PREDICTING MUNICIPAL SOLID WASTE GENERATION IN ANDORRA WITH SYSTEM DYNAMICS MODELLING

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OUTLINE

1. INTRODUCTION

   - Modelling MSW generation
   - State of Art
   - Study case context: Andorra

2. METHODOLOGY

3. RESULTS

   - Scenarios

4. CONCLUSIONS

1. MODELLING MSW GENERATION

Why? - Utility

- Waste management planning

- To achieve accurate and reliable waste information

    -Municipal waste collection system

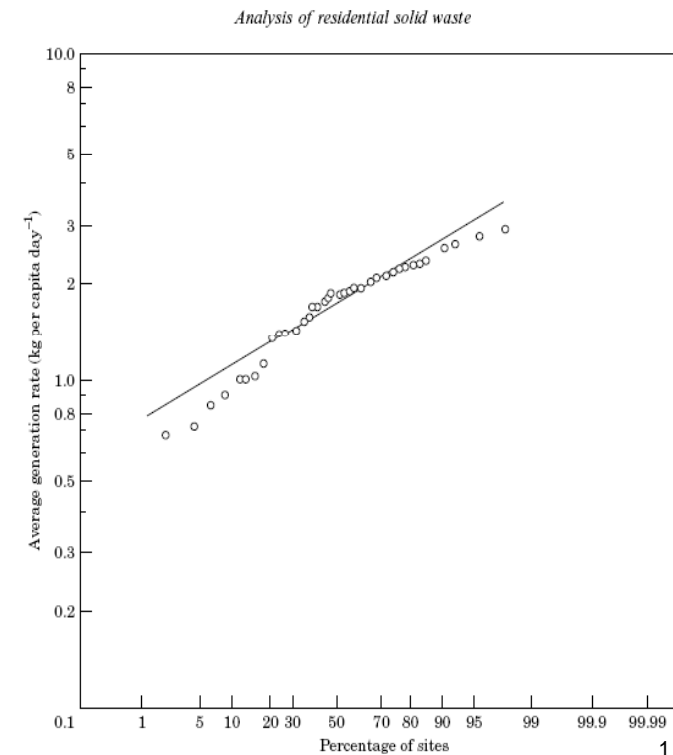   -Land demand for landfilling waste

    - Incinerators capacity evaluation

1. MODELLING MSW GENERATION

Traditional statistical forecasting methods

- Time analysis correlation

- Regression analysis

Analysis of residential solid waste

High quantity and quality data required

1. H. A. Abu Qdais, M. F. Hamoda, J. Newham. "Analysis of Residential Solid Waste at Generation Sites". *Waste Management & Research. Vol. 15.* **pp. 395-405**, **(1997).**

1. MODELLING MSW GENERATION

System Dynamics Modelling

- Fuzzy, not-well defined environments

- Limited data

- Large-scale complex systems

- Causal loops

1. MODELLING MSW GENERATION

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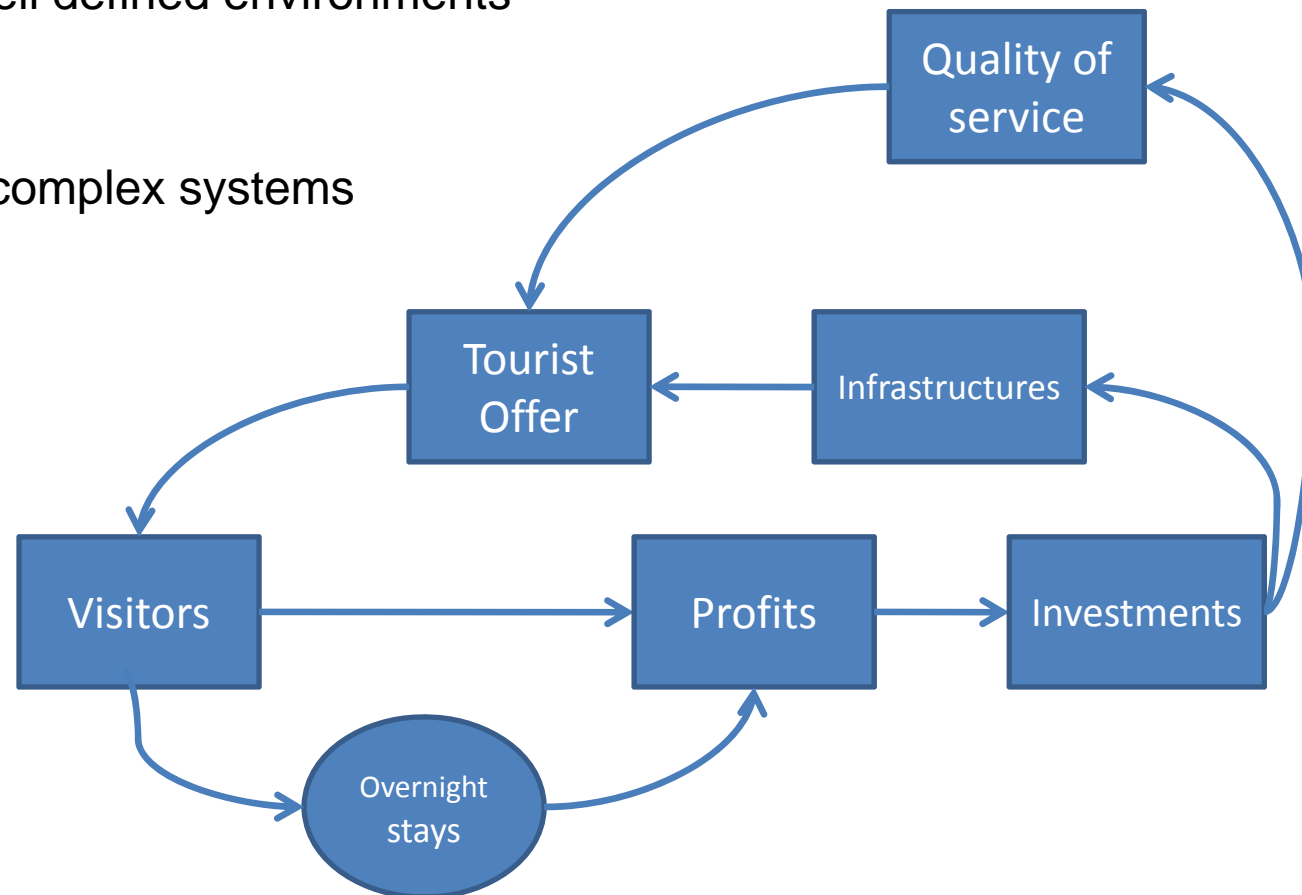
SD Modelling examples

MSW generation in San Antonio [1]

Waste generation, collection
capacity and electricity in Dhaka [2]
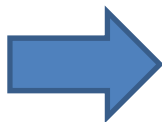
➡ **Based on economic and demographic information**

1.Dyson, B., Chang, N.-B., "Forecasting municipal solid waste generation in a fast-growing urban region with system dynamics modeling." *Waste Management 25 (7),* **669-679**, (**2005**).

2. Sufian, M.A., Bala B.K., "Modeling of urban solid waste management system: The case of Dhaka city." *Waste Management, 27(7),* **858-868,** (**2007).**

1. CASE STUDY CONTEXT - ANDORRA

Independent Principality

Population: 84.484 inhabitants

Area: 468 km^2

Pyrenees

Tourism main economic activity

10.193.749 visitors in 2008

1. CASE STUDY CONTEXT - ANDORRA
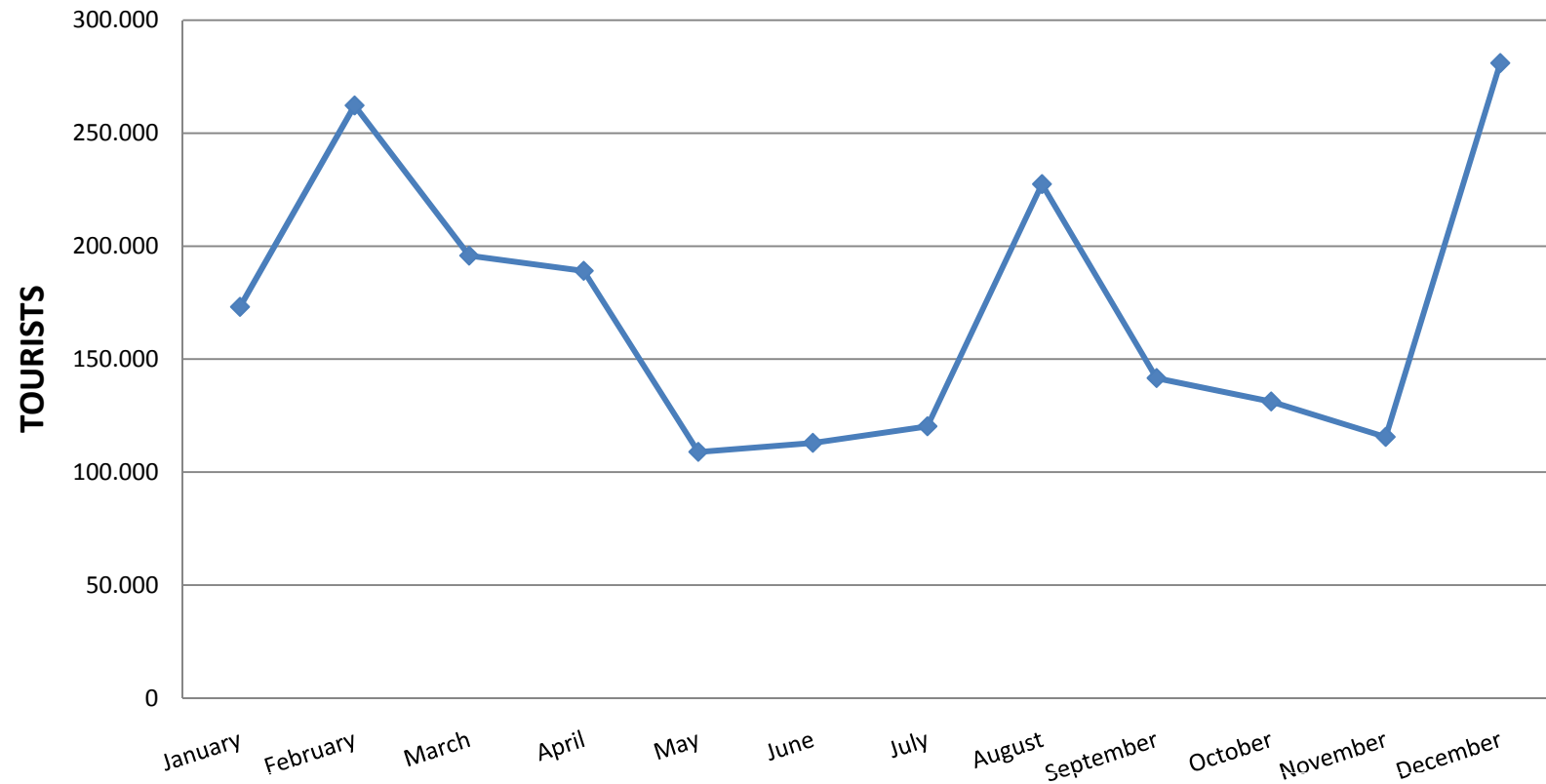
Data source: Tourism Department of Andorran Government

1. CASE STUDY CONTEXT - ANDORRA

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MSW kg/person/day
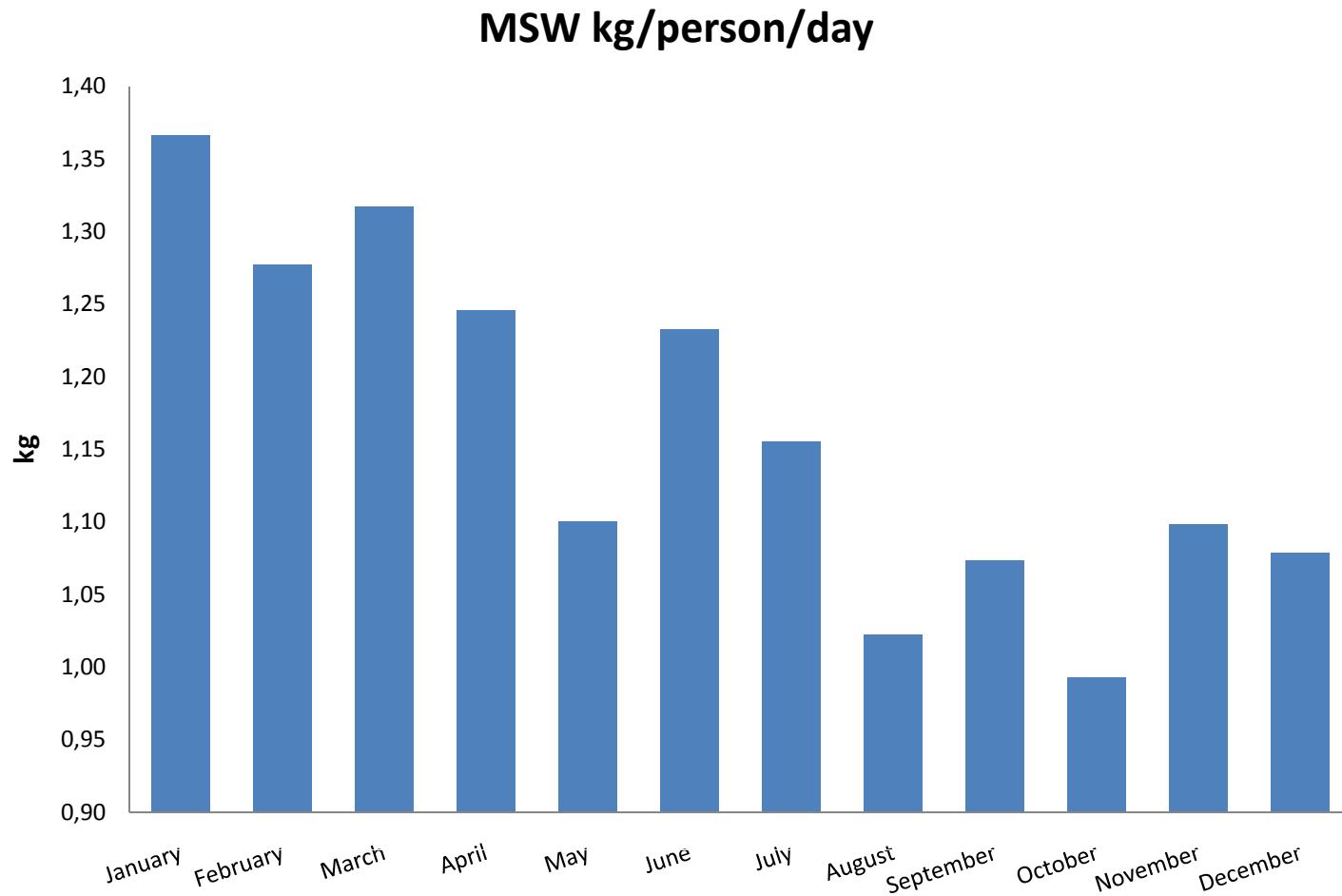
Data source: Environmental Department of Andorran Government

1. MSW GENERATION ON TOURISTIC AREAS

Balearic Islands:

MSW Generation /person /day

Winter ➡ 1,5 kg

Summer ➡ 2,5 kg

1. MSW GENERATION ON TOURISTIC AREAS

TORREVIEJA URBAN WASTE 2001 [1]
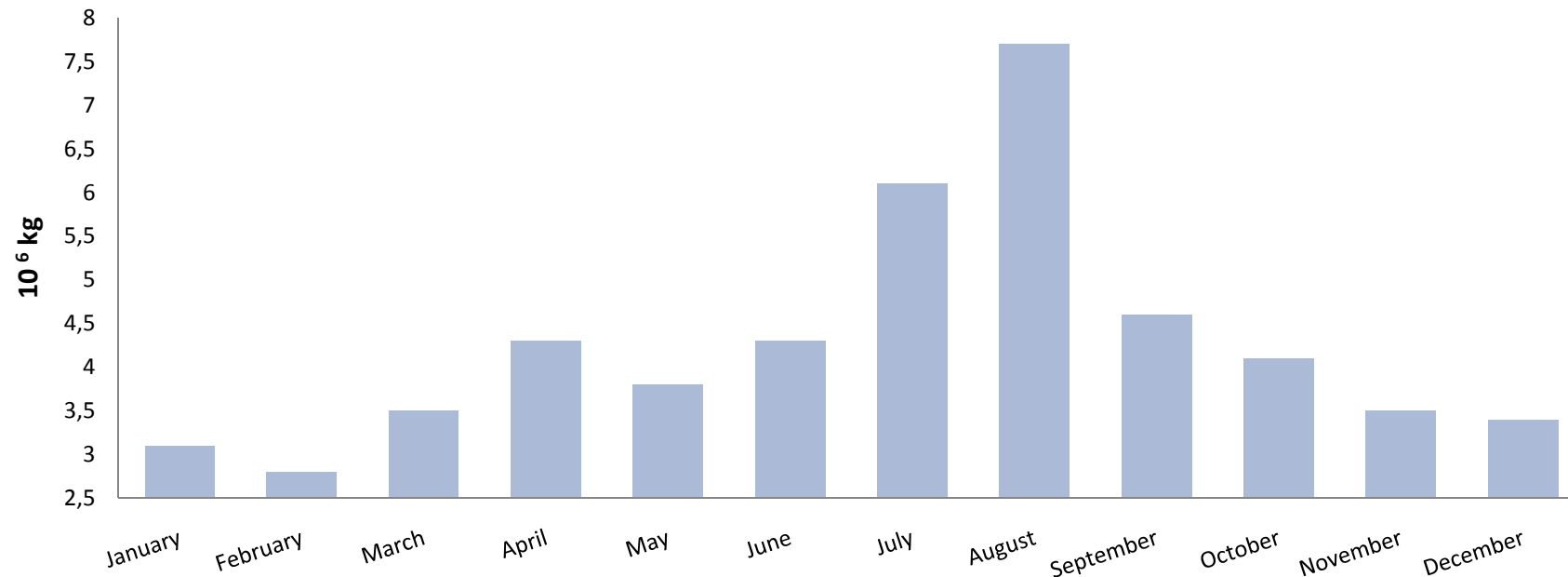
High impact of visitors flows on waste generation

Lack of models integrating visitors influence

1. J.F. Vera Rebollo and J.A. Ivars Baidal, "Measuring Sustainability in a Mass Tourist Destination: Pressures, Perceptions and Policy Responses in Torrevieja, Spain." *Journal of Sustainable Tourism, **11, 181-203, (2003).***

2. METHODOLOGY

Model tackling with:

- Data scarcity

- Importance of visitors flows
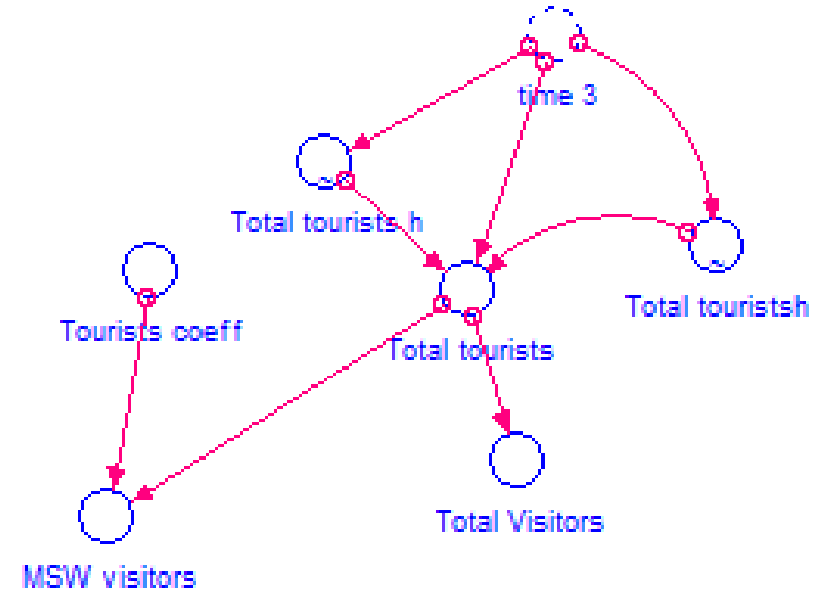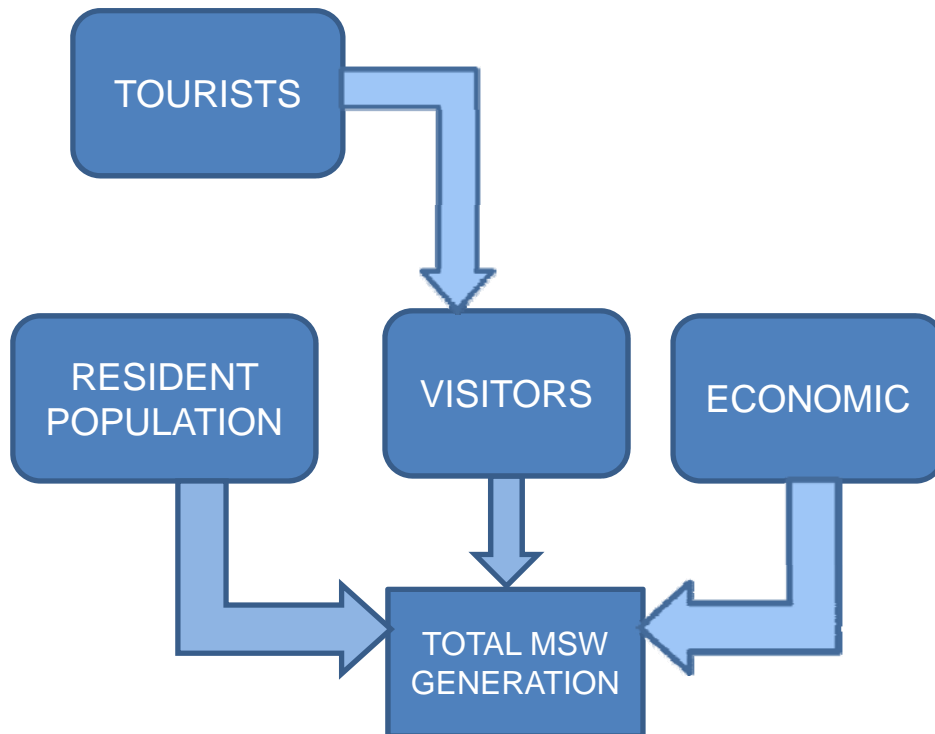
SD based on:

- Economic
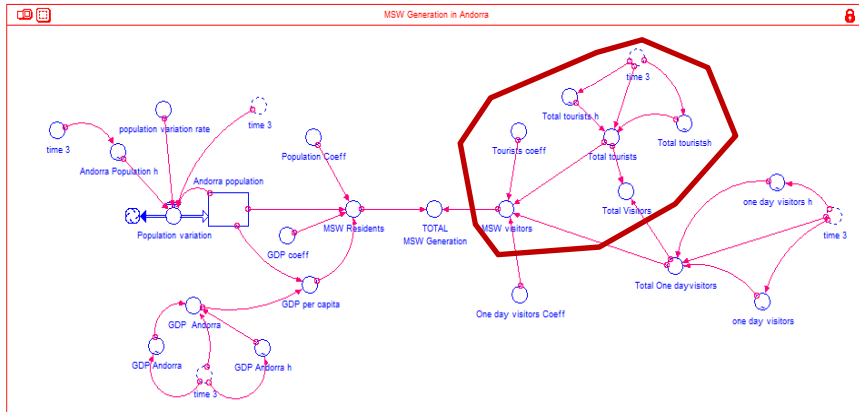
- Demographic

- Visitors flows
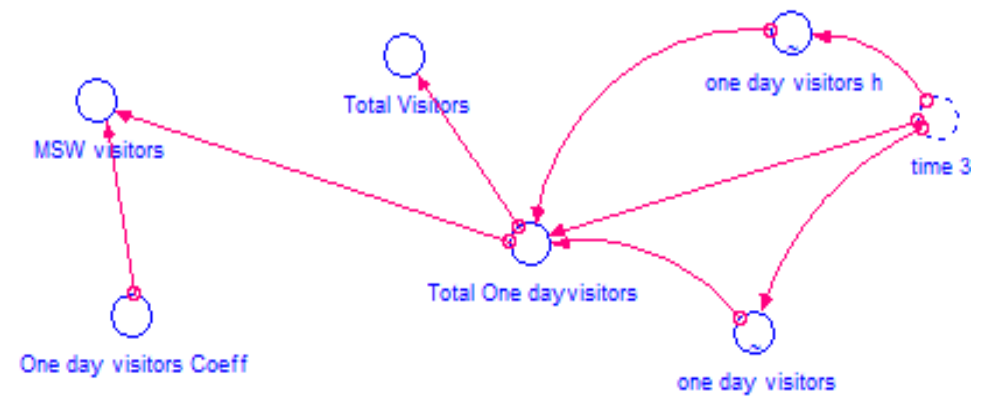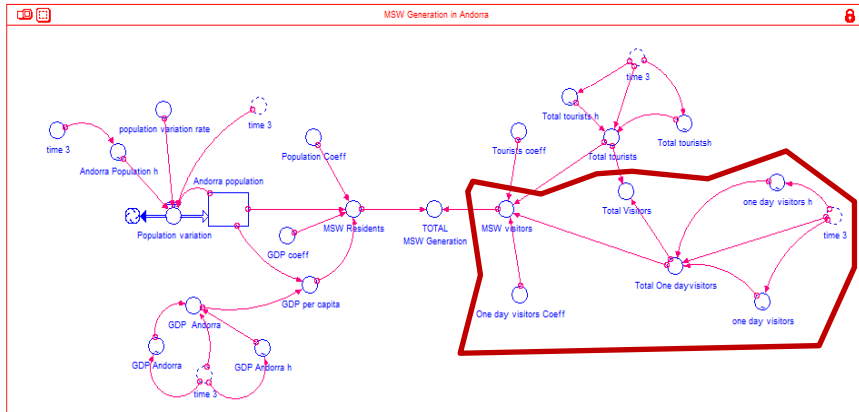
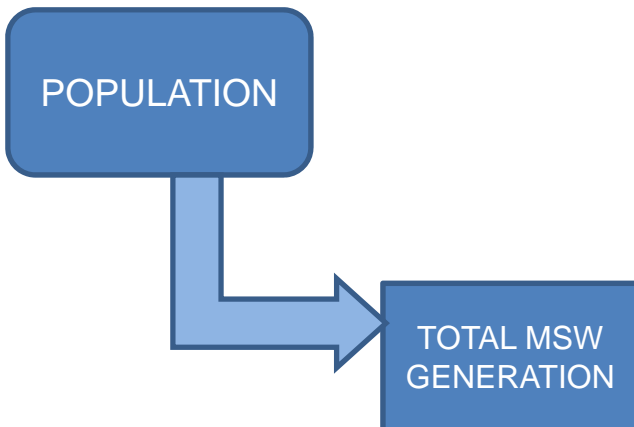# 2. METHODOLOGY: DYNAMICS SYSTEMS MODEL
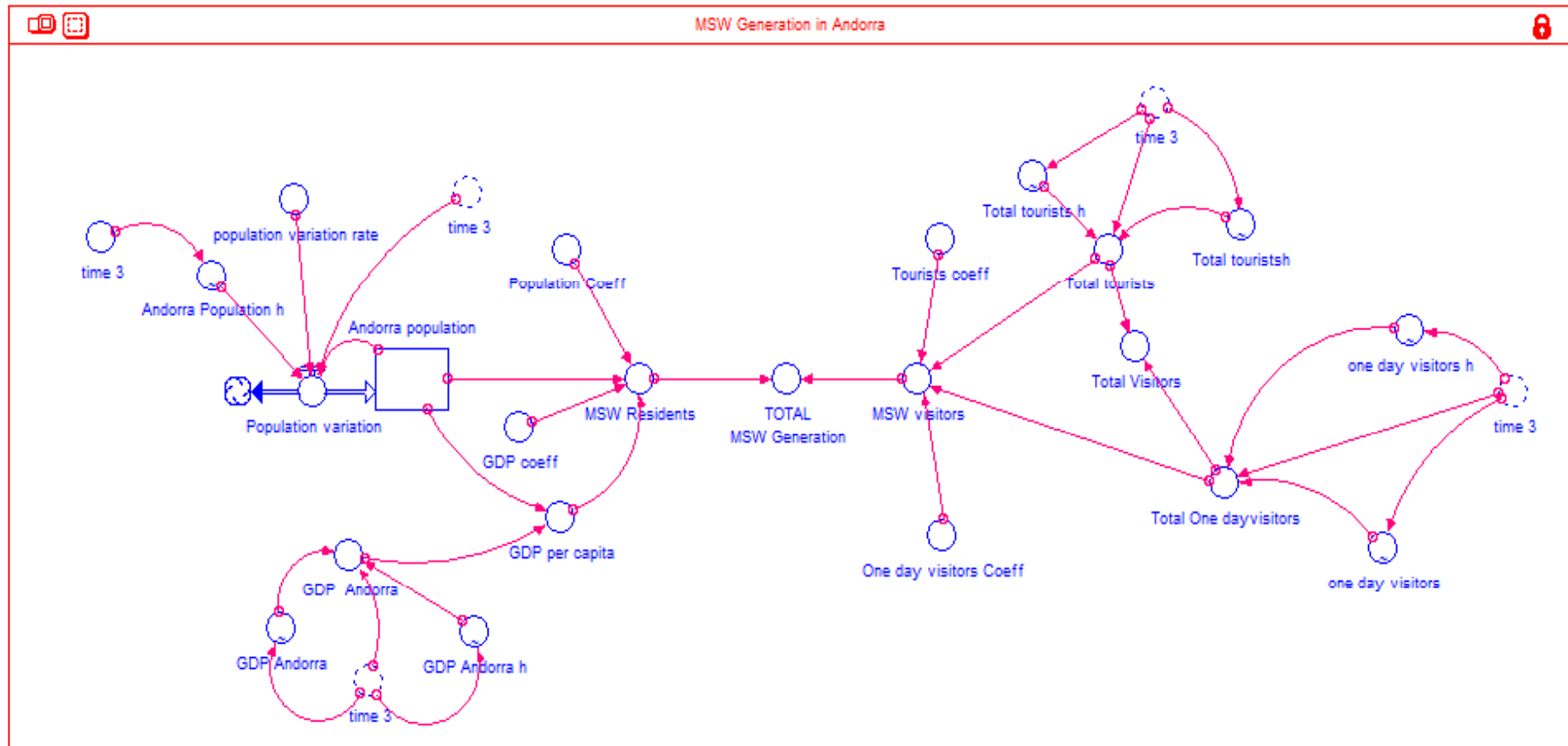
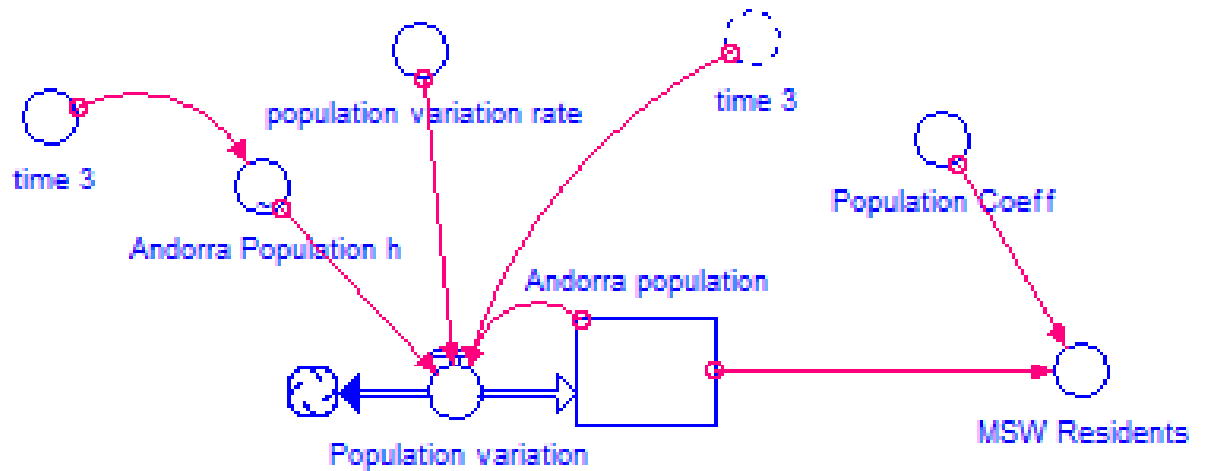# 2. METHODOLOGY: POPULATION
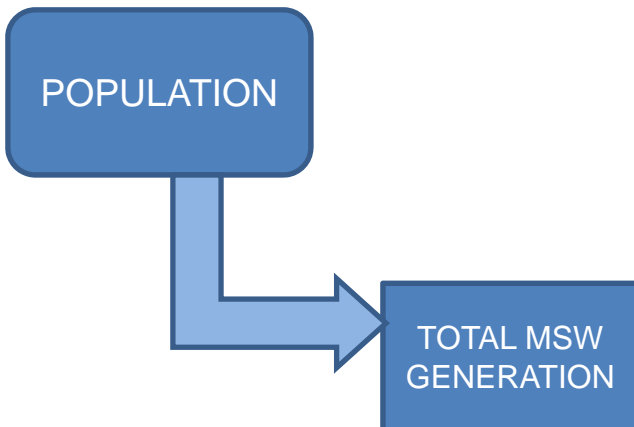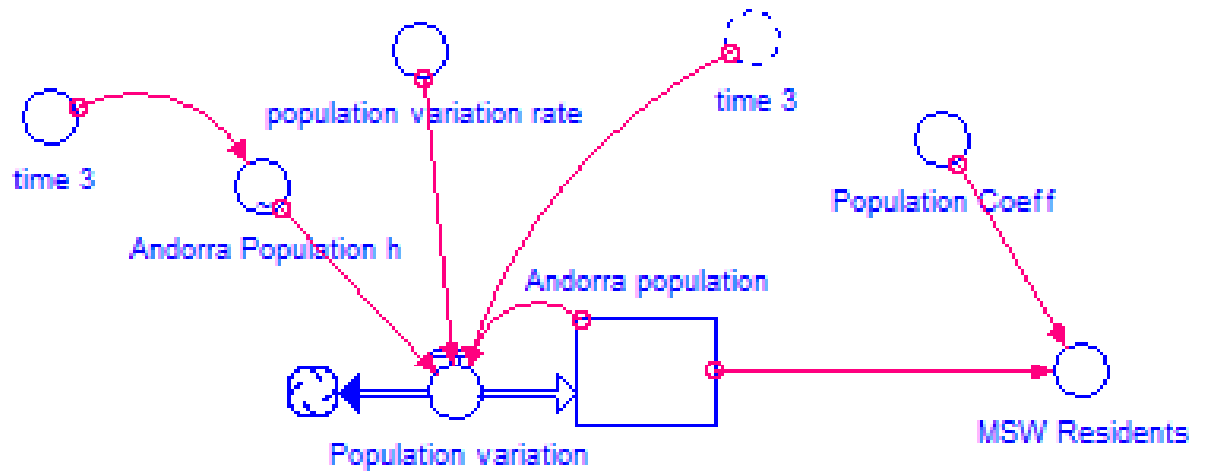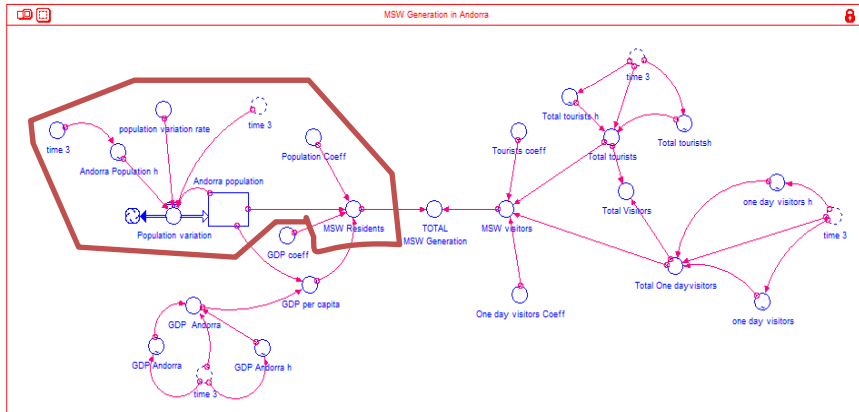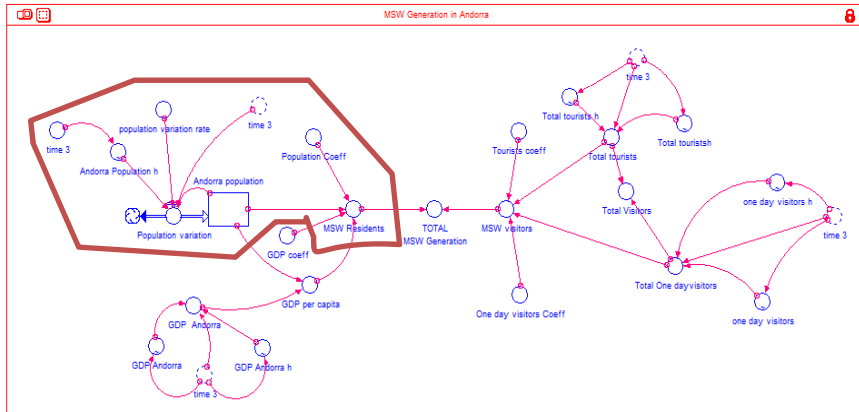
2. METHODOLOGY: GDP
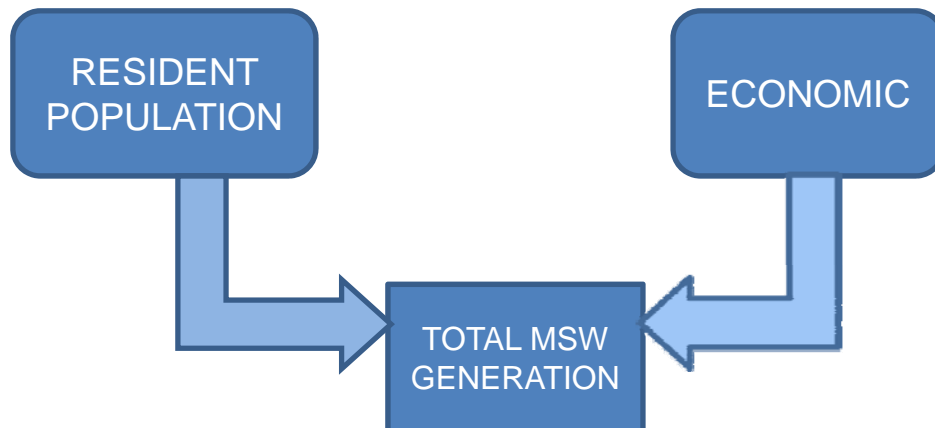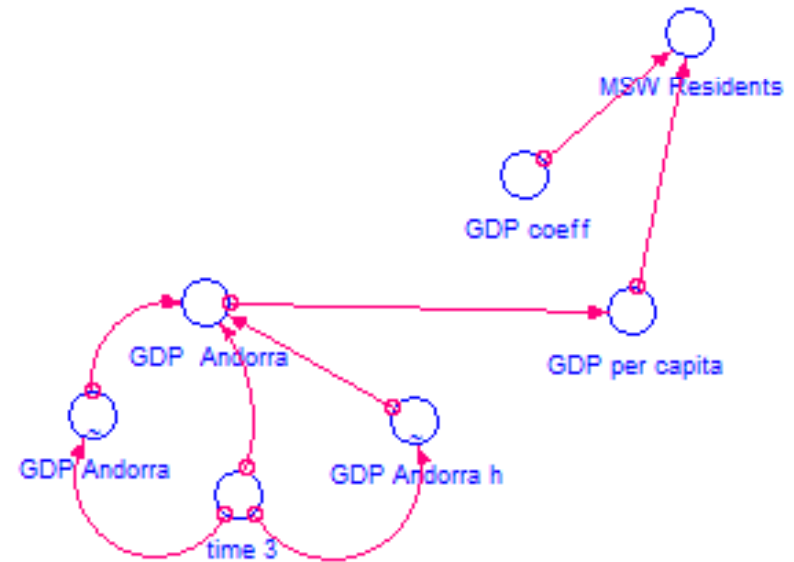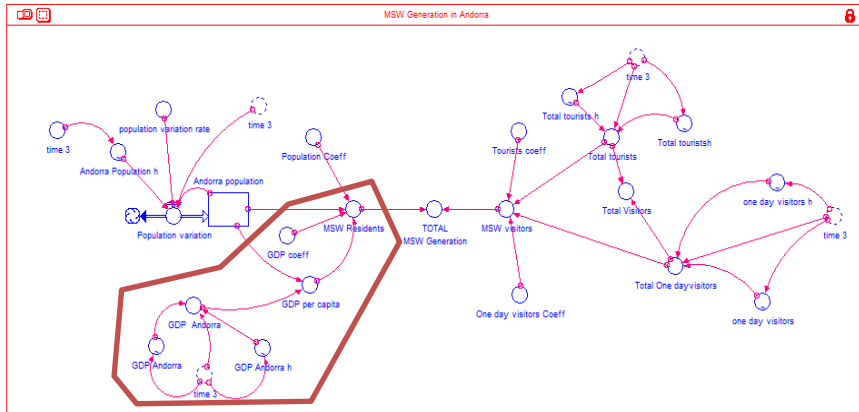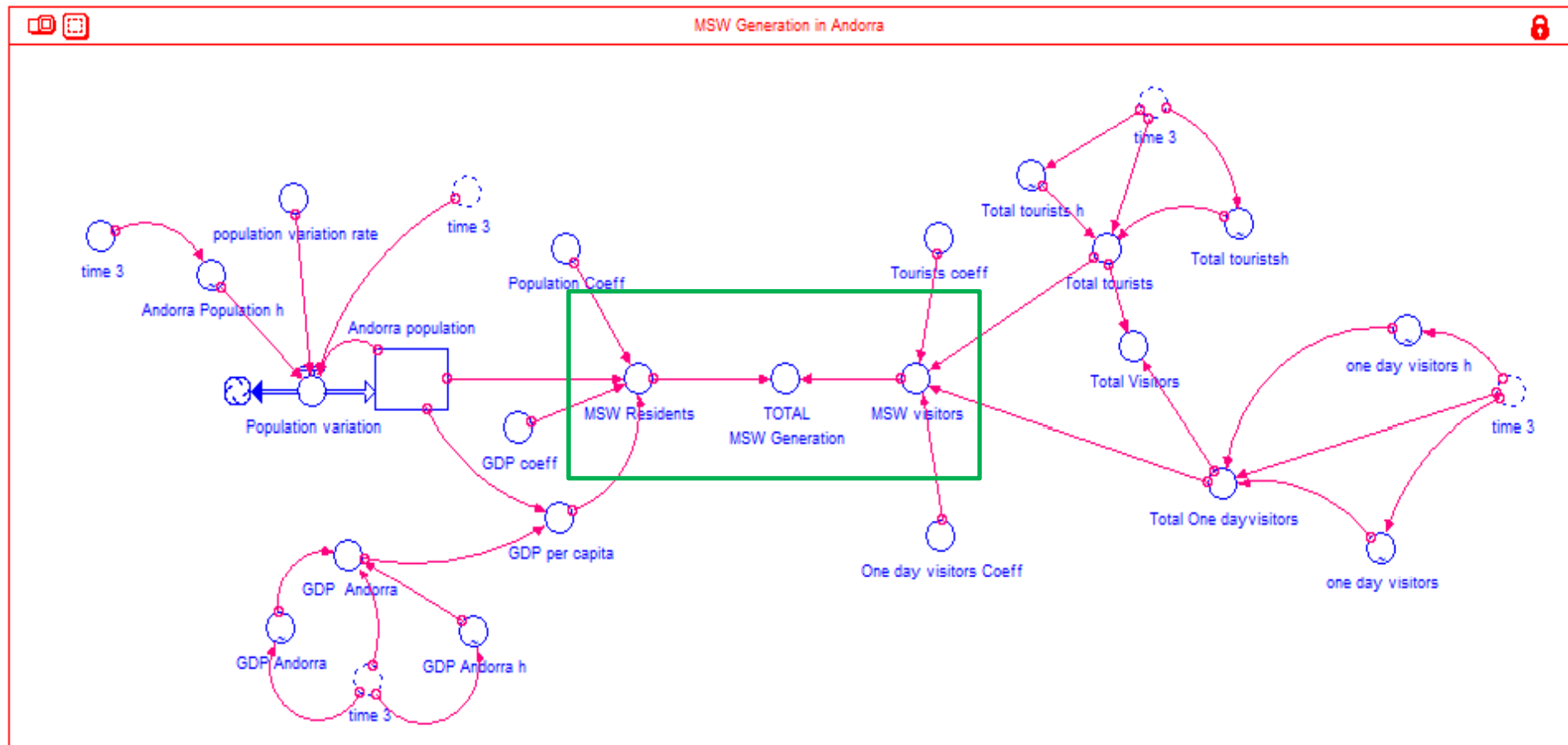
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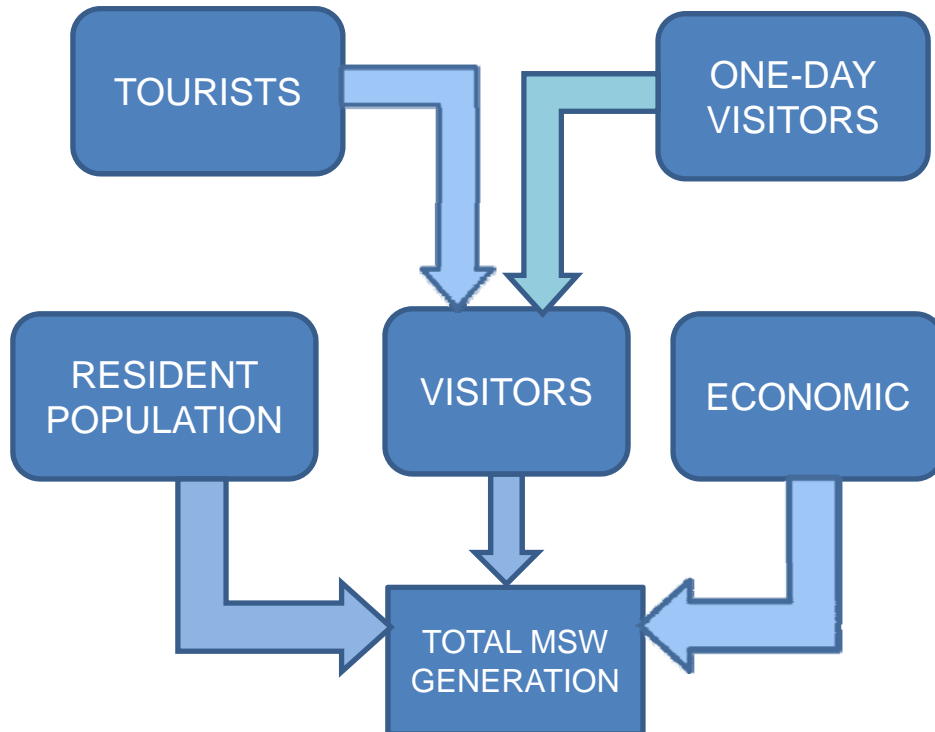
2. METHODOLOGY: POPULATION

2. METHODOLOGY: DYNAMICS SYSTEMS MODEL

3. RESULTS: SCENARIOS

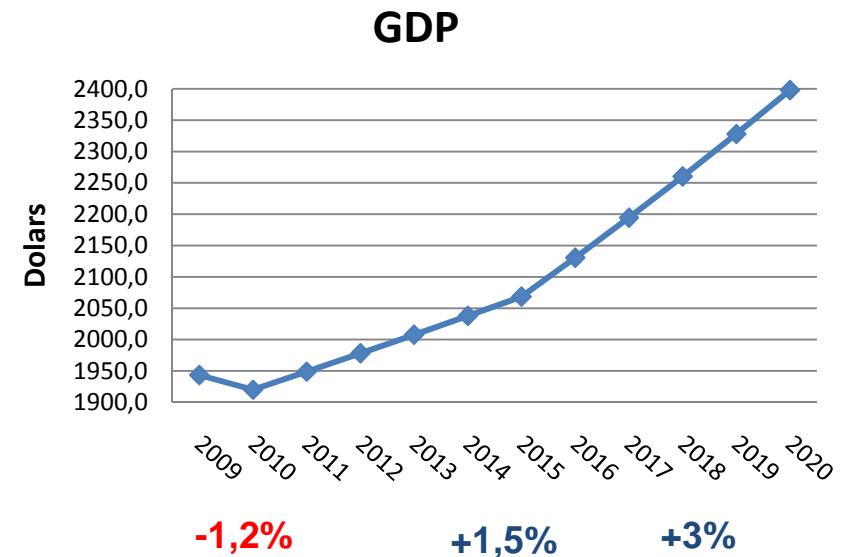# AS USUAL SCENARIO

HYPOTHESIS:

Annual variation rate of variables

POPULATION ➡ + 1 %

GDP

TOURISTS ➡ - 1,7 %

ONE DAY VISITORS

➡ - 1,3 %

GDP

-1,2%   **+1,5%**   **+3%**

4. CONCLUSIONS

- SD Model integrating demographic and economic parameters as well as tourist flows

- Correlation between visitor flows and MSW generation

- Compulsory when studying tourist destinations

FURTHER WORK

- To validate the model

- To model the recovering energy capacity

- To collaborate with local administrations

ACKNOWLEDGEMENTS

for their collaboration

for a fellowship

and   **ALL OF YOU FOR YOUR ATTENTION!!**