periods or tasks that require teamwork, coordination, etc. Through this way, any information from the lessons learned will improve visibility of the initiatives in process, using methods such as Scrum and Kanban to organize work.

Agile methods have come to stay, but their application requires training, and an organization culture oriented towards horizontal processes.

Can traditional methods coexist with agile ones? Only time will tell.

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Governance for Urban Sustainability and the Land Regularization

Maykon Fagundes Machado, Zenildo Bodnar, and Kaira Cristina Silva
Universidade do Vale do Itajaí (UNIVALI), in Itajaí (SC), Brazil

Abstract: This research aims to study urban governance performed from a sustainable point-of-view that could enable it to encompass the city in every aspect and to ensure the safeguarding of individual and collective rights. Its specific aim is to emphasize how important is the land regularization in the urban context as an instrument to grant the effectiveness of the right to housing — in special to the part of the population that lives in precarious conditions and needs the public policies to support them — by converting tenure into a property. The research leads to the conclusion that comprehending sustainability — that is, perceiving the web of life, understanding the interconnection of the human being, environment and the nonliving components in a systemic relationship — is vital nowadays. The Inductive approach with bibliographical research was the method adopted to apprehend the justification for the topic and to elaborate this scientific article.

Key words: urban governance, land regularization, sustainability

1. Introduction

We live in a generation that lacks environmental awareness; child, teenager and adult all need to receive adequate ecological literacy to allow them to build a sustainable society. Therefore, a sustainable governance — understood as a collaborative interaction between political, social and economic actors taking sustainability into consideration while deliberating in favour of society — becomes indispensable to manage a society.

According to Bosselmann (2017, p. 70) [1]: "[...] Without effective participation of civil society and transparency of governance, sustainable development will remain an unfulfilled promise."

However, despite the need for a "macro" vision and the effectiveness of such perspective in what concerns the global aspects of sustainability, we also have to examine the cities. It's becoming a big challenge to actualize the principle of sustainability in the face of the exaggerated economic development in local scenarios.

Addressing the concept of a sustainable city which encompasses a series of fundamental rights, we have highlighted the right to housing. We have identified considerable inequality between the urban centres and the so-called ghettoes since in those places, people don't enjoy the fundamental rights and warranties with equality. The land title regularization then appears as an instrument to take those people from their situation outside the law and establish their right to housing.

The Aim of this research is the analysis of the category "sustainable governance" and the sustainability before the challenges it faces to establish the effectiveness of fundamental rights, such as the right to housing, through essential public policies.

Its General Aim is to analyze the governance that aims for urban sustainability within contexts of social and environmental vulnerability and informality and to investigate the role of land title regularization as an instrument of change in informal and marginalized

Corresponding author: Maykon Fagundes Machado, Graduate of Law; research areas/interests: environmental law and sustainability. E-mail: maykonfm2010@hotmail.com.

cities, with a potential to promote a new socio-environmental paradigm, the sustainable city.

Its Specific Objectives are: characterizing the governance for urban sustainability in general lines, including structures and authorities connected with the defense of the sustainable city's environment and fundamental rights; analyzing the granting of formal access to land and housing as a fundamental precept for urban sustainability, through full land regularization; identifying the social actors and the occurrence of protection of fundamental rights within the urban governability model, highlighting the importance of the citizen participation; verifying the basic legal aspects of land regularization and the recognition of inherent rights as provided for the Constitutional and sub-constitutional norms; emphasizing the importance of land regulation in the urban context, as an instrument able to assure the effectiveness of the right to housing by converting the title of tenure into property, especially to the part of the population that lives in precarious conditions and needs access to the public policies and the judiciary system; and to stress that comprehending the sustainability is crucial both in global and local scenarios.

The Method (Approaches and Techniques) chosen to elaborate this Article considered the Scientific Research stages [2].

Considering this reference, the Deductive Approach was applied during the Research Stage; the Analytical Approach was used during the Data Analysis stage; and the Inductive Approach was used during the Reporting Stage, during the elaboration of this scientific article.

The Bibliographical Research Technique supported the Approaches.

2. Sustainable Urban Governance

When the Brazilian Constitution of 1988 addresses the theme of urbanism, it emphasizes the importance of the protection among the rights pertaining to the society related to environmental preservation, and its rules provide much more than conditions to live at subsistence level. It is necessary to safeguard the fundamental principles and rights of the citizen inserted in the society. Sustainable governance then arises to manage the whole collectivity considering both the environment and the citizens.

Studying the urban governance, Rhodes characterizes governance as "a change in the meaning of government, referring to a new process of governing; or a changed condition of ordered rule; or the new method by which society is governed". This new method brings the innovative idea of cooperating with the political agents and with the citizens in a way to provide equality, with rich and poor being supported indistinctly. The principle of public participation becomes fundamental to implement this thesis [3].

Cymbalista says those who are "inside" the city get full support from the public policies resulting of a good management: they can access libraries, universities, museums. Usually, such places are built in the established parts of the city. The ghettoes, on the other hand, suffer due to separation caused by the greed of the market, which stimulates indifference through surveillance and security apparatuses, and fails to promote a governance performed jointly by the society, the government and the environment [4].

According to Stephens and Wikstrom, one reason for the outbreak of the concept of governance or urban governance is that the context in which the local government works is becoming ever wider and more complex. In the United States, the researchers are replacing the term "metropolitan government" with "metropolitan governance' when dealing with metropolitan problems, due to the more inclusive connotations of the older terminology [5].

One of the biggest challenges of governance is a quadripartite challenge, in which the organizer, the facilitator, the inspector and the regulator should interact and promote the interaction with the other social agents, to outline, democratically and with public participation, some relevant management plans and sectoral agreements in favor of the society and the

environment [6].

The concept of urban governance "relates to the new practices of coordinating activities through networks, partnerships and deliberative forums that have grown up on the ruins of the more centralized and hierarchical corporatist representation of the period up to the 1970s" [7]. It is important to mention the relevance of social media as governments' partner in urban governance, as Frey advocates. The rise of social networks to counter the dominant social groups' traditional selective media deserves to be highlighted. The initiative of local governments to create deliberative municipal councils, participatory budgets and the very Agenda 21 represent an attempt to break with the elite consensus, to create countervailing powers capable of promoting equality and democracy, and of granting to the whole population access to the financial and informational resources, to the public services and to the political decision-making arenas [8].

When coming across this relevant approach to the governance from a pro-sustainability point-of-view, it is natural to think of it as a new theme. However, in municipal administration, the sustainable politics and governance are not fresh news. The activities traditionally commissioned to the municipalities are, in fact, inseparable from their environmental assignments. Those assignments have belonged to the municipalities for a long time and are carried out with different degrees of quality. The culture of the city and the public policies that once looked only to the individual are being transformed. Within this new sustainable perspective, we break with old paradigms to promote good governance by inserting in the praxis regulations that integrate paradigms of defense of the environment, as it has been happening in the sanitation, solid waste and urban planning sectors [9].

Nowadays, when the governance is mentioned in association with the discussions about State reforms, it is sheltering considerations about the efficiency and the effectiveness of the governments' management practices. When we talk about sustainable governance, we're following the same line of thinking: we should analyze what these governments that arise and appear with the power to do something have done in favour of the environment. Taking this into account, the researchers and authorities that study this theme usually classify governance as "public" or "local", to differentiate different applications in practice. For example, the concept of "public governance" appeared within the field of Public Administration and Political Science, and its definition points to a new model of public administration and development management, which links the different political, administrative and social actors. On the other hand, the term "local governance" is used when we refer to the local urban management of cities and metropolitan areas. The local governance strongly requires engagement by social and political actors prepared to deal with sustainable governance within the city, what is certainly a big challenge [10].

It is in this context we notice that governance differs from government. Governance refers to a relationship between civilians, the society and the State, between the people in the government and those governed by them, all debating future sustainable ideas. The citizens' participation should be active, in this light. In short, [...] it is this last aspect — the relationship between civil society and State — that distinguishes the study of governance from other studies of government [11].

Klaus Bosselmann emphasizes the need of conciliating economic development with the protection of the environment. Sustainable governance should be thought with this focus [12]. According to the traditional concepts, the administration of a city was considered good when it created jobs and generated income. This, of course, is an excellent goal. But the sustainable development appears in the article 225 of the Brazilian Constitution of 1988, bringing upon the concern with the welfare of your neighbour: we ought to think about the environment, to increase the economy along with the sustainability, in this generation and in the next ones.

The concept of environmental governance also deserves mention. It is fundamentally different from the concept of governance for sustainability, and it's considered the poor man's economic governance, for it addresses only superficially and in a minimalist way the social factors in relation to the environment. We should go further. The governance for sustainability carries the concern for the whole environment. The human being should be contemplated by a good governance just as much as the rivers, seas, forests, cities and other phenomena. The traditional focus of the current governance is the human community; the new focus should be the community of life in its widest range. Including all forms of life in its concept, side by side with the human life, is a big advance.

We see the legislative power editing laws of public interest every day; with this new concept of governance, though, the "public" would be expanded. By using the principle of sustainability as a compass to guide projects of law and urban governance both in the local and regional levels, we would make great progress, from which the whole Earth would benefit, as we accept that not only the human being should benefit from such attitudes, but all the living community [12].

The Earth Charter also raises our awareness to the importance of the environment, aiming "to bring forth a sustainable global society founded on respect for nature, universal human rights, economic justice, and a culture of peace". The Charter contains a series of principles; however, the concern for the environment deserves highlight. The environment is not seen as a mere resource available for human consumption, but as a pillar, a basis for all the life. From its beginning, the Charter highlights the importance of the cooperation and the exercising of one's citizenship to provide a local sustainable governance, or a global one — which is the greatest goal. It proclaims in its preamble: "We are at once citizens of different nations and of one world in which the local and global are linked. Everyone shares responsibility for the present and future well-being of the human family and the larger living world". The partnership between government, civil society, and business becomes essential to an effective governance, and, to build a better world, our obligations should be fulfilled, since the smallest actions concerning the environment to the big obligations that can only be fulfilled in the international level [12].

3. Land Regularization, Its Applicability and Challenges

The concept of land regularization is provided for in the article 46 of the Brazilian Federal Law Nº 11.977 of 2009. It establishes that it's indispensable to pay attention to the urbanistic aspects when performing a land regularization, aspects such as the design of the roadways, the mandatory sizes of the plots of land, the allocation of precarious houses or houses at risk, everything that can be done to integrate the urban space under regularization to the city. Besides, it's vital to regularize the area formally and legally, to provide legal certainty to the area residents. And the whole process should consider both the environmental and the social aspects, involving all the population.

What happens is that "the informality of the hovels jeopardizes the dignity of people". They cannot enjoy their right to the city and, therefore, they aren't effectively citizens. To live irregularly is the same as to sail in permanent insecurity. Besides, the land regularization will reverberate in the rational management of urban lands, since the settlements, once regularized, appear in the municipal records [13].

We can see two immediate purposes for the land regularization. The first is adopting measures to regularize the settlement itself. Those measures are a set of actions which aim to implement the public facilities provided for in the Brazilian Federal Law Nº 6.766 of 1979 as a way of granting elements essential to the dignity of the human person. And [...] as a second aspect, the regularization of the enterprise aims to entitle its occupants [13].

From this point-of-view, Nalini [14] highlights that housing is essential to the dignity of the human person; in this logic, the housing can be considered the fundamental social right of the citizen. "Red" fundamental social right, to be exact, as it demands from the State a concrete action so that its holders could enjoy it. It's easy to understand why it is so. A shelter is indispensable to warrant most of all the other rights pertaining to the rational being.

Land regularization is a legitimate instrument to enable the dignity of people who were compelled to occupy or buy land in irregular condition. This occurs often with people of low purchasing power, who, due to their precarious economic situation, submit to living in irregular houses in a bad state of repair. The omission of the State in creating and administrating public policies appears as the main cause of this phenomenon. The land regularization isn't carried out only in favour of the irregular occupant. The legal incompatibility of mere tenure forbids investments in public policies, including sanitation, urban infrastructure and the betterment of life quality. Besides, it's a fundamental *erga omnes* right, and it can be argued against the State that omitted to adopt the needed measures and let the situation grow into a debacle [14].

It's important to highlight that the fundamental right to housing is acknowledged in countless international treaties and instruments [12], however, the failure to bring it to effectiveness remains remarkable. The City Statute of Brazil is an example of a legal text that should be strictly followed. The City Statute "introduces the legal concept of guarantee of the right to sustainable cities. It's a fundamental right whose holders are every person. The right to the urbanistic order is also stated there" [14]. It should be said this right must be equalitarian and *sine qua non*, granted to everyone in a fair and isonomic way. Not only the great businessmen and the holders of the most significant part of the wealth should enjoy the urbanistic order; the goal is to bring the equality of rights to effectiveness.

Still, it's of high importance to regard the social function of property within this context. The social function of property is not only a legal principle but also a legal rule since it was incorporated in the statute elaborated to establish the city planning guidelines. The Master Plan, another important instrument to promote urbanistic order, should specify the content of the social function of property, paying attention to the peculiarities of each city, and thus materializing this legal principle and rule [13].

In the same work organized by Nalini, Salles (2014, p. 86) points out, concerning the social function of property:

With the status of a constitutional principle, and as the vector of all the ordinary law (City Statute of Brazil, Brazilian Federal Law Nº 10.257 of 2001, and the Master Plan), the social function should be comprehended within the implement of the several legal instruments. Among these instruments, the land regularization assumes special relevance due to the disorganization and ownership informality that reigns in the large urban agglomerations nowadays. It aims to promote the urbanization by providing the region or area with the public services that make up the basic city infrastructure, and with the needed titles of property, through the acknowledgement or declaration of the right to property of the area residents.

The local government, the Public Prosecutor's office, the Public Defender's office or the municipal service of legal assistance, the Land registration office, the Judiciary and the residents of the areas affected by the land regularization should all take part in its process. The local government should regulate the uses of the urban land. It's the main actor of the land regularization process, as it's responsible for approving the projects of collective interest, including those that discuss land regularization, even if other institutions elaborated these projects. In such cases, the local government can close partnerships with the federal government and other interested institutions.

The Public Prosecutors should act to defend the social right to property, and for the sake of the diffuse right to urbanistic order, considering they belong to a permanent institution dedicated to the defense of the legal order, enabled to inspect the fulfillment of the law in every legal suit, aiming to reassure the democracy and the consolidation of the social rights and the individual non-disposable rights.

The Public Defenders or the attorneys appointed by the municipal service of legal assistance are responsible for assisting the occupants of the irregular areas, providing for the citizens of minor acquisitive power a quality service that will reflect upon the materialization of these citizens' social right. And, as the property of the real estate in Brazil is formally constituted by the registration of the title of the property in the respective office, the official entitled to realize this registration also takes part in the process of land regularization. If there is no title, there are no legal conditions to constitute the property. In the absence of the title, there's only tenure (informal property) of the real estate. Considering this circumstance, the participation of the official responsible for land registration in the process of land regularization is of major importance, as he can intervene to prevent the uselessness of the titles that result from the process, due to the unfulfilment of legal requirements.

Thus, this official will have a double function within the land regularization process: he shall be the guarantor of the legal certainty and the professional with a knowledge of Law that will assist the citizen, showing how the citizen should act to bring their right to effectiveness, and he will also make available as much legal assistance as possible to identify the area to be regularized, its dimensions, neighbors and all the information required by law. It is the registration that enables the people contemplated by the social interest land regularization to convert their tenure into a property.

The Judiciary, in its turn, will take care of eventual adverse possession suits, sometimes, and respond to the doubts manifested in a petition by the official responsible for the land registration, according to the procedure provided in the Brazilian Law. The participation of the area residents and the municipal house of representatives deserve to be highlighted. It's impossible to act without effective participation of the portion of the society that needs the fulfilment of their rights, and without the participation of the entire society. The society should be acknowledged with these rights that are sometimes forgotten. A previous contact between the population and the institutions that will act during the land regularization is also vital to the success of this process.

Finally, the house of representatives shall deliberate and approve the laws and projects pertaining the materialization of such rights (ZEIS, the Master Plan, concession laws, etc.), and other public policies relevant to the exercise of these fundamental rights. For example, in the State of Santa Catarina (Brazil), there is the Legal Home Program (Programa Lar Legal), thought to make the concession of titles of property easier and guarantee the land regularization. Such projects are of major relevance to the population.

There are many types of land regularization provided for in the legal order, such as the social interest land regularization, the specific interest land regularization, the nameless land regularization, the social interest land regularization in public real estate authorized by the Brazilian Federal Law Nº 11.481 of 2007. Every one of these types has peculiarities and they're all very important to the consolidation of the individual rights and guarantees, especially the right to housing. They won't be detailed in this paper, but it's indispensable to know them and use them as needed.

In short, Prestes quoting Nalini [14] shows that it's indispensable to face the land regularization in all its three dimensions:

[...] urbanistic, with the necessary investments to improve living conditions; legal, with the recognition of tenure, using the instruments that make it possible to acquire property in private areas and with the

concession of the right to housing in public areas; and the registration dimension, writing down the rights acquired in the real estate main document, to attribute *erga omnes* efficacy for all purposes of civil life.

The acknowledgement of the fundamental rights goes beyond the urban agglomerations; the whole society should enjoy the public policies, and that is why such instruments appear as fundamental tools to consolidate democracy. Looking at the human being as a holder of rights encompasses a series of factors that must be considered in their peculiarities. The right to decent and legitimate housing is a great step towards the realization of human dignity.

4. Urban Sustainability and the Sustainable Development

Outlining a concept for sustainability is not completely viable if our aim isn't to find a closed concept according to this or that author and stick to it because the sustainability evolves every day in the risk society we live in and unfolds in many questions.

However, to think of sustainability we should look beyond the political borders, as the environmental damages affect not only the local scenarios but even cross the limits of the sovereign countries. This characteristic gives reason to concerning, as it's of little use for a single country to adopt extremely sustainable measures while others break international treaties and agreements, and keep degrading and polluting the planet Earth.

According to BOFF (2013, p. 17) [15]:

Sustainability must be thought from a global perspective, encompassing the whole planet, and with equity, not making what's good for some at the cost of damage to others. Costs and benefits must be proportionately and jointly distributed. It's not possible to ensure sustainability to one portion of the planet without elevating the other parts to the same level or to a close level of sustainability, as much as possible.

It's a valid point, as the environment, the human being and even the non-human being aren't separated into different categories in relation to the world. We're all interconnected by the unbreakable bonds of life. This interconnection is the so-called Web of Life [16], and can be understood as well through the theory of Santiago [17]. Capra (2006, p. 135) [18], still from this point-of-view, highlights that:

Comprehending nature from a systemic perspective means to identify a set of general criteria through which we can make a clear distinction between living and non-living systems. Throughout the whole history of biology, many criteria were suggested, but they all turned out to be flawed in one way or another. However, recent formulations of self-organizing models and the mathematics of complexity indicate that it is now possible to identify these criteria. The key idea of my synthesis is to express these criteria in the three conceptual dimensions: standard, structure and process.

Understanding we are united in this ecosystem is to comprehend that when we talk about protection of the environment and sustainable development, we shouldn't look at it through anthropocentric eyes, searching only the benefit of men; the entire living community should enjoy it, not just one part, to the detriment of the other.

Thus, treating the earth as a resource chest is a big mistake. Century after century, the earth has received the treatment of a mere *res extensa* (a broad thing). We have devastated about 83% of the planet, due to our values that benefit only the mankind. The remaining 17%, luckily, are inaccessible to men. It's a great advance to break with this anthropocentric vision extracted even from the bible. The man was not made to rule and destroy all the surrounding environment, but to coexist with it, and although he needs natural resources, he should extract them in an aware and sustainable way [15].

Bobbio (2005, p. 8) [19] affirms that the fundamental right to environment is informed by third generation rights: "[...] The most important of these is being demanded by the ecological movements: the

right to live in an unpolluted environment". However, some people criticize this position. Eduardo Gudynas, for example, comprehends this question within a conception of citizenship called by him "Ecological Meta-Citizenships" [20]. The group rights that appear in the modern times cannot exclude the non-human community, by adhering to the anthropocentric concept of sustainability. Increasing civil awareness and bringing to effect the decisions of the international courts — including those that discuss the principle of sustainability — is vital to avoid adopting the anthropocentric concept.

The importance of the duty of solidarity in relation to the environment was acknowledged in a case debriefed by the Minister Celso de Mello [21], when he appointed in the judgement performed by the Supreme Federal Court of Brazil that the environment is a right of all, therefore, we can also say everyone must preserve and protect the environment, not only the government and the political actors, but the whole society.

The Spanish author Luño (2013, pp. 163-169) understands solidarity as a value that guides us like a compass in what refers to equality. Solidarity is essential to the constitutionalism, but its dimensions in the cases connected with the environment surpass the national borders, generating a right to the collectivity that also implies a distribution with equality of the rights to health, life, and to legitimate and decent housing.

However, understanding the category "sustainable development" is a matter of great complexity. To Bosselmann, "the need to reconcile economic development with protection of the environment is aptly expressed in the concept of sustainable development" [1]. The target is not to merely reduce the economic development in favour of the sustainability, because, in a boomerang effect, we would increase the masses of unemployed people and boost poverty and misery. There's always a risk. We should strive for a balance between the economic and the sustainable; even if it looks like an utopia, there's a chance.

Beck asserts that, even if it seems impossible to solve a problem, we should take action to face it. It's not enough to keep a critical distance from this civilization crisis that generates risks by adopting a mocking, cynical or indifferent attitude, just because the doom seems unavoidable. We might be a minority doing something, but we should promote good ideas, establish parameters, propose solutions, even if they seem utopian — the Earth is our home.

4.1 Sustainability in the Cities and the Challenges of Bringing the Fundamental Rights into Effect

To comprehend how a sustainable city could be, it's fundamental to analyze first the City Statute of Brazil, provided in the Brazilian Federal Law Nº 10.257, of July 10th, 2001 [22], which regulates the articles 182 and 183 of the Brazilian Constitution of 1988 and establishes:

Article 2. The purpose of urban policy is to give order to the full development of the social functions of the city and of urban property, based on the following general guidelines:

I — to guarantee the right to sustainable cities, understood as the right to urban land, housing, environmental sanitation, urban infrastructure, transportation and public services, employment and leisure, for current and future generations;

Under this light, it's easy to notice that, although the sustainability is a global matter that crosses borders and transcends horizons, leading people to talk even of a transnational sustainability, it is also a local question worthy of emphasis and effectiveness.

Romero (2007, p. 51) [23] understand the sustainable city as:

[...] the human settlement constituted by a society aware of its role as an agent that transforms spaces and whose relationship is not based on the nature-object logic but on a synergistic action between ecological prudence, energetic efficiency and socio-spatial equity.

In the meanwhile, sustainable development should be thought of especially in the cities that impact the most the economies of the states in which they are located. Such cities are spread throughout the country. About this affirmation, Leite & Awad [24] emphasize that "The sustainable development is the biggest challenge of the 21st century. The agenda of the city is, on an urban planet, of major importance for all countries". When we realize that a) two-thirds of the world's energy consumption comes from cities, b) 75% of the waste is generated in the cities, and c) there is a dramatic process of water depletion and excessive consumption of drinking water in course, we can see the truth in their arguments. Everything starts in the city, and thus, increasing the local awareness and stimulating sustainable actions and public policies that bring the principle of sustainability to effectiveness in the city is of vital importance to the development of the country and, consequentially, of the entire world.

5. Final Considerations

During the research that led to the writing of this article, it was possible to take part in study groups, presentations and conferences on Sustainability, Urban Law and Public Policies and publish texts on these topics. Therefore, upon the conclusion of the research, it can be stated that the knowledge of the researchers about its theme increased.

From the perspective of the General Aim of the research, we noticed that the ghettoes are marginalized and rejected in the urban context. The introduction of Public Policies is restrained by the lack of governmental interest, and this makes even the right to housing unfeasible, increasing the difficulty to implement the land regularization. However, as the concept of sustainability encompasses the whole collectivity, to get a sustainable city, the fundamental rights of every citizen should be acknowledged, and these citizens may also exercise their citizenship and take an active part in the democratic process of conquering their own rights.

When the specific objectives of the research were taken into consideration, the land regularization was highlighted as an instrument able to bring effectiveness to the right to housing. Its types and derivations were studied along with the ways to make use of this important legal mechanism that allows converting titles of tenure into a property, especially for those who lack assistance from the State to do so. After this analysis, the inequality existent inside the urban scenery became clear. Sustainability was highlighted as a paradigm that should gain effectiveness also in the cities through the comprehension that the earth is not an inexhaustible resource chest, but instead should be taken care of, as it is our home.

In short, this research was of great value for the improvement of the researchers' knowledge about the topics covered here. It served as well to stimulate the discussion of this topic still unknown for many but that has already resulted in programs created to provide opportunities to the community members of regularizing the situation of their properties, such as the Legal Home Program. Such initiatives make clear the purpose of the Urban Governance, properly carried out with a partnership between state and private organs, to consolidate Public Policies and make the effectiveness of the Fundamental Rights leave the field of theory and materialize in the practical life. This is fundamental.

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Contribution of Indigenous Knowledge to Adapt to Floods in Mekong Delta, Vietnam: Case Study in An Phu, Chau Thanh, Tri Ton Districts, An Giang Province

Pham Xuan Phu[1], Nguyen Ngoc De[2], and Ngo Thuy Bao Tran[1]

1. An Giang University, Vietnam

2. CanTho University, Vietnam

Abstract: This research was carried out to systematize and assess the appropriateness of farmer's indigenous knowledge and their adaptive capacity with floods. The research aimed at providing scientific foundation for proposing solutions to conserve and enhance the effectiveness of valuable indigenous knowledge in reducing vulnerability of people living in flooded areas. The results showed that local people are using several effective indigenous knowledge for coping with floods. However, the valuable indigenous knowledge has not recorded yet, nor documented in written materials for sharing to young generation and communities. Besides, some indigenous practices are not suitable in practice which required reevaluation for current flood adaptation strategies. The research suggested some solutions to conserve the most valuable indigenous knowledge for pro-active adaptation of local people in changing climate.

Key words: climate change, indigenous knowledge, flood, adaptation

1. Introduction

An Giang, one of the headwater provinces in the Mekong River Basin, should be influenced by the annual floods. When floods coming, besides bringing a huge amount of silt and improving soil fertility, field sanitation, washing alum [3]; as well as creating jobs and income for local people through natural fishing, aquatic vegetable picking, tourist services, etc. However, from 2000 to the present, the abnormal flood circumstances have affected livelihoods of local people. To be able to adapt to the changes of the flood, with the changes of the society and environment, human must always know how to use indigenous knowledge to exploit natural resources appropriately and manage more flexibly [2]. Indigenous knowledge in adapting to floods in An Giang is understood as experience that has been accumulated by the local community over many generations and inherited widely. It is reflected in the lives of local people and harmonized responses to floods every year to effectively exploit resources brought by the flood, but to avoid the damage caused by floods [6, 15]. Responding to floods activities based on prior knowledge of the local community should be investigated and disseminated effectively to contribute to the sustainable development of the locality before the circumstances of climate change are affecting vagaries of floods. There had many systematical research and evaluation relevance system to indigenous knowledge to adapt to flooding changes in agricultural production in the study area in the scene of climate change, preserve medicinal plants, preserve genes, local varieties, live with floods in the Mekong Delta, change the weather of author [1, 4, 5, 7, 8, 9, 11, 16]. However, the fact that there has not had many systematical research indigenous knowledge system

Corresponding author: Pham Xuan Phu, Lecturer; research areas/interests: livelihood and natural resources management, community-based tourism, indigenous knowledge. E-mail: phamxuanphu@gmail.com, pxphu@agu.edu.vn.

and assessment of indigenous knowledge in adapting to floods of farmer's in study sites in context climate change. . For these reasons, it is necessary to carry out the study *on* "Contribution of indigenous knowedge to adapt to floods in An Giang province". This research was carried out to systematize and assess the appropriateness of farmer's indigenous knowledge and their ability adapt with the flood in An Giang province, results of the research will provide a scientific foundation for proposing solutions to conserve and enhance the use of indigenous knowledge in reducing the vulnerability of people living in flooding changes in agricultural production in the study area in the scene of climate change.

2. Research Objectives

Generally, the main purpose of the study is that to provide information on farmer's indigenous knowledge and their adaptive capacity to floods in An Giang province provide a scientific foundation for proposing solutions and policies to conserve and enhance the use of indigenous knowledge in reducing the vulnerability of people living in flooded areas and livelihood strategies of flood affected people are both effective and sustainable.

The research will focus on the specific objectives below:

- To systematize and evaluate the suitability of indigenous knowledge and the ability of farmers to adapt to floods in different conditions.
- To find out the needs which should be done to build the links between traditional knowledge and modern techniques to adapt with the effects of flood.
- To propose conservative measures and promote the value of using indigenous knowledge of farmers in An Giang province.

3. Research Questions

The research is focusing to answer the following questions:

- What is farmer's indigenous knowledge and their adaptive capacity to floods of diffirent zone ?
- To what extents the traditional knowledge has been used helping the local people to adapt with flood?
- What should be done to make sure the traditional knowledge will be work well in terms of interaction with modern techniques to reduce flood damage?
- What are proposing solutions to conserve and enhance the use of indigenous knowledge in reducing the vulnerability of people living in flooding areas and livelihood strategies of flood affected people are both effective and sustainable?

4. Research Methods

To achieve objectives provided, the study was analyzed and synthesized from different information sources. Field survey was conducted from July 2015 to March 2016 at upper zone (Phu Huu. Phuoc Hung communes), middle zone (Vinh An, An Hoa communes) and lower (Vinh Phuoc, Luong An Tra communes), An Phu, Chau Thanh, Tri Ton district, An Giang province.

The following methods have been done:

Literature review: to refer the previous researches and reports which related to climate change, the status of drought and its impact, especially in the Mekong delta.

Both the quantitative and qualitative methods were used for survey. The research was done following these methods: in-depth interview (for both local authorities and local people), focus group discussions and questionnaires.

In-depth interview: the team has conducted in depth interviews those people who are representative of local authorities at the three levels (province, district and commune). By interviewing, the general information about the how local people know about flood and their actions to cope with it will be understood. In addition, the demand of local people may be found out in this

step. Also, individual people who showed appreciable knowled of environment change were selected for in-depth interviews. The interviews focus on the story of using their own knowledge to adapt wele with the effect flood. The in-depth interviews were conducted by using semi-structured questionnaires. Information were written down and recovered by voice recorder.

PRA (Participatory Rural Appraisal): the meeting was done, the participants for the meeting were 15 people. It was done in the upper zone (Phu Huu. Phuoc Hung communes), middle zone (Vinh An, An Hoa communes) and lower (Vinh Phuoc, Luong An Tra communes), An Phu, Chau Thanh, Tri Ton district, An Giang province. Therefore, these households have enough time to experience and accumulate local living experiences while gaining indigenous knowledge that has been applied to life experiences and to get a general understanding about the life of local people, their assets and also to know how they have faced with the flood in context of climate change. The criteria to people that they are farmers, who are experienced households living with floods and more than 50 years of living of study sites. These five tools were used: time line, mapping, seasonal calendar, problem tree, Venn diagram, ranking. The participants are people doing in agricultural production in the community.

4.1 Questionnaires

Questionnaires is used to find out the damages of flood on the livelihood of local people, questionnaires mainly to identify current observed flood and its effects of such changes particularly on local livelihoods; the resources available to them, and the extents the traditional knowledge to help the people live and cope with the effects of flood. Interview local experienced households living with floods and more than 50 years of living of study sites such as: the upper zone (Phu Huu. Phuoc Hung communes), middle zone (Vinh An, An Hoa communes) and lower (Vinh Phuoc, Luong An Tra communes). Therefore, these households have enough time to experience and accumulate local living experiences while gaining indigenous knowledge that has been applied to life experiences. Totally, 360 questionnaires were done, the interviewees are divided into two groups: (i) people living in high dyke (180 housholds); (ii) people living in no dyke (180 households).

5. Results and Discussion

5.1 Flood Occurrence During 1926-2015 and Adaptation with Flood of People in An Giang Province

5.1.1 Flood Occurrence over the Years in the Period of 1926-2015 in An Giang Province

The annual flood season in the upstream lasts about 6 months; at the same time, the level of inundation varies between 0.3 to 3 meters depending on the topography of each place. Floods are divided into three levels including high, medium and low levels according to upstream flood levels, corresponding to the water level at Tan Chau Station at more than 4.5 m, 4-4.5 meters and less than 4 meters respectively. Large flood occurs when at the same time having a large amount of water pouring in from upstream, large long-lasting rains and the impact of surges in place. The daily increase and decrease flood levels for about 10-20 centimeters for big floods and 5-7 centimeters in normal floods [3]. According to the data recorded by meteorological radio of An Giang province from 1926 to 2015, there has appeared 22 times of greater floods and 31 times of small floods [4]. In particular, 2015 was a special year having the smallest flood of all the years (Fig. 1). Small floods have caused considerable disturbance of crop calendar, affecting agricultural production, causing difficulties to the people's livelihood depending on floods as fishing, fishing gear production and means participating in fishing fish during floods.

Local people stated that small and slow floods in 2015 had a direct impact on the lives of many residents living by catching shrimp and fish in the commune. According to statistics of the meteorological radio of

An Giang Province [10], flood peak since 2000 has had the lower trends (Fig. 2), the number of catches of natural fisheries resources has had the decreased tendency between 2000 and 2015 (Fig. 3). In addition, the research results of Phu. P. X and Tran N. T. B. [12, 13] proved that within 10 years, natural fish production in An Giang region has decreased by about two thirds of wild fish; aquaculture production exploited per capita/household/year decreased significantly, from an average of 1,120.5 kg/household in 2000 reducing to 563.7 kg/household in 2010, equivalent to 49.7% reduction.

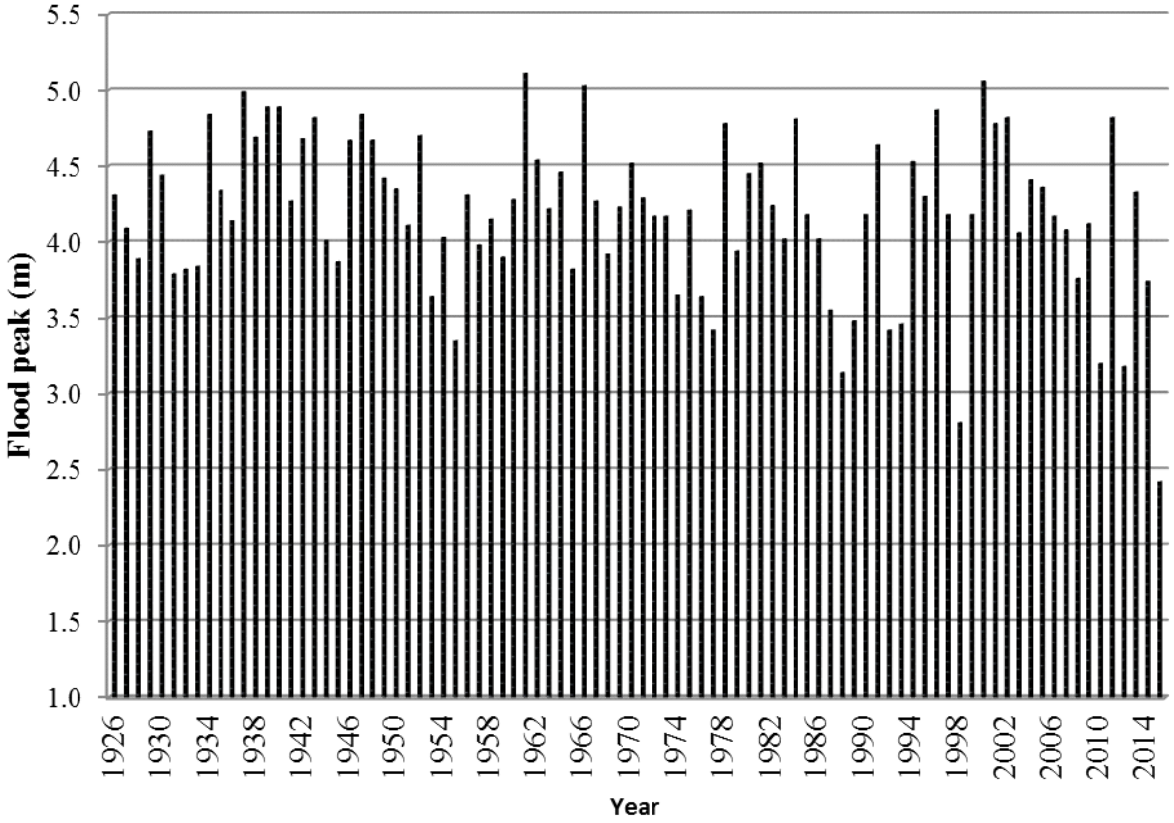

Fig. 1 Flood peak of Tan Chau from 1926 to 2015 [10].

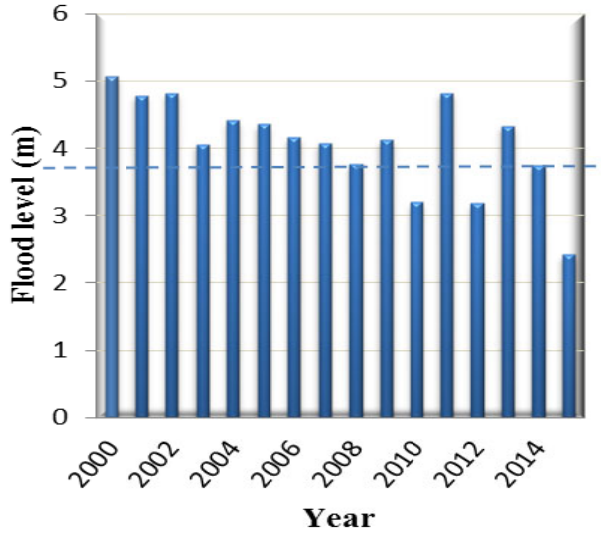

Fig. 2 Flood peak from 2000 to 2015 [10].

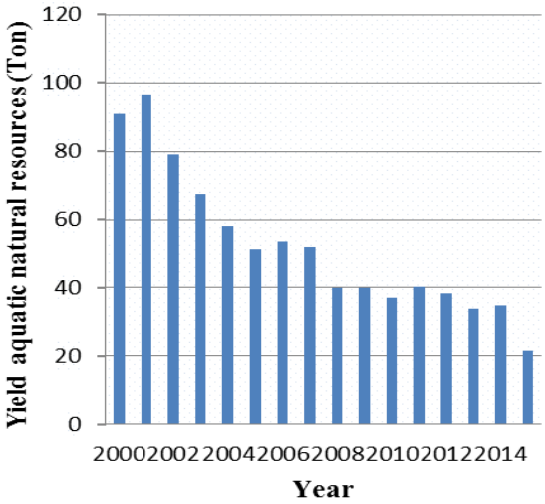

Fig. 3 Yield of natural fisheries exploitation from 2000-2015.

According to the results from the survey, when the water level decreases, fishing yields naturally also decreases; when flood levels increase, the fishing yields also rise. This shows that there is a linear correlation between the flood water level and fish production by a factor of $R^2 = 0.87$ (Fig. 4).

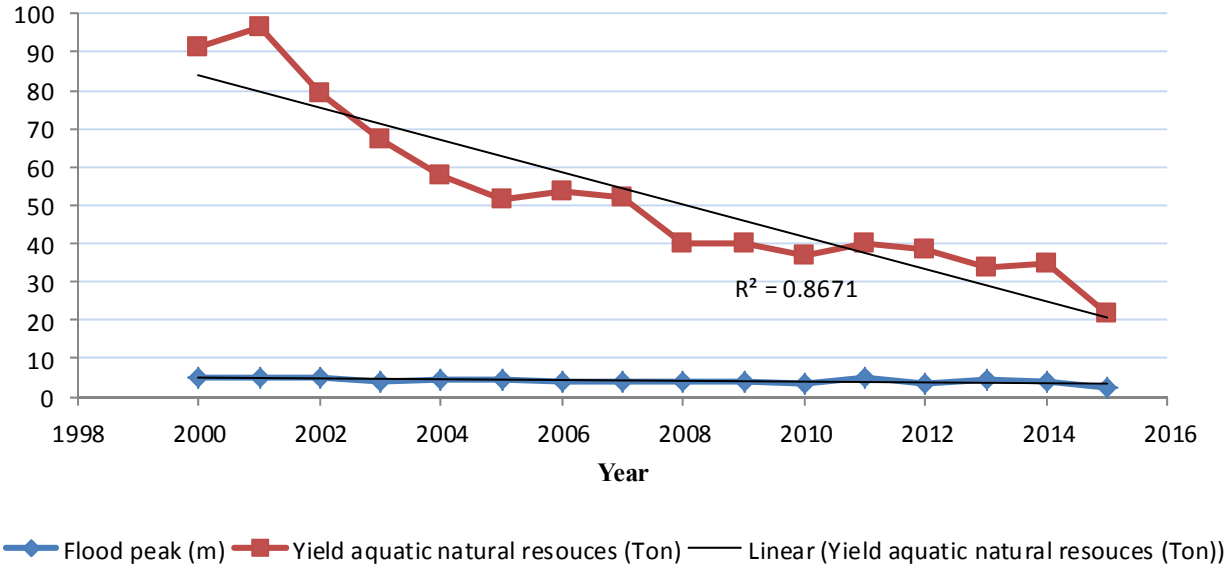

Fig. 4 Correlation between the flood water level and fish production.

5.1.2 Adaptability and Flood Forecasting of the People in An Giang Province

According to Mr. Nguyen Minh Nhi, former Chairman of An Giang People's Committee, An Giang people in particular and the Mekong Delta in general are familiar with the annual flood season and was named as "flooding season". This is the name that many generations of people in the wetland calling the floods. This call is full of optimism, expressing the spirit of active living with floods; considering flood exploitation as one of the advantages to develop. Limiting the harmful effects of the initial flood is "avoiding flood" through measures such as building houses with floor, moving people and animals to higher places, choosing plants and arranging appropriate seasonal schedule to keep up harvested before the flood, etc. To do so, the people living in the flood zone are experienced the impending flood situation such as high or low flood, flood sooner or later. The experience that people are used to predict floods including small flood in every 3 years will have one major flood year; looking downwind in the South. If strong winds accompanied by rain, fast and flowing water over, the flood of that year will be high, whereas if the flood of small anticyclone. Besides, in recent months in the flood season, they also see the expression of a number of species of plants, insects, and fish eggs to predict the flood situation in the coming years that helps them prepare appropriate seasonal schedule and prepare fishing gear and means of fishing accordingly. However, people also said that in recent years the flood prediction based on the above expression has been no longer true, namely in 2011, though small bamboos grow less than mature bamboos, the floor was still high; or in 2015, water had its infancy, but still did not have flood (PRA, 2016).

5.2 Situation on Indigenous Knowledge of the Local People in Flood Forecasting, Weather and Agricultural Production

5.2.1 Indigenous Knowledge of the Local People in Flood Forecasting

Household interview results (2016) showed that people used natural characteristics to predict flood. These experiences mainly passed on from generation to generation (Table 1). In addition, upstream communes

seem to have more flood forecasting experience than midstream and downstream ones because floods occur earlier with higher vulnerability (Fig. 5).

Table 1 Prediction for severe floods.

Signs	Descriptions
Flood period	In May and July of the Lunar year, the water rises quickly; In July and August, flood starts. Big flood takes place during Year of Dragon or October of Lunar year. Every 3 year with small flood, 1 big flood will take place.
Water color	The water is red or dark. More algae in water(water ovum) or water ovum appears early (In May, June of lunar year)
Plant observation	Reed shoots have 4-5 segments during Lunar May (2 segments indicate small flood) Reed leaf tip has more than 2 segments. (1 segments indicate small flood) Reed has 50 cm long segments. Grass leaf grows near the tip or grows multiple segments. Young bamboo shoot grows higher than older ones. Elaeocarpus grophilus roots grows more than usual.
Animal behavior observation	Bees, ants, termites, weavers nest on tall trees; rats burrow on high places. Swallow, storks come in groups Spider web appears more than usual in lunar July
Water measure	On December 30 of lunar year, people weigh a bottle of river water; On January 1, people get a different river water bottle at the same position then weigh two bottles, big flood are about to take place if the later bottle is heavier.

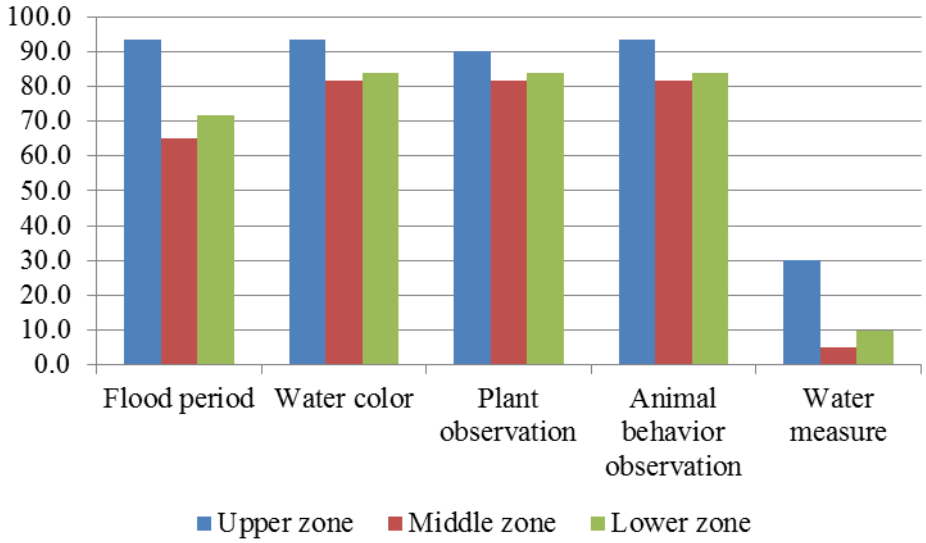

Fig. 5 The difference in people's flood forecasting in flood areas (source: interviewing household, 2016, n = 180).

5.2.2 Indigenous Knowledge of the Local People in Weather Forecasting,

Household interview results (2016) showed that upstream communes seem to have more weather forecasting experience than midstream and downstream ones (Table 2).

5.2.3 Indigenous Knowledge of the Local to Adapt to Floods in Agricultural Production

Currently, due to unusual and complex weather, unpredictable nature so the accuracy of flood and weather prediction is no longer as high as before, in addition to the impact of science and technology, the number of people with indigenous knowledge is not many. Specifically, 89.4,% of the interviewees said that the current flood situation is not predictable; 10.0% said that they change their predictions a little and only 13.3% said that the weather situation remains in their predictions (Fig. 6).

However, in agricultural production, local people in three research areas still obtain a lot of experience to

adapt such as crop calendar change, seed cultivation, fertilization, tillage and harvest accordingly (Fig. 7).

Focus group discussion results showed that people with more experience in changing crop calendar according to different level of flood years (Table 3). However, extraordinary floods also caused disadvantages in rice cultivation such as short recover for the soil, no time to decompose rice straw after tillage, farmers must pumped flood water out of the field to do seeding. In particular, small flood in 2015 reduced the sediment of the soil, which increases the cost of cultivation of rice and vegetables.

Table 2 Signs for rain forecasting.

Signs	Descriptions
Rain period change	• Rains start in the beginning of lunar March or April. • More rains take place during lunar June, July.
Night sky observation	• Gloomy sky or less stars means rain the day after.
Daytime sky observation	• Windy and cloudy with thunderstorms • Large pale blue clouds • Heavy, soaked or black clouds with cold winds • It was hot for several days
Animal behavior observation	• Dragonfly flying low means rain flying high means sun, flying in the middle means shady • Ants stay higher place or move their nests and eggs to higher places. • Winged ants appear, rains take place the day after. • Termites appear, rains take place the day after. • Flies and gadflies attack paddy fields, rains are about to take place.

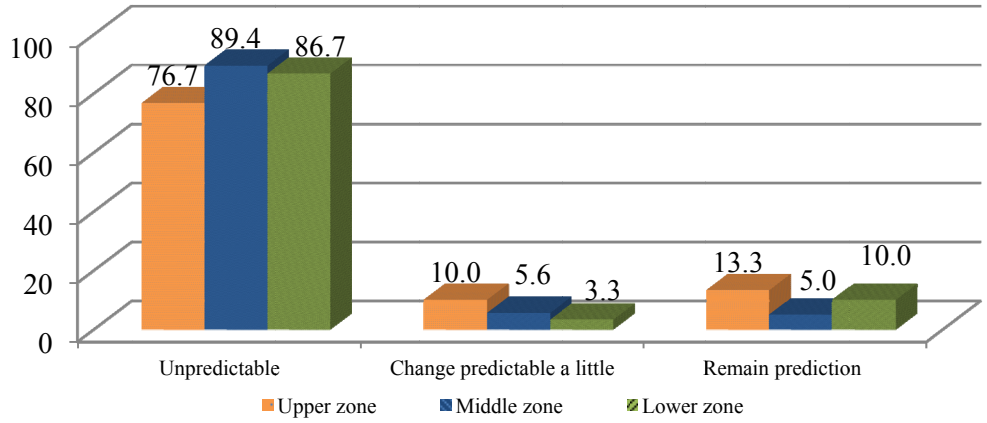

Fig. 6 Assessing the accuracy of the predicted flood and weather local people (source: interviewing household, 2016, n = 180).

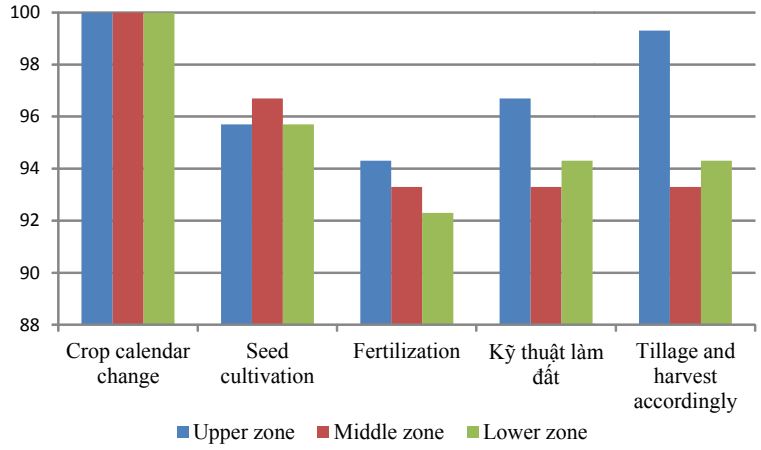

Fig. 7 Indigenous knowledge to the local people in adapting to flood in agriculral production (source: interviewing household, 2016, n = 180).

Table 3 Seasonal calendar of high flood, medium flood, small flood in study side.

Zone	Seasonal calendar	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
Upper zone	Two rice crops (ĐX-HT)	ĐX 2009-2010 10/3 20/3 HT 2009-2010 15/7 10/11 ĐX 2011-2012 25/3 30/3 HT 2011-2012 15/7 25/11 15/2 15/3 HT 2014-2015 15/6 10/11 ĐX 2014-2015											
	Flood season	5/7 Flood in 2009 5/11 5/7 Flood in 2011 15/11 Flood in 2015											
Middle zone	Two rice crops (ĐX- HT)	ĐX 2009-2010 15/2 15/3 HT 2009-2010 15/7 10/12 ĐX 2011-2012 25/3 30/3 HT 2011-2012 15/7 10/12 15/2 20/3 HT 2014-2015 15/6 ĐX 2014-2015 1/11											
	Flood season	10/7 Flood in 2009 25/11 10/7 Flood in 2011 5/12 Flood in 2015											
Lower zone	Two rice crops (ĐX-HT)	ĐX 2009-2010 15/3 30/3 HT 2009-2010 15/7 1/12 ĐX 2011-2012 HT 2011-2012 10/12 25/3 30/3 15/7 15/2 25/3 HT 2014-2015 15/6 15/11 ĐX 2014-2015											
	Flood season	15/7 Flood in 2009 30/11 Flood in 2011 12/7 7/12 Flood in 2015											
	Floating rice-vegetable	15/2 30/3 Vegetable 15/6 157 Floating rice (6-7 month)											

Source: PRA, 2016; Note: ĐX: Winter Spring, HT: Summer-Autumn.

5.3 The Information Channel Used to Monitor Rainfall, Flooding for the Next Generation

People use various information channels to predict the flood from reviewing rain and flood information through the daily weather forecast to exchange information between together. In particular, daily weather report on TV is the most effective assessment

thanks to easy access, regularity and relatively accurate information. Local news channel and neighbors' information is the 2nd most effective assessment; Communal meeting and radio are the two least effective information channels (Fig. 8). The local knowledge on forecasting weather, flood is transferred to the next generation based on weather expression observation, television forecasts; folk songs, proverbs about weather predictions such as "dragonfly flying low means rain flying high means sun, flying in the middle means shady" or "big flood in Dragon lunar year" are no longer applicable. The indigenous knowledge on coping with floods transferred to the youngsters such as house reinforcement during the rainy season, moving to safe place, learning to protect themselves in the flood season (Table 4) in which self protection such as swimming skill is the most focused. Up to 92.2% of interviewees said that all family members are able to swim, not including children younger than 5 years old. Swimming skill is taught by family members (75.6%); learning with neighboring children (8.9%); 2.2% of children learns from local swimming class and 1.1% learns to swim in school. In the upstream area, the proportion of children able to swim since 4-5 years old is higher than the midstream and downstream areas because flood takes place earlier than the other areas.

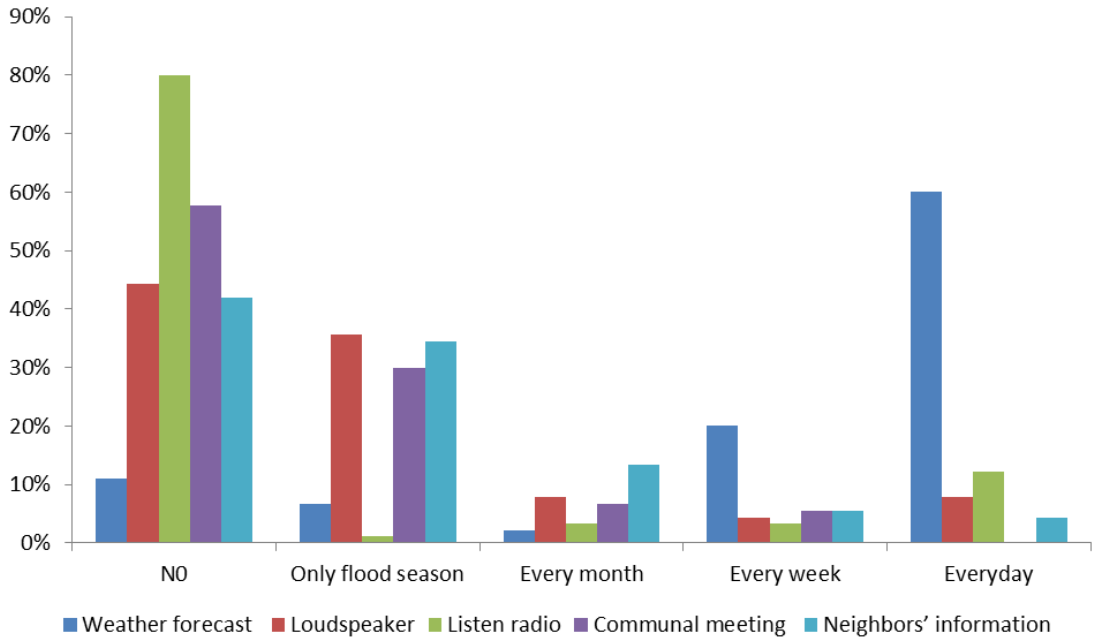

Fig. 8 People use various information channels to predict the flood (source: interviewing household, 2016, n = 180).

Table 4 The importance of the teaching indigenous knowledge for the next generation.

Skills	Mean	Std.	Importance
How to identify flooding period, flood water level, weather	3.07	1.467	High
Self protection during flooding season	4.36	0.975	Very high
Disadvantages and benefits of flood	2.74	1.312	Pretty high
Experience and skills in fishing	2.01	1.176	Low
Preparing house, food, clean water …	2.30	1.328	Pretty high
Usual diseases, natural cures	2.07	1.243	Pretty high

Source: Household survey results in 2016, n = 180

5.4 Conservation Measures and Promoting Indigenous Knowledge in Flood Adaptation

- The local knowledge mainly due to collected experience during agricultural production and transferred by word of mouth for the next generation without writing and widely dissemination. Therefore, in order to preserve and promote indigenous knowledge, it should be collected, documented and widely disseminated to the people.
- Local knowledge becomes less effective due to flood change and extreme weather. Therefore, local knowledge and scientific and technical knowledge should be combined to promote the its values and overcome the limitations.
- In order to maintain and promote local knowledge, it should be integrated into projects of local development.

6. Conclusion and Recommendations

6.1 Conclusion

Indigenous knowledge plays an important role in adapting to changes in the environment. As a national resource, it also contributes to the sustainable development of the local community in inexpensive ways, including the participation of people and achieving sustainable development. The study compiled 39 indigenous knowledge and adaptability to floods and weather forecasts in agricultural production and livelihoods of local people in the study area. Much indigenous knowledge is valuable in predicting and adapting to floods. However, this knowledge has not been specifically recorded and stored appropriately for transmission to the latter and widely shared in the community.

Indigenous knowledge of local people is based on the specific characteristics of the organisms and changes in environmental conditions such as warning signals for local people to forecast floods and weather to prepare for appropriate change in production and life. In addition, there is some indigenous knowledge that is no longer relevant and misleading compared to the present. It should be considered in the current context due to human impacts and climate change. Therefore, the possibility of flood forecast of the people also decreased, only a small number of people can predict the flood, the weather. It is necessary to increase knowledge and encourage people to combine indigenous knowledge and scientific knowledge to minimize the damage caused by floods.

The Government should also have insurance policies for people in flood-prone areas to ensure production and adaptation to floods in order to reduce vulnerability to climate change. In other to mitigate vulnerability, an early warning system for floods should be established for the people to manage and mitigate the vulnerability of livelihoods caused by floods; Strengthening propaganda and dissemination of knowledge to prepare for the flood season, opening training courses adapted to abnormal floods.

6.2 Recommendations

- It is necessary to recognize and preserve the remaining indigenous knowledge to accurately predict and adapt to floods more efficiently and sustainably, as well as facilitate the exchange and sharing of experiences between the people in the same and other localities.
- In order to develop local knowledge effectively and sustainably currently and in the future, community knowledge should be strengthened and combined with technological advances to help farmers adapt to environmental changes.
- Indigenous knowledge should be documented and summarized into a book to predict and adapt to flood changes and extreme weather events.
- Indigenous knowledge should be integrated into farmer service system and technical transfer such as providing suitable seed varieties for local conditions.

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Architecture for Grassroots Sport and Public Clients: A Comparative Analysis

Sara Giulia Troncone

Politecnico di Milano, Department of Architecture, Built Environment and Construction Engineering, Italy

Abstract: This paper moves from a doctoral research, still underway, which studies the development of grassroots sports facilities since the post-war period till today with the aim of drawing-up an atlas for the design of facilities in contemporary city. During these period, it is possible to recognize contexts in which the theme of sports and leisure facilities has been tackled in a systematic way. The study does not focus on facilities specialized for competitions but it deals with multifunctional facilities facing with the urban scale, related with the context in which are located and with a high level of attractiveness.

Two are the fundamental contexts of investigation:

- the English context of the post-war period: following some investigations (such as the Wolfenden report), the public administration recognizes the social role of sport. As a result of this conscience, in the context of post-war reconstruction (and related to the debate on Urban Planning), public administration invests in the construction of sports facilities as a logical component of the welfare state; the construction of civic centers where sport becomes an element of community life: the structures take on extraordinary dimensions where there is a high degree of activities combination;
- the Catalan context of the democratic reconstruction after the Franco regime: the neo-government is call to respond to respond to the request for spaces for the amateur sports practice promoted by the associative network born spontaneously during the last years of the regime. It's essential the role of the public administration in developing an investment strategy to provide the region with a basic network of services, and in the definition of models and regulations.

The outcomes of these two moments are very different: on the one hand (English case) there is the construction of civic centers, as places that define a centrality in the context in which they are located; on the other (Catalan case) the priority is to build minimum structures that can be placed in consolidated contexts. Regarding these contexts, a comparative analysis should be conducted with respect to three key factors: the role of public administration; the protagonists (politicians and architects); settlements and architectural experimentations.

Key words: grassroots sports facilities, sport in Britain, sport in Catalunya, reconstruction

1. Introduction

Studying the role of sport phenomenon in contemporary society, two fundamental themes are pointed out: the role of grassroots sport as a vehicle of social inclusion; the "new" clients related to the experiences of Second Welfare. Starting from this evidence, the topic of grassroots sport is investigated in the Twentieth Century highlighting the relationship between public and private, the cultural context and especially architectural issues as the variations of sport facilities, functional integration, figurative expression and the relationship shape-structure.

Compared to these issues, it was necessary to reach at a periodization of the sport phenomenon in Europe: in relation to time-spans, significant contexts have been identified for the construction of sports-for-all architectures. Especially two contexts have been examined in which the theme of reconstruction and the provision of grassroots services converge: the English context after the Second World War; the Spanish

Corresponding author: Sara Giulia Troncone, Ph.D. Student in Architecture; research areas/interests: urban and architectural composition; sports facilities. E-mail: saragiulia.troncone@gmail.it.

context in the post-Franco period. The Catalan region has been studied in depth in this last context.

1.1 Periodization of the British Context

The deepening of the English context allowed a more precise temporal organization with respect to the first hypothesis that recognizes in the period 1945-1975 the State as main promoter of grassroots sport. The period has been divided into two time-spans:

1960-1972: characterized by the publication of two Reports (Albemarle Report and Wolfenden Report) that open the debate on the involvement of the state in the promotion of sporting activity. In parallel, the first researches and experiments in the field of building sports facilities begin and comprehensive schools are built as "community schools", with services open to all.

1972-1975: with the establishment of the Executive Sports Council in 1972, sport became part of services included in the Welfare State. During this period the increase of sports facilities is significant. In ten years, five hundred new pools and a thousand purpose-built sports centres are built. This centres are the physical representation of the shift from sport to leisure.

The roots of this experience are traceable in two antecedents that are placed in the immediate aftermath of the Second World War (1945-1965). They are: the public administration investments in the field of education leading to testing of structures built with prefabricated elements and which finds in Hertfordshire City Council as an important application; the establishment and construction of the National Recreation Centres (among which the Crystal Palace National Recreation Centre by Leslie Martin is the most well-known) as places devoted to amateur sports by the Central Council of Physical Recreation, an organization that deals with the promotion of sport in England from 1935 (year of foundation) to 1972 (year in which the Sports Council is established).

1.2 Periodization of the Catalan Context

The main periodization defined by the relationship client-sport promotion-architecture identify the span 1975-1990 in which sports associationism is the main promoter of grassroots sport. The study of the Catalan context leads to a more detailed time organization.

1975-1979: association, spontaneously arise during the last year of dictatorship, promoted collective activities and events, including sports one. Following the death of General Franco, and the fall of the dictatorial regime (1975), the process of democratic transition begins by significant dates (1976 referendum for the political reform; 1977 general election; 1978 referendum on Democratic Constitution; 1979 municipal election and Statute of Autonomy of Catalonia).

1980-1988: following the establishment of *Generalitat de Catalunya* and the organization of the departments (as education and sports), promotion policies of grassroots sports shall be initiated. At this stage public administration cooperates with various institutions (clubs, associations, entities, etc.) that work in sport promotion.

Compared with issues raised by studying this time span, it is necessary referring to other periods of the Catalan history. Between 1916 and 1936 there are three fundamental issues: the role of Josep Goday, as the architect involved in the *Comissió de Cultura de l'Ajuntament* and as designer of the *Grups escolar* built in Barcelona in the same period; the drafting of the well-known project *Ciutat de Repós i Vacances* by GATCPAC; the rise of the associative network for the promotion of the grassroots sports that brings to the organization, in 1936, of the *Olimpiada Popular*.

2. Methodology and Case Studies

Case studies were the object of a synchronic and diachronic comparative analysis.

In the first instance it is important to note that sport-for-all is defined at European level in the first half of the seventies (the 1976 *European Sport For All Charter* is the first official document based on developing grassroots sport). Compared to this date the

English case is earlier, while the Catalan one is later.

Regarding the British context it is possible to identify two main peculiarities:

- the promotion of sport as a recreational factor: in the different building types (sports centres, sports halls, etc.) one of the dominant themes is that of "social amenities"; associative areas (refreshment areas, bars, club rooms, etc.) that are integrated into sports facilities and which are privileged places from which to watch who is practicing physical activity; moreover, the interest in recreation rather than in sports activity is demonstrated by the transition from the construction of sports centres to the construction of leisure centres where the theme of the leisure pool is dominant;
- experimentation of ways of aggregating different activities; whether it is a multi-sport center or a comprehensive school, the theme is that of the volumetric articulation and the architectural definition of a complex functional program in which the relationship with open spaces is important.

On the same line, it is possible to identify two main peculiarities of the Catalan architecture for sports. These have targeted research into specific topics:

- promoting physical activity as an educational factor: both through the construction of sports pavilions where there is no exclusivity of sport activity but it can also accommodate cultural and social events; both through the construction of school centres designed as integrated structures and nuclei of cultural life, experimenting the ways in which sport is integrated into the educational structure;
- the definition of an "urban" architectural typology for practicing sports: a program of minimum buildings that are located both within the consolidated city and on the outskirts in order to solve the relationship between the places of everyday life (home, work, study, etc.) and those of sports practice.

It is important to consider that the British and Catalan governments have chosen two different strategies to promote the construction of sports facilities: the first has provided "indications", through the publication of official circulars, that local authorities had to decline according to the needs of the their population; the second one has instead stipulated a general plan for the construction of sports facilities throughout the territory.

3. Welfare and Leisure Architectures during the British Re-Construction of the Post-War Period (1960-1975)

3.1 The Gap as a Disparity to be Minded

To understand the development of sports services within welfare systems it is important to focus on two reports, both published in 1960.

The first *The Youth Service in England and Wales*, known as Albemarle Report, is the result of the work led by the committee chaired by Diana Keppel, Countess of Albemarle appointed in 1958 by the Minister of Education to study the contribution that the Youth Service can offer to young people aged between 14 and 20 with regard to out-of-school recreational activities [1].

The second *Sport & the community*, known as the Wolfenden Report, is the result of the work conducted by the committee chaired by John Wolfenden, commissioned in 1957 by the Central Council of Physical Recreation to study the state of the sport and elaborate "recommendations" addressed to the statutory or voluntary bodies , so that sport could be part of the services included in the welfare state system [2].

In the first report the analysis of the status of services aimed at young people leads to identify a serious gap. These is the gap between what is provided for the social and recreational life of young people, so long as they are in formal education, and what is provided thereafter; that is, the difference in opportunities to

develop a social life, having available leisure services for as long as you are part of a training program and what is offered instead of this.

The identification of this gap is particularly significant as it represents a further incentive to study how the school system offers these opportunities; with which figurative and settlement methods a series of services, including sports, are part of the educational buildings. These refer to the development of the comprehensive schools.

The second part of the text deals with topics to young people. These data include important data for physical activity. Arguments declared three fundamental reasons that prove the importance of physical education: sports and physical activities generally are a major leisure-time interest in the lives of the adolescent boy and girl; this interest is unrelated to academic ability or manual skill: it cuts across the stratification of society, the incidental effects of which we have deplored; work and their present leisure activities fail to satisfy the increased physical energies of many young people.

The contents of the report *Sport and the Community*, the second analyzed report, published a few weeks after the closing of the Olympic games in Rome, touch three fundamental questions: analyzing the situation of sport, especially the amateur; to introduce the function of a desired Sports Development Council as director of the national and international sports scene; indicate a series of recommendations for measures to be implemented over the short and long term so that sport can become an integral part of the general welfare of the community.

The status of sports facilities is an important chapter in the analysis conducted by the committee. In addition to outdoor equipment and swimming pools, the indoor practice and multi-sports centers are studied.

Indoor practice facilities are particularly lacking. Multi-sports centers are not widespread in England, where the single-activity club concept prevails. The commission, having also studied other European contexts, sees the potential of this type of structure whose characteristic is that of grouping different sports activities and is prefigured as a possible center of community life.

3.2 Sports Hall and Recreational Centre: Spaces for Socializing

Despite the great consensus that led to the publication of the Wolfenden Report by the sports lobbies with the recommendation of the establishment of a Sport Development Council, the conservative party of Winston Churchill remains skeptical in expanding the role of the state in the field of sport and volunteering. On the other hand, those in favor of welcoming the indications contained in the report are the members of the Labor party, Harold Wilson elected in 1964, establishing, adhering to the electoral manifesto, the Advisory Sports Council with the task of advising the government on matters relating to the development of amateur sport and physical recreation. Among the issues that the Council is called to give indications are: provide standards for sports facilities; coordinate the use of community resources; identify priorities for the development of sport [3].

Following the publication of the Abemarle Report and the Wolfenden Report, which underline the need for more and better sports facilities, the demand for information on modern sports facilities (modern sports halls and other indoor facilities) increases. The research aims to make up for the lack of existing information and the work was published in 1965 with the title *Community sports halls* [4].

The research is organized in three sections: the first in which the question of sporting practice is updated from a sociological point of view and the different scales of sports service planning are presented; the second one is dedicated to the definition of the sports halls; the third is composed of a series of attachments in which different issues such as existing types, sports centers and technical data sheets are dealt with.

Regarding the planning of sports facilities, a "strategy" is presented to be implemented at the local level, that is, at the level that most involves users in the regular use of the structures. Future "Three-Tier" provision consists in identifying three concentric areas of a city in order to relate the increase in intensity of use with the increase in land value; closer to the city center, the greater the value of the land and the greater the intensity of use of sports facilities.

In the inner ring (Tier Three) the structures are located nearby, if not within the town center, and a high intensity of use is necessary for its placement to be justifiable. For this area two "obvious" structures are indicated: the sports halls and sports centers.

The sports halls are referred to as those structures that meet both the need to practice sports throughout the year, and the need for places with a certain degree of "sociability", or meeting. In analogy, sports centers are described in which different sports activities are grouped on an area of limited size and, in some cases, may form part of the civic center.

From the review conducted in the English specialized magazines (Architects' Journal, Architect and Building news, Architectural Review, etc.) of the years between 1950 and 1980 it was noted how the university sports facilities make an important contribution to the experimentation of the typology of the sports pavilion. Perrin himself, author of *Community sports halls,* recognizes this role to the universities.

University sports facilities built during this period added much to the total feedback of philosophical, practical and technical experience recorded, especially as University Grants Committee cost yardstick were sufficiently tolerant to permit experimentation in the field of structure and finishes [5].

Among these, the sports centers of the Liverpool and Hull universities set the theme of the double sports hall crossed by a central spine where the services and the spaces for the spectators are located. This type is the same used for the Sports hall at the Crystal Palace by Leslie Martin [6].

3.3 From Sport to Leisure

During the early seventies, the success of the work conducted by the Advisory Sports Council was also recognized by the newly elected Edward Heath, Prime Minister from 1970 and 1974 and leader of the Conservative Party. In 1972, in fact, the government stipulates the Royal Charter that recognizes the Sports Council an executive role. This act is significant because it marks the moment when sport becomes part of the welfare state system; the Sports Council works within a public service culture where service planning is a central issue for public administration.

The Sports Council has the responsibility, according to the Royal Charter, to develop and improve the knowledge and practice of sport and physical recreation in the interests of social welfare and the enjoyment of leisure among the public at large in Britain [7].

The priority is to increase the facilities by direct grants to projects submitted by local authorities. Although the first sports centres have been built since the end of the 1960s, it is in the decade 1970-1980 that there is a concrete increase in sports facilities; 500 swimming pools and 450 indoor sports centres are built [8]. This figure is important because it demonstrates the government's commitment to increase opportunities to participate in sporting activities. Two reports are published to give evidence to the importance given to sport as a fundamental service for the welfare of a community: *Sport and leisure*, published in 1973 by the House of Lord Select Committee; *Sport and recreation*, published in1975 by the Department of the Environment [9].

Both document endorsed the acceptance of sport and leisure as aspects of welfare provision and the broad quality of life of communities.

John Coghlan, who played a leading role in shaping sports development policies in England (as Secretary General of the Sports Council from 1976 until 1982

when he was elected as vice president) identifies a key text describing the social change brought about by the leisure boom: The Architects' Journal on January 1965, *Fourth wave. The challenge of leisure* edited by Michael Dower. Dower, at one time a member of the Sports Council (1971-1972), wrote that "three waves have broken across the face of Britain since 1800. First the sudden growth of dark industrial towns. Second the thrusting movement along far-flung railways. Third the sprawl of car-based suburbs. Now we see under the guise of a modest word, the surge of a fourth wave which could be more powerful than all the others. The modest word is leisure". Dower warned of how this wave would bring both immense pleasure to an increasing number of leisure-seekers, and a danger of damage and destruction to the very sources of that leisure. The demand by Dower for land, water, better housing, a better deal for young people, more creative use of city parks, the establishment of permanent leisure sites and attractions, regional parks, and more imaginative plans to cater for sport and long holidays was a blue-print from which those involved could derive inspiration and work to achieve [10].

As noted by John Coghlan this publication had a profound effect on sport and recreation policy-makers and providers, and stimulated both action and research. The conclusion, organized in twelve points, formed a blue-print for the early work of the research committee of the Sports Council.

The issue of leisure is investigated at three different scales: national, regional and urban. The cities, defined as "arid", must be equipped, according to Dower, with parks and buildings that must offer opportunities for recreation in which the emphasis is placed on family entertainment.

On these two fundamental questions, namely the entertainment of the family and the set of recreational activities as a fundamental element of the life of a community, leads to a new architectural experimentation: the leisure center.

Lance Wright, editor of The Architectural Review, commenting on a series of sports center projects, identifies the question of defining the leisure center as the dominant theme of the decade 1965-1975.

This is the era too of the switch from "sport" as a specialised activity to "leisure" in which sport figures as part of a new and better way of life. This era begins with Billingham Forum (started 1962, opened 1967) and is, of course, still in full blast. The achievement of this era will undoubtedly be seen in its attempt at a synthesis between "sport" and "life": the "leisure centre" is a place is a place for everyone, from infants to geriatrics [11].

4. Architecture for Grassroots Sport and Public Clients during the Democratisation Process of Catalonia (1975-1990)

4.1 Public Administration and Sports Practice

1979 is a key date for the reorganization of the public administration: the *Estatut d'autonomia de Catalunya* (approved by the Ley Orgánica in 1979) establish, with the art. 9, the exclusive competence of the Generalitat in sporting matters; the Reial Decret 1668/1980 sets the condition of the transfer of competences in sport from the State to the Generalitat.

The following year is establish the *Direcció General de l'Esport* and four provincial delegations are institute to set up and coordinate on the territory the promotion and dissemination of physical culture (Barcellona, Girona, Lleida e Tarragona). The aim is to develop a plan of construction of public building and the promotion of sport in schools.

> Es va prendre la decisió de posar els recursos, la capacitat de traball i l'autoritat moral de l'Ajuntament de Barcelona al servei d'un objectiu prioritari: rehabilitar, dignificar i potenciar el papel de l'educació física i l'esport a les escoles de Barcelona [12].

In the same year, the election of Narcís Serra as mayor of Barcelona marks a decisive point in the organization of sports development policies.

Collateral is the publication of the "*Manifesto*", drawn up by the *Asociaciones de Vecinos de Barcelona*, which identifies the main problems of the city, including those related to sports practice.

> Se debería obtener equipamientos deportivos, desprivatizando zonas deportivas, hasta las municipales, reordenando zonas libres para la construcción de nuevos equipamientos para la práctica de deportes. Importantísimo será coordinar actuaciones con los equipamientos escolares, culturales y deportivos [13].

Priorities for associations, and therefore for the public administration is that of *deporte-para-todos* (sport-for-all), in close relation with the the educational and cultural systems (functional integration). A series of *equipament public*, including sports equipment, are the hinges of the plans to *rehabilitar* the built city.

4.2 Olympic Sport and Sport-for-All

The studied period of the Catalan context includes the nomination (1981) and the assignment (1986) to host the 1992 Olympic Games.

As highlighted, research focuses on a widespread and non-competitive practice of sport: for this reason, facilities designed to host high-level sports events (such as the Olympics) are not part of the field of investigation. Moreover, the matter of "Olympic Barcelona" has been the subject of numerous investigations [14].

It was therefore preferred to highlight the relationship between Olympic candidacy and the promotion of grassroots sport. The presence of both amateur and recreational activities with an elite practice of competitive sport is paramount to Enric Truñó. Enric Truñó was member of the Barcelona City Council since 1979 to 1998: in particular as Councillor for Youth and Sport in the Barcelona City Council (1979-1995) he collaborates with Narcís Serra, Mayor of Barcelona, and Josep Lluís Vilaseca, director general of Sport at the Generalitat, in the redaction of the dossier of the bid of Barcelona. Truñó in 1987, when Barcelona has already been named the city hosting the 1992 Games, publishes the book *La ciutat de les anelles. L'esport a la Barcelona Olímpica* in which he analyzes the development of grassroots sports practice and actions for its promotion by the municipal administration and the Generalitat.

> El govern de la ciutat era coscient en aquells moments que no es podia caure en la contradicció que hauria significat adreçar tots els esforços municipals cap a les tasques de promoció de la candidatura olímpica i, al mateix temps, oblidar les mancances de l'esport de base a la ciutat, començant pel deficient estat de l'esport escolar [15].

As Truñó points out, investments in building or adapting Olympic structures do not stop the work started by the Generalitat in the framework of grassroots sports facilities, but help to complete it according to a coordination and hierarchy criteria leading to an acceleration of that process.

Two fundamental elements make evidence of this acceleration: on one hand, the actual continuity in the construction of sports facilities not intended to host Olympic events (such as sports facilities linked to schools); on the other, the construction of a series of *Sala da Barrio*, which we will face later on, throughout Catalan territory to host "minor" Olympic events (such as qualifying races for the finals, uncommon sports competitions, etc.) [16].

4.3 Tools and Criteria for the Construction of Sports Facility: Types and Shapes

The public administration identifies the promotion of the *deporte escolar* a key factor in the spread of grassroots sports. In relation to this theme, attention was focused on school architecture to study the ways in which sport is "embedded" in the educational structures.

A second theme emerging from the study of the Catalan context is that of the sports pavilion (between 1980 and 1988 they built more than 34 of them). To introduce the theme of the pavilion is interesting to recall the consideration of Núria Puig Barata, professor

of sports sociology at the Intituto Nacional de Educación Física in Barcelona, on the adaptation of architectural structures to aspirations of sportsman. According to Núria Puig Barata in the *Salas da Barrio* (one of the three types of sports pavilion) there is a certain adaptation of the architectural model to the *modo de vida*, as the set of daily activities of individuals and groups of people. In this sense, the *Salas* are designed to accommodate sports events as well as activities of different type (e.g., local festivals) [17].

This character of *contenidor polivalente* combined with constraints of the sports practice brings the sports pavilion to be a structure of high *rendibilidad funcional*.

4.3.1 Clients: The "type unit"

The Fitxes Tècniques (data sheets) represent a guide for designer set up by the Generalidad with the technical needs of each sporting space:

- functional organization and area-dimension;
- project features (users and viewers path division, size of changing rooms, etc.);
- technical features (flooring materials, acoustic conditions, etc.);
- installations characteristics (temperature and air change, lighting, etc.)

The data sheets define the *mòduls tipus* of sports facilities. Instead of privileging a pre-figured choice of architectural solutions, administration decides to follow a case-by-case policy, entrusting the Sixties Generation with the experimentation of a variety of architectural solutions [18].

4.3.2 Architect: Pluralism of a Generation

As already shown, the tools developed by Generalidad for the design of sports facilities are very precise with regard to the technical elements (surfaces, materials, air exchange) but do not give any indication of the architectural elements: looking at the panorama of the sport pavilion built there is in fact a diversification of the architectural solutions used.

On this topic, it is interesting the article written by Ignacio Paricio *Más urbanos, más amplios, más fuertes*, in which he recognizes that the education received by a generation of architects has conditioned the sports architecture:

> Las naturales limitaciones presupuestarias, la escasez dimensional -avalada por algunos modelos del Movimiento Moderno- y la ordenación abierta de los polígonos que hacían -o deshacían- la ciudad en aquel momento, formaban el marco del ejercicio de la arquitectura. Consecuentemente, el arquitecto se preocupaba por la distribución interior, el ajuste de las superficies al programa y la tipología organizativa de la agrupación. Unos accesos con galerías y patios que contribuyesen a la relación vecinal eran tan valorados [19].

The Sixties Generation shared the vision of an architecture that is *doméstica*, with few monumental ambitions, in agreement with the "Escuela de Barcelona" of Bohigas: a general attitude for which architecture is not a necessity for monumental creation, but the possibility of serving the collective interests with a coherent design method both in the program (in the case of sports architectures defined by the technical sheets) and in architectural choices [20].

These "domestic" character become the design themes of the sport pavilions: the organization of the paths, the use of patios and galleries are elements that make up the halls and determine their relationships with the surrounding.

In fact, looking at these works can be captured the "vocación por definir su entorno que se aprecia en la mayoría de estas obras como consecuencia de su carácter público".

To these elements is added the structural theme: how to cover the light of the sports hall. Even in this case, looking at the numerous buildings, there is a variety of solutions adopted. Covering beams (predominantly trusses) define the covering of the hall: they design the plant, define the rhythm, order it and govern the lightening [21].

The panorama of these works demonstrates a pluralistic declination of the theme proposed by the administrations. A framework of buildings that work

on a shared typology, the sports pavilion, and whose architectural elements are recognizable:

- organization of the paths: a continuity of external routes entering the building and distributing spectators and players on different levels;
- spectator spaces offer privileged points for viewing the playground such as balconies or small steps, and others, such as halls and patios, for the social life of the community;
- a hierarchy between the volume of the sports hall and the services: volumetrically and structurally a smaller structure is at the service of the main space, the sport hall;
- the structural elements of the sports hall are conceived as architectural elements: they define the interior space of the hall by drawing the section in which arise the coherence between form and structure.

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Public Spaces: An Overview of the Portugal Square Uses Over the Years

Mariana Saraiva de Melo Pinheiro, and Maira Façanha
University of Fortaleza, Brazil

Abstract: Public spaces in cities around the world are changing under the prioritization of the automobiles. The consequence of this culture is deterioration and elimination of the spaces that would encourage social contact, such as squares, urban parks and areas of landscape contemplation. These aspects contribute to the emptiness of the urban areas and the growth of public insecurity. In the city of Fortaleza, in Northeastern Brazil, the need for improvements on urban mobility has led the local government to enlarge roads, eliminating icons of the city's history. In 2014, with the purpose of reducing the traffic jam, the local urban administration proposed the creation of a crossroad on the Portugal Square site. The possibility of destruction of a historical heritage stimulated the emotional memory of the people of Fortaleza, promoting protests towards the development of a mobility project that considered the permanence of the Portugal Square. The success of the campaign goes beyond the achievement of the restoration and amelioration of this public area and involves the development of a debate among the citizens about the quality of urban spaces, the spontaneous policing and the alternative transportation.

Key words: public spaces, urban planning, social engagement

1. Introduction

In the city of Fortaleza, the capital of Ceará in the Northeastern of Brazil, the transformations brought by the capitalist model of organization and the intense use of automobiles have changed the formal structure of the city and the way people use the urban space. In a scenario of pressure from the real estate market, urban mobility chaos and the growth of the fear of violence, the Portugal Square (*Praça Portugal*), a historical and cultural landmark of Fortaleza, went through a process of social discard and annihilation of its formal structure.

Studies about the importance of the human scale and the pedestrian transportation in contemporary cities have guided the analysis of the changing relationship between society and urban space among specialists. These spaces have increasingly lost their traditional function as a meeting place and social forum due to obstacles, noise and urban pollution [1]. At the same time that the deterioration of the public spaces in accessibility and quality makes these spaces less welcoming and attractive to people, the lack of people using them contributes to its degradation and disappearance.

The vitality of the spaces is also studied from the perspective of the production of monofunctional areas, which stimulates the use of automobiles to overcome long distances in a short time. The contribution of this urban logic is the loss of the affection for urban spaces and the feeling of collectivity. Tolerance, awareness, alertness, identity and mutual respect are feelings that emerge in places where interpersonal relationships occur. The absence of people in public spaces also eliminates spontaneous policing, which is replaced by official policing, making the environment less welcoming [2].

Corresponding author: Mariana Saraiva de Melo Pinheiro, Architecture and Urbanism Student; research areas/interests: landscape architecture, urban planning, social movements, public spaces. E-mail: mariana.saraivamp@gmail.com.

Thus, this research aims to analyze the correlation between the physical transformations of the Portugal Square and the change of the citizens' emotional relations with it under the context of the Fortaleza Government's proposal for its elimination in 2014 and the following social protests that took over the place for months. The change of character and function of this public urban space, from a square into a crossroad, was justified by the need of improvements in urban mobility and reduction of congestion in the most expensive region of the city. It is relevant to emphasize that this public square holds historical importance for Fortaleza, conducting the understanding of the city in its social, political, cultural and urban aspects, and configures itself as a heritage. Therefore, a survey of the morphological, functional, cultural, and social changes over the years was developed.

2. Material and Methods

The study was conducted in four months by the Laboratory of Landscape at the University of Fortaleza within the line of research "Theory, Methodology and Technologies of the Environment, Landscape and Public Space", represented by the research group "Dynamics of the City". The research method had two main steps: a theoretical, which includes a literature review and a fieldwork, through investigations at the site. In weekly meetings at the Laboratory of Landscape, the material collected was discussed and analyzed by the research team.

In the first moment, a literature survey of the historical process of occupation and development of the city was made through books, newspapers, and documentaries. Also, the information about each structural reform the square have passed was raised and correlated with the change in the society's engagement and relationship with the place.

After that, in the second moment, the fieldwork investigation of the current situation of the square and its surrounding areas was done under a socioenvironmental dimension, through visits to the site, observations, and informal conversation interviews [3]. Finally, the field data was analyzed in comparison to literature information about the historical and current situation, taking quality and functions of the urban space as research categories.

3. Results and Discussion

3.1 The History of Fortaleza and the Portugal Square

As well as some streets, the public squares the of Fortaleza that have survived to changes over time tell the history of the city. Some of them are the Ferreira Square (*Praça do Ferreira*), the Public Walk Square (*Passeio Público*), the Square Luiza Távora (*Praça Luiza Távora*) and the Portugal Square (*Praça Portugal*). This last one is the most recent and has emerged in a context of post-war, in the mid-1940s, when the desire for transformation and development was spread over the society. It was in that time that the city, yet concentrated in a single region, began to undergo a process of decentralization and expansion into its Eastern Zone.

With the desire of bringing innovation to the city, urban planners proposed the creation of wide avenues, not limited to the implementation of a geometric grid plan, to guide occupation. The elite, aiming to move away from the commercial zone to calm areas, began to build their houses in remote areas from the center, taking advantage of the openings of roads and the new infrastructure. This migration is responsible for the consolidation of a new neighborhood in Fortaleza, the Aldeota, influencing the economic, cultural and urban development of the city over the years through urban public spaces, squares, social events, markets, etc. Therefore, the local authorities decided to build the Portugal Square to set a centrality in the neighborhood where the interpersonal, cultural and landscaped aspects would be remarkable and attractive in a way to contribute to the process of expansion and development of the Eastern Zone (Fig. 1).

As a result, the icon of the new neighborhood was built, a roundabout with public square's character, in

Fig. 1 The Portugal Square in 1971 [4].

the meeting of what would be, in the future, two of the main avenues of Aldeota: Desembargador Moreira and Dom Luís Avenue. It is worth mentioning that at that time the number of automobiles in the city was not significant and the purpose of the Portugal Square's construction was to contribute with the quality of urban life in the new neighborhood. Therefore, urbanists designed the square on a circular shape along with other four adjacent triangular public plazas located in the corners of the square (Fig. 1). This urban complex has become an important meeting and leisure venue not only for residents of the region, as well as for society in general.

3.2 Transformations on the Portugal Square's Shape and the Citizen's Relation

The formal structure of the Portugal Square as we know today was conceived in 1947 by a group of architect urbanists led by Maria Clara Nogueira Paes during the expansion towards the East. At that time, the square was not yet called Portugal Square, but Nunes Weyne Square.

Despite its construction, it was only after the reform to implement urban furniture and equipment (fountain, light pole, benches, etc.), in 1968, that the Portugal Square was officially opened. This gain represented a great improvement and the square became a place of leisure and meetings for the population, mostly when it started to host public and cultural events, such as the New Year's mass and the weekly flower market. This last grew so significantly that the diversification of the products offered promoted the accumulation of garbage, which culminated in the banning of the market by the government. Thus, in 1987, the proposal of another restoration arose and, through new design and spatial barriers, the flower market was definitely over [5].

Along with the rapid development of the area and the emergence of new leisure attractions in the city, these transformations changed the relationship the citizens had with the square, bringing impoverishment of the social-spatial interaction and the feeling of belonging. In this context of the population's loss of recognition with the place, local authorities proposed in 1991 a change of identity, the modification of the square's name to Parsifal Square. However, due to the strong objection and claim by the Portuguese Community of Fortaleza, this change did not happen. After some debates about the relevance of the Portuguese people to the history of Ceará, not only the name did not change but also a reform in 1992 built a monument to honor their contribution.

Throughout the years and the changes of use, the square continued to experience small reforms. However, the primary function of the square as a place that would encourage social contacts became hardly recognized. The subsequent transformation of the adjacent plazas into parking lots and taxi stands along with the difficulty of accessing the central core, due to the traffic jam, led to its emptiness. In addition, the development of a strong culture of consumption, the increased urban inequality and public insecurity contributed to the population's new leisure preferences,

mostly indoors, air-conditioned and with a security officer such as the new shopping malls nearby the square.

Hence, progressively emptier and challenging to access, the square began to attract urban tribes, small groups of people whose interests are different from the dominant culture, that did not fit in the Fortaleza's contemporary society, as well as the Portugal Square. This public, mostly the young people pre-judged by their way of dressing and behaving, fuelled the belief in urban violence inhibiting, even more, the diversified use of the square. In this process, the public investments in infrastructure and maintenance of urban spaces have also decreased and became focused on the issue of urban mobility.

The creation of viaducts (Engenheiro Santana Junior Avenue) and tunnels (Padre Antônio Tomás Avenue) compose a series of other new urban reforms with the aim of improving urban mobility and the quality of life of those who pass through Aldeota neighborhood. Despite of these punctual reforms, the end of the congestions in the area was not guaranteed.

3.3 The Elimination Proposal and the Manifestations

In a continuous search for the annihilation of traffic jam chaos, in March of 2014, architects and urban planners responsible of the Plan of Immediate Actions on Transport and Traffic *(Plano de Ações Imediatas de Transporte e Trânsito*) of Fortaleza presented a project to transform the Portugal Square (morphologically a roundabout), in a traffic light intersection, as shown by Fig. 2 [6]. The change was a consequence of the mobility plan to make the Dom Luis Avenue a one-way towards the West (working along with Santos Dumont Avenue towards the East). The new design proposed the construction of four squares, one at each corner of the intersection, and the elimination of physical barriers to the automobiles.

Fig. 2 The first new proposal for the Portugal Square [6].

Together with experts in city studies and the Portuguese Community, citizens conscious of the tradition and culture of Fortaleza have objected to the project that physically erases the history of the city. However, the local administration discussed about the need for change in four essential aspects: an exclusive bus lane, crosswalks, bike lane, and expansion of space destined to pedestrian circulation and leisure [7].

Stakeholders, such as taxi drivers and local business around the areas added that, due to the difficulty to access the central core, the square became useless and the project would not only create new areas of leisure but also finally decrease the traffic jam in the region [8]. The contrasts of opinions grew in a very conflicting

way due to the lack of sense by some city managers and stakeholders about the relevance of the contemplative, landscaped and cultural aspects of the square to the society, besides its history.

However, the challenge of comprehending the urban spaces under a sensitive perspective is not only a barrier for local authorities but also for population itself, whose bad daily life behavior (wrong waste disposal, degradation of green areas, disregard of the laws of heritage, etc.) disrespect the urban environment. At this point, it is relevant to emphasize that the city of Fortaleza do not count with a long history of the citizens' involvement on the urban decisions neither on manifestations and the case of the Portugal Square represents, in this context, one of the most remarkable protests under the urban planning theme.

On March 10th of 2014, the Portugal Square was isolated by the local administration and the fear of its elimination rapidly spread over different segments of society. The growth of manifestations on social media, as well as at the site, and the urgent need to stop the elimination of the Square led to a judicial decision. The judge who wrote the official document determined that Fortaleza's government "must refrain from any idea of demolition" [9].

As a result, on 14th of March, the Mayer of Fortaleza said that he was "happy to watch the citizens moving and discussing the projects" and assured that the Portuguese Community would participate on the development of a new project [7]. In May, the local administration published the new plan that would enhance urban mobility and the landscape while reinforcing its importance as a heritage of Fortaleza's history. Although the design once again had the function to promote a fluid traffic flow, the importance of the Square as a landmark and heritage was this time considered (Fig. 3).

The construction would, indeed, improve the pedestrian mobility, expand the surface of the green areas and the spaces destined to leisure and social interactions. Besides, the importance of the Portuguese Community to the history of the city would be honored through the construction to the Portugal Pavilion (Fig. 4).

The proposal of reforming the four corners in quality on the landscaped, cultural and environmental aspects would not preserve the central core, eliminating one of the fewer traces to the city's history that is still possible to identify. Thus, citizens continued to reject the automobile prioritization as an instrument of urban planning.

The movement stimulated the debate among the entire society, empowering the residents of Fortaleza to think about the quality of life in the city under a perspective of spaces to encourage social relations, cultural activities and the contact with green areas. The social engagement on the public decision about the Portugal Square also led students of Architecture and

Fig. 3 The second new project for the Portugal Square [8].

Fig. 4 The Portugal Pavilion [8].

Urbanism to design alternative solutions, sharing them with the society and fueling the manifestations. Under the society's pressure, the local administration decided then to preserve the formal structure of the central core.

3.4 The Restauration

The construction started two years after the beginning of the discussions, in April of 2016, under the responsibility of five Construction Companies that are also responsible for its maintenance. The project considered, then, reforming the Portugal Square in the sense of exalting its importance as a social forum of leisure and meetings, following the original purpose of the 1947's project.

Despite the heritage conservation, the intervention divided opinions. The diameter of the central core was reduced from 40.5 to 36.5 meters, based on the argument of the creation of a new lane to improve transit mobility. On the other hand, the four adjacent plazas were revitalized and the pedestrian accessibility was improved through four crosswalks towards the central core. Also, the implementation of a bike lane around half the perimeter of the circular core provides access to both the exterior and interior of the square. The interlocking paving of the region was renewed and horizontal signalization placed at points of alert for the crossing of pedestrians and cyclists. The most significant impact of this reform was, perhaps, the construction of a barrier to block the automobiles to turn 360° around the square, and eliminating the principles of a roundabout. It is also at this point of interruption that the cycling accessibility is interrupted due to the lack of an integrated system in the city (Fig. 5).

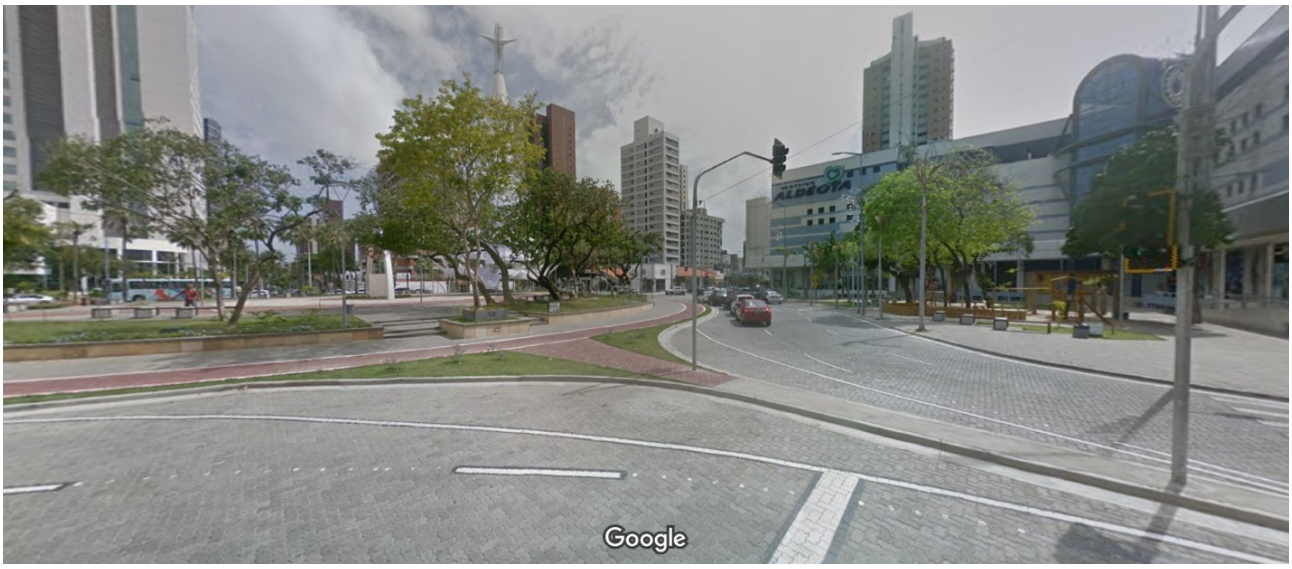

Fig. 5 The interruption of the Cycling Lane [10].

Despite the different opinions, finished in September of 2016, the reform of the Portugal Square improved the quality of the urban environment in the area in a way of transforming it into an attractive place that encourages social contact as it was before. A diversity of activities have been carried out in the square as the example of the event You at the Square *(Vós na Praça)* that brought together craftsmen, food trucks, autonomous producers, families, young people, and artists during the vacations of July 2017.

The Figs. 6 and 7 illustrate the population using the Portugal Square after the last revitalization and the implementation of public policies related to the promotion of cultural events. The preservation of this historical landmark is not the only achievement of all debate, but the development of the values of respect for the physical environment and for all people in society.

Fig. 6 Picnic in Portugal Square.

Fig. 7 People on seating puffs in Portugal Square.

4. Conclusion

The proposal of elimination of the Portugal Square in 2014 stimulated the emotional memory of the residents of Fortaleza as a trigger to one of the most remarkable protests on urban planning of the city. Due to the achievement of the preservation of this historical heritage, the population developed the sense of quality of urban spaces, spontaneous policing and alternative transportation.

From this Portugal Square's study, it is possible to evaluate the impact of the structural changes on the urban landscape and the following citizens' engagement with the public areas. Urban spaces designed for activities, which express the desire of society, become welcoming and encourage social relations. When the citizen's desire does not guide the project, the place becomes empty and degraded, facing the risk of disappearance.

The many reforms implemented by the government along with the abandon of the square by the population raises the curiosity of the real aspirations of the society. The management of urban policies and planning are indeed the responsibility of local authorities, however, it is important to highlight the need for social participation on decision-making to guarantee the transformations meet the common desire of society.

The study of the public spaces of the city of Fortaleza and the society's participation does not finish with this research, instead, it is the starting point for an ongoing debate.

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Prospectives of Zhaylminsk Graben Syncline for Polymetals in Central Kazakhstan

Amangeldy Abeuov[1], Mukhtar Abeuov[2], and Damir Karim[3]

1. Karaganda State Technical University, Karaganda, Kazakhstan

2. Joint Stock Company "Aluminum of Kazakhstan", Pavlodar, Kazakhstan

3. National Mining Company "Tau-Ken Samruk", Astana, Kazakhstan

Abstract: The Zhailma graben-syncline, within which there are large deposits of iron (Karazhal) ferromanganese ores (West Karazhal, Ushkatyn-III) and polymetals (Zhairem), is a rift structure formed in the Upper Devonian - Lower Carboniferous and complicated by subsequent orogenesis processes. At the same time, iron and iron-manganese deposits with barite-polymetallic ores are located on the sides of the graben-syncline, and zinc-lead-barite with numerous lenses of iron and iron-manganese ores in its axial part. In them, the ratios of magnetite to hematite are different: magnetite prevails in near-ore ores and hematite - in axial ores, which is a consequence of the geothermal process of dislocation metamorphism on the boards, rather than in the axial (central) part, which differs from the first in tectonics. This ratio of iron minerals led to the discovery of all the “side” deposits by magnetic prospecting, and the Zhairem deposit, located in the erosion window in the axial part, by gravity prospecting. Such an arrangement of the deposits should be a criterion for the search for deep-lying deposits of the Zhairem type in the axial part of the Zhailminskaya graben-syncline under a thick layer of limestone of the lower tour using modern aerogeophysical methods.

Key words: graben-syncline, metamorphism, deposit, iron, polymetals

1. Introduction

In Central Kazakhstan there are two deposits of half-metals with industrial reserves — Akzhalskoe and Zhairemskoe. In the first of these, reserves will soon be completely exhausted. The works on strengthening and expanding the raw material base in the region of polymetals, and not only them, despite the huge costs, have not been successful in recent decades due to the lack of effective criteria and methods for predicting hidden deposits located at considerable depths, because the fund of deposits located at surface or at shallow depth, completely exhausted. Therefore, to identify hidden fields, we have focused on identifying a geological prospecting model based on geological and paleotectonic positions, spatio-temporal and genetic relationships with specific structural-material formations using and combining the results of geological and geophysical studies of the Zailminsky graben-syncline area.

2. Material and Methods

The Zhailmina graben-syncline (rift zone) is a complexly dissected crest-shaped trough, bounded by intersecting deep faults of the north-western and sublatitudinal strike. Its length is 140 km with a width of 10-30 km. The rift was preceded by terrestrial Lower-Middle Devonian volcanism of andesite-basalt and rhyolite composition. As the rift developed, it was carried out by the association of continental and marine formations, including products of contrasting differentiated land and underwater basaltic-rhyolite

Corresponding author: Amangeldy Abeuov, Mining Engineer Geologist; research areas/interests: review and analysis of the monograph and periodical literature to establish criteria for prospecting for deep-seated mineral deposits. E-mail: a.abeuov@gmail.com.

volcanism, red-molasse, marine siliceous-carbonate and carbonaceous-terrigenous formations of the Upper Devonian - Lower Carboniferous [1].

Iron, iron-manganese, zinc-lead-barite ores are developed at the deposits of the Zhailminskaya graben-syncline. They are enclosed in clay-carbonate sediments of the upper Famenn and according to alternate with the products of the underwater basaltoid volcanism of the jasper-diabase formations. On the deposits of the upper Famenn there are limestones of the lower tour everywhere. The listed rocks are covered with loose Cenozoic sediments with a thickness of up to 60 m. The ores are spatially combined and their ratios are different. Some deposits are iron (Karazhal) and iron-manganese (West Karazhal, Ushkatyn-III), others are lead-zinc with a thick layer of iron ore lying above (Zhairem), the third are intermittent iron-manganese-lead-zinc (Arap). According to the content of metals, iron and manganese ores in zinc-lead-barite deposits are non-industrial.

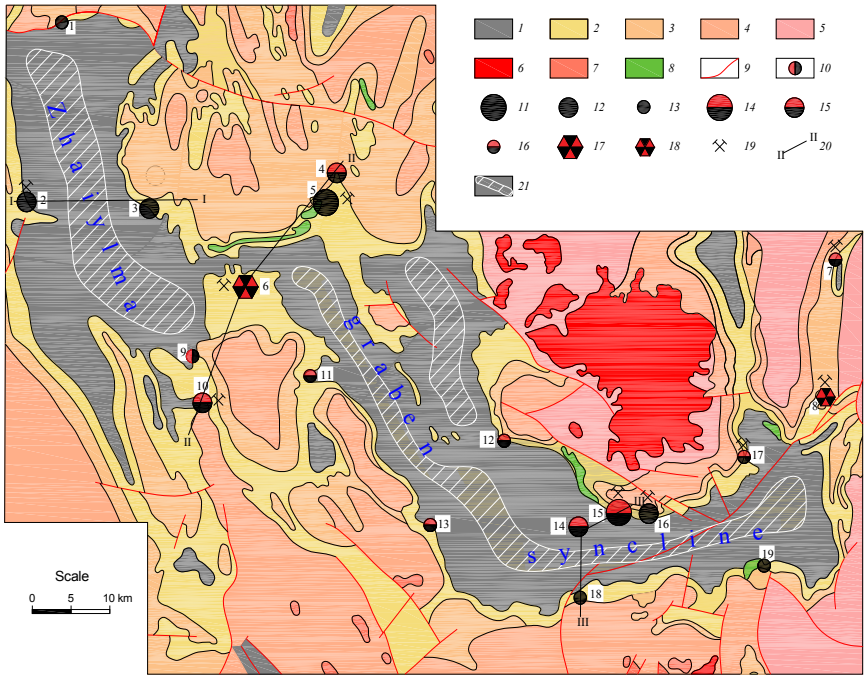
Lead-zinc-barite ores are closely related to the clay-siliceous-carbonate formation. Ore bodies are represented, on the one hand, by reservoir-shaped deposits of sedimentary genesis, and on the other, by crossing lenses and veins, formed in disjunctive disorders in the process of dislocation metamorphism of primary sedimentary ores. As a rule, those and other ore bodies are present in all deposits, but their relative numbers are different. They are composed of rocks of a siliceous-carbonate formation of the Famennian age, forming an ore-bearing association formations are transgressively deposited on more ancient sediments and are overlapped by rocks of the carbonaceous-terrigenous-carbonate formation of the Tournaisian and Visean low Carboniferous. In this association, facies of various depths are noted: coastal terrigenous carbonate, reef, silt-depression, siliceous-carbonate with relicts of products of basalto-rhyolite volcanism. Mineralization mainly to deposits of silt-depression facies and their facial joints with shallow sediments [2].

From barite-polymetallic objects, the Zhairem deposit, which is confined to a brachyanticlinal structure (erosion window) in the central part of the graben-sync window, is of practical value in the region. and consists of three sections: East, West and Far-West. Ore deposits are represented by pasty deposits, consistent with host rocks ranging in thickness from the first tens of centimeters to the first tens of meters. Along the strike, ore bodies are traced for kilometers, by a fall-up to 500-900 m. Their boundaries, as a rule, are indistinct and are established according to sampling data. The secant lens-and vein-shaped ore bodies have a very whimsical shape, but clear boundaries; their power ranges from a few centimeters to several meters. Ore changes are relatively weak, expressed by baritization and silicification. Ores are barite-lead-zinc and they form the main reserves and industrial value. The average lead content (in %) is 1.7, zinc is 3.75, barite is 37. The main minerals are sphalerite, galena and barite. The ores also contain about 60 non-accumulating minerals. Reserves are estimated in industrial categories (in thousand tons): lead - 2602, zinc - 5620 [5]

3. Results and Discussion

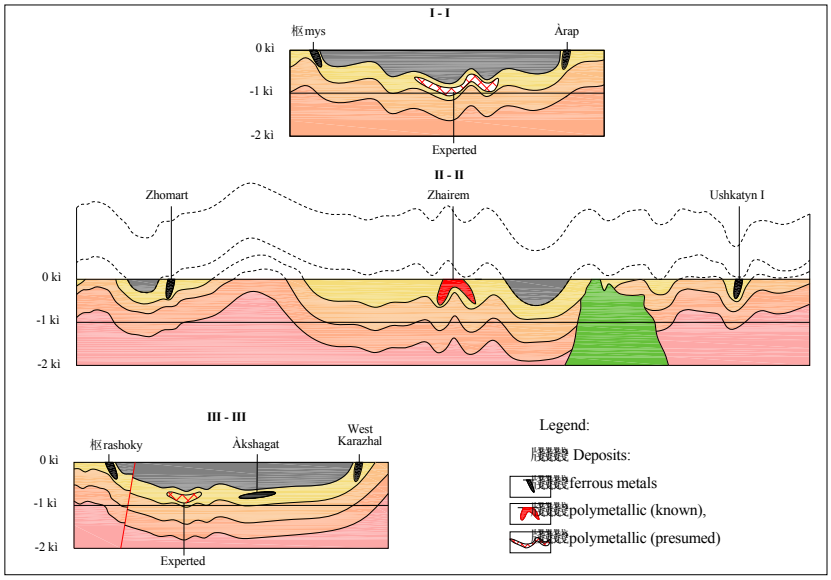
A characteristic feature of the Zhailma graben-syncline is that the iron-manganese deposits are located on both sides of the rift, and the lead-zinc deposits are on the axial part (Fig. 1). They go to the erosion slice (under the sediments), due to which they have become available for exploration and exploration by common methods (Fig. 2).

However, the main part (about 90% of the area) of ore bearing rocks of the upper famen, with the exception of the erosion “window” where the Zhairem deposit is located, covered with limestone of the lower tour with a thickness in the axial part of the rift up to 1200 m, has not been studied because of the impossibility of unambiguous interpretation of the deep structure methods used at the end of the last century.



1. Lower Carboniferous - limestones, mudstones, sandstones; 2. Famennian Stage - limestones, clay-siliceous carbonate rocks with layers of ferromanganese and barite-polymetallic ores, tuffs, tuffites; 3. Darin suite of Devonian - red conglomerates, sandstones, siltstones, lenses of trachidaceous porphyrites; 4. Lower - Middle Devonian - terrigenous-volcanogenic deposits; 5. Lower Paleozoic - metamorphosed volcanogenic-terrigenous deposits; 6. granites of the upper Permian; 7. Devonian granitoids; 8. gabbro-diabases; 9. discontinuous faults; 10. 18-stratiform volcanogenic-sedimentary deposits (Atasui type): 10. iron ore - small; 11. 13-manganese ore: 11. - large, 12. medium, 13. small; 14. 16-ferromanganese: 14 - large, 15. medium, 16. small; 17. 18 - barite-polymetallic: 17 - large, 18. medium; 19. deposits being developed; 20. cutting line; 21. area of possible localization of barite-polymetallic deposits of the Carboniferous deposits.

Fig. 1 Schematic geological map of Zhaiylma graben syncline.



22. ferrous metals and 23. polymetals (known), 24. polymetals (expected). The map shows: 1. Kartobay, 2. Kamys, 3. Arap, 4. Ushkatyn I, 5. Ushkatyn III, 6. Zhairem, 7. Keregetas, 8. Kentobe, 9. Tamara, 10 . Zhomart, 11. Akkuduk, 12. Altynshoky, 13. Karaoi, 14. Akshagat, 15. West Karazhal, 16. East Karazhal, 17. Bolshaya Ktay, 18. Karashoky; 19. Klych.

Fig. 2 Schematic geological sections by lines: I-I, II-II, III-III.

It should also be noted, and this is especially important for search criteria — uneven concentration of magnetite in hematite ore. In the ores of deposits confined to the rift flanks, in the quantitative ratios of magnetite is much more than in the deposits in the axial part [3]. This ratio of iron minerals in ores led to the discovery of all “side-by-side” deposits of magnetic anomalies, and the Zhairem deposit, located in the axial part of the graben-syncline far from the sides, was not marked by magnetic prospecting; it is open gravity survey. This was also facilitated by its location near the day surface in an erosion "window". Integration of methods of magnetic exploration and gravity exploration with high-frequency ore seismic exploration in order to search for deep-seated deposits did not give the desired effect due to the powerful cover of loose Cenozoic deposits [4].

The marked pattern of distribution of iron minerals are, in our opinion, a consequence of the thermodynamic effect of dislocation metamorphisms on them Orphism arising in the process of orogenesis, where it manifests itself more strongly on the sides of the rift structure or in the joints of faults, rather than in the blocks located far from them. This led to the transformation of hematite into magnetite and the formation of rich ore pillars in the ore fields of similar deposits of polymetals Akzhal and Uzunzhal (Kaskaaygyr, Zhunda) and manganese Zhezdy (Naizatas). At the same time, the quantitative ratio of these minerals depends on the intensity of metamorphism, the depth of the ore object and the chemical composition of the ore-bearing rocks.

Searches by magnetic survey methods that led to the discovery of all near-surface deposits and one deep-lying Akshagat iron ore deposit within the Zheilminskaya graben syncline are not effective for detecting deep-seated of the Zhairem type deposits due to the impossibility of breaking up weak gravitational and magnetic anomalies as ore or pedigree.

4. Conclusion

To search for deposits of polymetals under the Lower Tournai deposits, which cover the Upper-Famennian ore-bearing rocks throughout the entire area of the Zhailma graben-syncline, it is necessary to apply modern technologies in order to study the spatial structure and accurately predict the desired objects. These include aerogeophysical studies, namely:

- electromagnetic survey by the WTEM system in the class of transient processes in combination with high-precision magnetic gradiometry to study the spatial structure of the anomalous magnetic field and geoelectric sections of known fields and establish a search “image” for them to predict according to the obtained characteristics similar objects on the whole area;
- ZTEM audio magnetotelluric method in combination with aero-gravimetric gradiometry for structures spatial mapping to a depth of 1-2 km and localizing sources of anomalies for the purpose of targeted drilling.

The use of these methods, combined with the results of previous geological exploration, will undoubtedly lead to the discovery of large deposits like Zhairem within the limits of the Zhailma graben-syncline and multiple expansion of the mineral resource base and improvement of the investment climate in the region.

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