For office use only	Team Control Number	For office use only
T1 _____	**1903455**	F1 _____
T2 _____		F2 _____
T3 _____	Problem Chosen	F3 _____
T4 _____	**E**	F4 _____

2019

MCM/ICM

Summary Sheet

Ecosystem services matters! Sustainability is necessary

Ecosystem services(ES) are the conditions and processes through which natural ecosystems and the species that make them up, sustain and fulfil human life (Daily, 1997). However, whenever humans alter the ecosystem, we potentially limit or remove ecosystem services. The impact of these projects of varying sizes may seem negligible to the total ability of the biosphere's functioning potential, cumulatively they are directly impacting the biodiversity and causing environmental degradation. In order to understand the true economic costs of land use projects and propose sustainable development factor, we establish an Ecological Services Valuation Model.

To begin with, in order to measure the impact of ES numerically, we introduce MA classification method to make up the **ecosystem services index(ESI)**. Furthermore, 11 indicators are selected from four aspects primarily, and then they are integrated into ESI by using entropy weight method (EWM) and coefficient of variation method (CVM). In addition, hierarchical clustering analysis(HCA) is applied to divide the ecosystem service intensity of the project into three categories: **weak**, **moderate** and **strong**. As a result, we found that private enterprise relocation project and house construction belongs to weak, factory construction project is determined to be moderate and national pipeline engineering has strong ecosystem service intensity.

Next, to calculate the true economic cost of land use projects, an **Ecological Services Valuation Model** is established. First, we analyze the impact of original cost on ES when the cost of ES is not taken into account. Then, we analyze the benefit and cost of land use project, on this basis, we find that the cost of ES has an important influence to the life cycle of a project. We also use **support vector machine** (SVM) to forecast the benefit-cost ratio of land use, the result shows that considering the cost of ES of project has the accumulation of a long life cycle and high efficiency. For private enterprise relocation project, without considering ES, we calculate that it reaches the maximum benefit-cost ratio **in 2013**, and predict that it will stop making profits **in 2033**. When ES is taken into account, the cost-benefit ratio of land use projects will gradually **increase**.

At last, for the sake of exploring the impact of sustainable development measures on ecosystem benefits, we divide the 11 three-level indicators into two categories: sustainable development indicators and unsustainable development indicators. After that, we introduce **sustainable development factors** θ to describe the impact of different ecosystem service measures on the final development status of projects. Eventually, the values of θ for four different size projects are $\mathbf{P_A=87.31}$, $\mathbf{P_B=88.4}$, $\mathbf{P_C=101.4}$, $\mathbf{P_D=11.98}$, it is obvious that θ increases as the size of the project increases.

To conclude, We first construct the ecosystem service system, establish the Ecological Services Valuation Model and conduct the cost benefit analysis to four projects of varying sizes. What's more, introduce the sustainable development factor to evaluate the development of land use projects and propose our suggestion for developing land use projects.

Key words: Ecosystem services, ESVM, SVM, sustainable development