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Master's Thesis

**FECES STANDARD MONEY: BEYOND  
TRANSACTIONS**

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2020

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submitted to the Graduate School of UNIST  
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requirements for the degree of  
Master of Science

Nyamador Jonas Akorm Mawuli Kwame

12. 17. 2019

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# FECES STANDARD MONEY: BEYOND TRANSACTIONS

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## ABSTRACT

Feces Standard Money (fSM), is a complementary currency that is different from other currencies in a number of ways. It is the first currency to adopt feces as its standard. In a world where objects and people are thought of as "goods and services," reality is compressed into conceptions of "use value" or "utility". However, in the fSM system, feces and food waste that have traditionally and culturally been classified as "human waste" are used to produce biogas, creating value. Feces then becomes a representation of a new conception of value - one based on abundance instead of scarcity.

This study aims to explore how the use of fSM can facilitate a redefinition of sustainable wealth. It begins by exploring neoclassical and modern theories of money and their relationship to the current state of money. It argues that economics' failure to adequately account for the role of money as a basis of social relations contributes to the current unsustainable economic system. Building on the background and philosophical underpinnings of fSM, it postulates that money based on a feces standard might be a possible solution to developing a monetary system that can serve as the basis of social relations and facilitation of exchange as a means of instigating social change in attitudes towards global challenges like inequality and climate change. Social network analysis is used to investigate the social footprint of fSM in a game simulation of the fSM system. It is found that the mechanisms of fSM has the potential to imbue the network with tight knit connections -knots- that can contribute to a more inclusive monetary system.



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# 1 INTRODUCTION

## 1.1 MOTIVATION

We begin the discussion by exploring the origin of the value embodied by fSM. We argue that the basis of this value is the feces standard; a unit of account that aims to trigger a fundamental psychological change in the perception of money. In particular, we argue that modern economics' inability to account for social relations in its postulations about money calls for the need for an alternative definition of money- one that is based on abundance and not on scarcity. This paves the way for a conception of money that encourages exchange as a basis of social change.

### 1.1.1 MONEY

Money has been conventionally defined as a medium of exchange, a store of value or a unit of account (Mankiw 2014). Money is generally expected to play all these three functions equally. However, a critical look at some of the world's major challenges like poverty and climate change shows that there is a serious challenge to the suitability of the current conception of money to play all these roles. We postulate that adequately addressing these inherent flaws of money requires a deeper look at the conception of its role in society by modern economics.

What is money and its role in society? Turning to economics in an attempt to understand money in a social context yields surprisingly unconvincing answers. Modern economic theory defines a monetary economy, as a system to which money is created by actors within the economy to organize transactions; especially those related to production and distribution of goods and services. This is the bank-credit type of money. This definition, although true, tells us nothing about the true nature of money and why money is unpredictable and difficult to fully grasp. For instance, money from gambling winnings are treated differently from one's salary. Money earned by wives are separated from that of husbands and used differently. Money can be used to pay for services from strangers but becomes unacceptable in an intimate relationship.

The closest that economics comes to incorporating a social characteristic to money is the concept of equilibrium, a system where needs meet, and every participant realizes their wants and wishes contributing to the completion of the whole scheme while money in itself is considered neutral.

It is nonetheless evident that money is a form of social relations, a way to belong to society. Money is a signifier and can be considered another form of language (Aglietta 2018). It embodies a meaning for

all who utilize it. It serves as the signifier of value. Aglietta describes value as the “abstract space of measurement in which the diverse activities that take place within a human group can be exchanged”. At the core of all these transactions is the connections that money creates whether temporary or permanent through exchanges that it facilitates. Money takes away the lack of trust between strangers and allows them to transact in a space devoid of fear. From the meaning we attach to money we are able to gain insights into the relationships between two individuals; what we believe is commendable or deplorable, our biases and what we classify as valuable or unnecessary.

Why has the central and dominant theories of modern economics struggled to find a place for the social aspect of money in their narratives? An answer proposed by (Ingham 1996) is that the social bond and its implications is difficult to measure. Social Bond theory is described as “Elements of social bonding which include attachment to families, commitment to social norms and institutions (school, employment), involvement in activities, and the belief that these things are important” (Hirschi and Stark 1969). Additionally, the external characteristics that are apparent and manifested in the way that money is conceived and used are rooted in internal psychological and emotional characteristics that are challenging to quantify. A proposed argument is that the intense and complex emotional charge that money can engender stems from the role that money has, not so much in the external world, but in a primarily internal economy ruled by unconscious fantasy, where every external transaction has an internal, emotional counterpart, whose impact is mysterious, deep, and far reaching (Carrington 2014). Furthermore, money and the distribution of wealth has always been deeply political, and it cannot be reduced to purely economic mechanisms. If economics does not account for the social aspect of money in its postulations, then how does it explain the origins of prices and valuation?

## **1.1.2 ECONOMICS OF MONEY**

### *1.1.2.1 PURE THEORY OF MARKET ECONOMICS*

According to the pure theory of market economics money plays no role in the formation of the equilibrium price system on which economics and exchange is built. It alludes to a common nature of goods – a nature that allows them to be considered equivalent when they are exchanged. Thus, value is embodied by the “utility-scarcity” frame. Leon Walras theorizes that material and immaterial goods are important to people but are only available in limited quantities hence it is the scarcity of these goods that brings value (Walras 2013). An emphasis is placed on the nature of goods and not on the nature of money in this postulation of value. Walrus by making these observations described a way of creating wealth through value. People want things and things are scarce so by providing these things to them one can get what he or she wants in return. Here Walrus once again makes no mention of the role of social relations in creating value. Based on his prior description of value he had made the connection that value is analogous to scarcity. It is surprising that the neoclassical economists insisted on the

independence of money and social relationships in the context of valuation. This definition was ultimately an attempt to render pure economics autonomous from social relations enabling economists to study markets on the basis of principles analogous to those of the physical sciences (Aglietta 2018).

Ultimately, this definition of value became the basis of the capitalist system. For much of the last century it was one of two major approaches to economic organization. Capitalism is often described as an economic system in which private entities own the means of production and operate them for profit based on their own self interests. The free market is the perfect representation of a capitalist system where actors are unrestrained in the manner in which they undertake their activities (Baumol 2002). They are free to choose what activities to engage in, what to produce and exchange and the prices to charge or pay during an exchange. Capitalism is now the backbone of the current economic system and hence wealth creation.

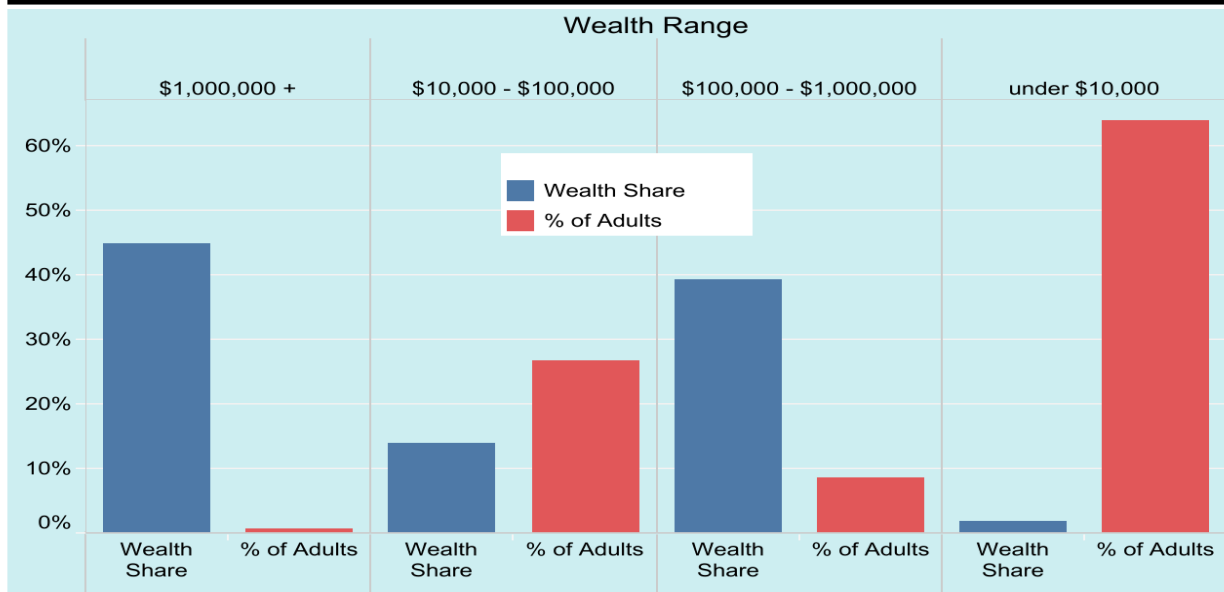
#### 1.1.2.2 WEALTH

A major consequence of the theory of utility-scarcity is the notion that collective wealth adds up to a finite amount. That the financial and natural assets present are scarce and hence the main source of worry should be how to distribute it so that everyone gets a slice of this small pie.

It is important to note that all wealth is created by a society not by individuals. Producers of cement still need good roads built to deliver them to construction companies. One of the main pillars of creating wealth in today's financial system is the banks. We consider the banks to be safe havens for money. They in turn use this money to give out loans to others and some of the interest accrued from these loans are paid out to us. We receive monthly statements that convince us of this fact. The main issues with wealth based on fiat money is that it is rooted in the notion of utility-scarcity. This is evident in the wealth inequality we experience today, the richest 1% own a whopping 45% of the world's wealth (Figure 1). This calls for the need for a redefinition of wealth. One that works for all.

### The Richest 1% Own 45% of the World's Wealth

Global adult population and share of total wealth by wealth group, 2018



Source: Credit Suisse, Global Wealth Databook, 2018

Figure 1 Global adult population and share of total wealth by wealth group, 2018

#### 1.1.2.2.1 REDEFINING WEALTH

In *Creating wealth: growing local economies with local currencies*, wealth is defined simply as prosperity or well-being (Hallsmith and Lietaer 2011). Although this can be considered akin to the notion of utility maximization, it looks at wealth on the principle of obtaining well-being not in the conventional sense of doing so by acquiring financial assets. It means meeting the needs of individual's so that they also feel a sense of well-being. Not just the basic needs like food and water, but also the need to contribute to the community, to choose what they career they want to pursue etc.

From this redefined notion of wealth, we can begin the process of mapping out a path to sustainable wealth. Wealth that is created for and shared by all.

To create sustainable wealth, one needs to first understand the needs of the community. These include the social needs, cultural, economic, environmental, infrastructural needs that contribute to overall wellbeing of a community. Lietaer describes social needs as needs that can met by having a sense of belonging in the community. These include supportive relationships, network of friends that we can rely on and a sense that we have a purpose and can contribute to the community. When these systems are in place, individuals feel empowered to fulfill these needs sufficiently.

Additionally, there are material needs. Manufactured products, technology and infrastructure. To meet these requires built and technological capital. These material needs are based on environmental assets that should be consumed sustainably to elongate their life cycle to ensure their availability to current and future generations. This would be considered Natural capital.

Last but not least are the economic needs for a medium of exchange through which we can co-operate, meet and exchange resources. Money serves as money of our contributions to society. In (Figure 2.) Hallsmith and Lietaer show how specific human needs relate to community assets and how they translate into capital that can used to sustainably meet those needs.

It is evident that depending on government to provide all these forms of capital to satisfy the needs of the people is not the best way forward. There is the need to foster parallel local efforts to cater to these needs.

One of many efforts is community currencies or complementary currencies.

| Human Need<br>General/Specific             | Community Asset   | Type of Capital         |
|--|---|-------------------------|
| Connectedness                              | Network of friends  | Social                  |
| Aesthetic Enjoyment                        | Arts, Theater, Music  | Cultural                |
| Human Development/<br>Knowledge and Skills | Schools, Colleges,<br>Universities, Lifelong<br>Learning Programs | Human                   |
| Material/Shelter                           | Housing   | Built and Technological |
| Clean Air/Stable<br>Climate                | Forests   | Natural                 |
| Conflict Resolution                        | Courts/Mediation  | Institutional           |
| Exchange of Goods                          | Barter  | Potential Exchange      |
| Exchange of Goods                          | Money   | Financial               |

Figure 2. Relationship between human needs, community assets and the types of capital they embody (Source: Hallsmith and Lietaer 2011)

## 1.2 COMPLEMENTARY CURRENCIES

A complementary currency (CC), also called community currency constitutes a specific unit of account that is used in addition to the official currency and has its origins from a group of agents (individuals, economic and social structures, local authorities or banks) that creates a local network with the intention of accounting or regulating exchanges of goods and services (Fare and Ahmed 2017).

CC creation and use has seen an increase in the past decade in response to current contexts of crises in the global financial system (Seyfang and Longhurst 2013). They aim at integrating sustainable local development with social integration. They are also aimed at improving new economic and monetary governance based on democratic sovereignty with society playing an active part (Michel and Hudon 2015).

At the core of CC's is the rejection of the capitalist systems, theories and practices of money creation. One major reason is that current capitalist wealth is based on debt and the repayment of credit with interest which leads to a growth economy whose limits knows no bounds. In this regard (Kennedy 1991) states: "Interest leads to compound interest. Compound interest leads to exponential growth. And exponential growth in turn wherever it cannot be transformed is unsustainable." (Kennedy 1991).

Some communities are now undertaking major efforts to create and use local currencies to boost trade and co-operation on the local scale. There is therefore a lot of work needed to categorize and differentiate them due to the significant contrasts in their objectives, design and mechanics of operation. Nonetheless some work has been done to study the impacts of CC's. (Place and Bindewald 2015) categorized the goals and objectives of these complementary currency systems and emphasized the need to appropriately evaluate CC's against their own targets and not against preconceived notions of success or ambition. Classification of the objectives of CC's has been carried out by dividing them into their meso and macro objectives by taking into account their performance criteria. (Dittmer 2013) purports that Local Exchange Trading systems (LETS) facilitate flexible measures of value. Time banks (like Ithaca hours) facilitate community building by improving local and social networks and reaching the socially excluded. They say that hour currencies do not stand out with regards to any criteria but may have some minor capacity to promote local trade. Additionally, convertible local currencies are more appealing to local businesses since it offers them access to liquidity in the case there is low circulation of the CC (Dittmer 2013). They categorize CC's into five broad social dimensions: culture, governance, economic social and environment (Table 1).



An investigation into goals and objectives of major complementary currencies shows that none of them are looking to tackle the above-mentioned flaws of money. This paves the way to take a deeper look at the complementary currency system proposed by Science Walden.

| Dimension                            | Level                            | Vision/Goal                                     | Mission/Objective   |
|--------------------------------------|----------------------------------|---|---|
| <b>Culture</b>                       | Meta                             | Societal acceptance                             | Recognition, credibility, legitimacy from (inter)- governmental institution   |
|                                      |                                  | Community                                       | Transverse cross-disciplinary integral holistic collective intelligence   |
|                                      | Macro                            | Inner/ outer sense harmony                      | Other oriented cooperation & self-oriented competition equilibrium  |
|                                      | Meso                             | Pluralism, inclusiveness, diversity, creativity | Alternative flexible libertarian measure of value   |
|                                      |                                  |   | Soft skills and hard skills design thinking   |
| Micro                                | Innovation, confidence, humility | Open questioning capacity                       |   |
| <b>Governance</b>                    | Meta                             | Participatory democracy                         | Collaborative election decision process; consent sociocracy   |
|                                      | Macro                            | Citizenship engagement recognition              | Effective stakeholder involvement stimulation   |
|                                      | Meso                             | Independent control                             | Independent quality control process   |
|                                      | Micro                            | Monetary creation as common good                | Open free code and legality   |
| <b>Economic</b>                      | Meta                             | Crisis resilience                               | Sufficient currency tool constellation: diversity inter-connexion   |
|                                      |                                  |   | Appropriate socio-environmental accountancy scheme  |
|                                      |                                  |   | Efficient externalities internalisation   |
|                                      | Macro                            | Make exchange possible                          | Unsatisfied needs meet unused resources   |
|                                      | Meso                             | Inclusive community-building                    | Income, employment and activities generation  |
|                                      |                                  |   | Financial inclusion & credit clearing & social inclusion  |
|                                      |                                  |   | Local economic actor liquidity  |
|                                      | Micro                            | Financial autonomy development                  | Turnover, sales   |
| Client loyalty                       |                                  |   |   |
| Purchasing power                     |                                  |   |   |
| Value-added                          |                                  |   |   |
| <b>Social</b>                        | Meta                             | Link share reciprocity solidarity               | Local, time and knowledge exchange  |
|                                      | Macro                            | Equity and justice                              | Public debt reduction   |
|                                      |                                  |   | Egalitarian or ethical value hierarchy  |
|                                      |                                  |   | Public services increase  |
|                                      |                                  |   | Social protection preservation  |
|                                      |                                  |   | Non-Speculative economy circulation   |
|                                      | Meso                             | Needs satisfaction                              | Informal primary livelihoods activities support   |
|                                      |                                  |   | Voluntary work valuation  |
|                                      |                                  |   | Keep wealth locally   |
|                                      | Micro                            | Cohesion cooperation sharing vector             | Value co-creation process   |
| SSE network activation               |                                  |   |   |
| Consumer-producer link reinforcement |                                  |   |   |
| <b>Environment</b>                   | Meta                             | Transition and autonomy                         | Encourage territorial community; conurbation regional development   |
|                                      | Macro                            | Eco-localization relocation                     | Incentive to attract local producer and consumer  |
|                                      | Meso                             | Ecological footprint reduction                  | Eco-citizen behaviour incentive: consumption reduction, repair, reuse, energy saving, waste recycling, biodiversity rehabilitation, organic agroforestry, water conservation, ethical banking, sustainable investment |
|                                      | Micro                            | Responsible consumption motivation              | Label network integration: Fair Trade, Organic products, Eco-friendly   |

Table 1. Goals and objectives for complementary currency systems (Source: Place et al., 2013)

## 1.3 SCIENCE WALDEN

To truly understand the origins of fSM requires a deeper look at the philosophy on which Science Walden was built. Science Walden draws from two books *Walden* by Henry David Thoreau and BF Skinners *Walden Two*. During the period of transcendentalist Henry David Thoreau's departure from communal life in an attempt to return to simple living in natural surroundings, he produced *Walden* and a host of other literary works as a part of his reflections and experiences.

First published in 1854, *Walden* chronicles Thoreau's journey over the two years, two months and two days he lived in a cabin he built near Walden pond(Thoreau 2006) . A majority of readers consider this an expression of Walden's desire to connect to nature with an end goal of self-sufficiency. While accurate, there is an underlying theme of radicalism – particularly, a break from the economic system of capitalism. Richard Povall summarizes "... Walden Thoreau's 1854 paean to Nature, is a mid-18th century hymn to personal liberation and a casting off of the restrictions and repressions of this most repressed of eras. It could be said to have helped invent the idea of Nature (with a capital N) as a noun, a thing, an object of desire. The book's reading of the natural world may be somewhat dated and idealized, but at its heart this book is not about physical landscape or ecology but about freedom, non-conformity, and rejection of an economic model seen as ignoble and leading to 'lives of quiet desperation' [dominated by] 'superfluously coarse labors of life....'<sup>1</sup>". During this period Thoreau had been arrested for non-payment of taxes as he hoped to use the jail time to raise awareness about the Mexican- American war (Cain 2000). According to the book, *A historical guide to Henry David Thoreau*, Thoreau refused to leave the jail cell even after an unidentified woman came by and paid his taxes for him." To Thoreau the essence of his experiment was to remind himself and others not to lose sense of what is most important -the human and the ecology.

In 1948 B.F Skinner wrote *Walden Two*. A utopian novel attempting to depict an achievable good life. (Altus and Morris 2004). Like Walden, he concurred that people had to take charge of the aspects of their lives that they did not like and to make efforts to change them. However, he preached against using political action since one might be less likely to do better than the people who came before. Last, he advocated for a simplification of our way of life(Skinner 1973). In *Walden Two* Skinner suggests that all organic behavior whether human, animal or other is determined by environmental variables and that by systematically altering or engineering those variables can generate a sociocultural system that recalls

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<sup>1</sup> Talk given at the Festival for Earth, Venice 2018

what we might think of as a Utopia(Skinner 1969). The world that Skinner created is sometimes labeled a dystopia but there is no denying that *Walden Two* is a major contribution to the emergence of the field of behavioral science.

Science Walden is an attempt at bridging Thoreau’s ideals of a nature-centric life and Skinners optimism and advocacy for the role science can play in the development of a community that embodies what it means to be human. A community that borders on using scientific achievement to create a perfect harmony between nature and humankind in order to facilitate shared well-being and sustainable development. Science Walden strives to create a space where, science, arts and humanities can push the boundaries of human progress. Science Walden proposes fSM as a complementary currency. A new order that emerges from interdisciplinary research to help mitigate problems from two of humanity’s greatest inventions: money and the flushing toilet. <sup>2</sup>

### **1.3.1 FECES STANDARD MONEY: BEYOND SHARING**

The social implications of money are so far reaching that it is not surprising that Science Walden’s first attempt at challenging the status quo is a medium of exchange meant to reimagine what is thought of and classified as money. Numerous attempts at reinventing money have been unsuccessful- from scrips being used in times of depressions to bitcoin as a decentralized economic system. Evidence suggests that attempts at challenging the status quo usually deviate from their initial goals, and for many reasons. Bitcoin, the latest in a series of innovations that was meant to be a panacea to financial institutions has ultimately become another financial instrument that is currently used mainly for speculation(Hanley 2013). It can be said that bitcoin as well as other cryptocurrency’s dependency on fiat currencies makes them susceptible to the same conceptions of value that current money suffers from.

Complementary currencies that are used in tandem with legal tenders have been touted as a way for local communities to share in their prosperity and facilitate sustainable development. They have the advantage of flexibility. Local currencies can be designed to suit specific needs of communities. They can also be reimaged to tackle a myriad of issues an evidenced in the creation of a signifier through the feces standard.

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<sup>2</sup><https://www.edge.org/response-detail/26660>

### 1.3.1.1 FECES STANDARD

The first known unit of account was the shekel in Mesopotamia and the shat in Egypt. In Egypt the shat was equivalent to 7.5 grams of fine gold. It is fascinating that people have always seen precious metals as a way to embody the value of money. The gold standard was the last metallic standard that was used before the global economy moved to a fiat standard.

A precise date for the start of the gold standard is not known but literature suggests that it started in the later part of the 18<sup>th</sup> century (1880-1890). Under a gold standard currency are valued in terms of their gold equivalent. Gold was a good standard in some terms because it was deflationary however gold like all other precious metals derived their value from being scarce. Once again tying into the utility-scarcity theory of value. We postulate that for a standard of money to adequately capture the fundamental quality of money, its intrinsic and extrinsic value should be accessible and naturally reproducible by all. This will allow all members of a society to participate and share in the social relations of money. I put forth a number of reasons why feces is the ideal standard for a money as a social relation:

1. Feces has extrinsic value. Humans have had an aversion to feces since it was a means of contracting diseases, was labeled unhygienic and was hence characteristically classified as waste. Nevertheless, it is a well-known fact that feces has numerous benefits. Feces is a known source of bioenergy. Ancient cultures have used feces for fertilizer and compost. Feces is also used for medicinal purposes. Fecal microbiota transplant also known as stool transplant is a process of transferring fecal bacteria from a healthy individual to a recipient. This process been shown to have high effectiveness for curing diarrhea(Garborg, Waagsbø et al. 2010)
2. It is accessible. All humans can produce some amount of feces hence feces as a standard removes valuation from a space of abstraction into a space of reality. All users have a more relatable way of valuing objects. If valuation of an item is based on how much feces an individual produces daily, then value takes on a notion of abundance as opposed to a notion of scarcity. This could be the beginning of a new age of sharing and co-operation.
3. Feces is a natural resource that can be considered a commons. The feces that we produce is a major part of biomass that is used to produce bioenergy. The commons refers to cultural and natural resources and wealth that should be protected and used for the common good (STANDING). There have been numerous mentions of water, forests and minerals as commons that should be protected. However, in no literature has feces been classified as commons. This is partly due to preconception of feces as “waste” and the penchant to characterize it as “useless” even though it makes up about 3% of global biomass supply (Figure 3a, 3b). In particular, the fact that everyone can provide more or less the same amount of feces as an energy source forms an underlying basis for the societal welfare system (Lee, Cho et al. 2016). Feces standard money can be paid as income to all people.

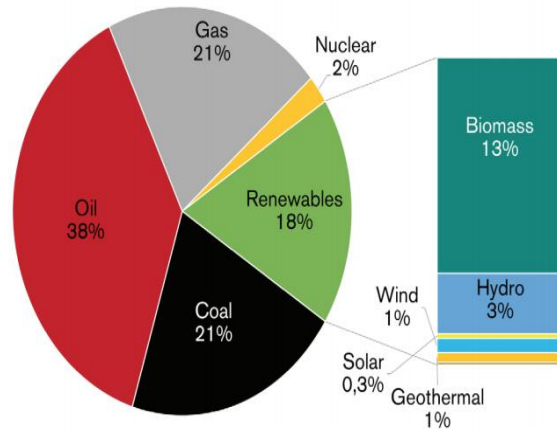


Figure 3a. Gross final energy consumption globally in 2016(All values in EJ. Source: Key World Energy Statistics)

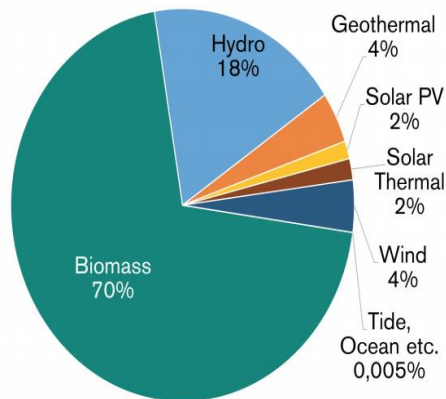


Figure 3b. Total Primary Energy Supply (Source All values in EJ. Source: IEA Key World Energy Statistics)

- It could be the nucleus to starting the change in consciousness that is needed to reduce global pollution and reduce climate change. According to the Environmental and Energy Institute “Many wastewater treatments plants (WWTP) already have on-site anaerobic digesters to treat sewage sludge; the solids separated during the treatment process. However, many WWTP do

not have the equipment to use the biogas they produce and flare it instead. Of the 1,269 wastewater treatment plants using an anaerobic digester, only around 860 use their biogas. If all the facilities that currently use anaerobic digestion—treating over 5 million gallons each day—were to install an energy recovery facility, the United States could reduce annual carbon dioxide emissions by 2.3 million metric tons—equal to the annual emissions from 430,000 passenger vehicles.”<sup>3</sup> By paying people money from their waste people might experience a level of awareness from perceptual and cognitive distortions that arise from the metaphorical contamination of their preconceptions about value and waste. Receivers of fSM could then use it to share and participate in exchange; exchange as a basis for social change. It gives a legitimate means of contributing other resources that are classified as waste- skills, talents, under-utilized and even undiscovered resources.

This exchange could be done on a platform or a marketplace where users can access different offering and also offer their skills, services and items to other members of the community.

### 1.3.1.2 fSM PLATFORM

The fSM network ([fsm.network](http://fsm.network)) is based on a virtual platform that has a broader vision to create a network of communities that embody the values of a sharing and caring economy. However, this is not only meant to be a sharing platform. The idea of fSM is to also rethink what a platform can be in order to create a space where exchange becomes a basis for social change. The fSM network currently has about four communities in South Korea and one community in India (Auroville) that are exploring the potentialities of the currency. In order for this platform to be sustainable, transaction have to be well coordinated.

A transaction can be defined as a social or economic interaction based on a single unit of account that involves the exchange of goods or services. Transactions are centered on co-operation. Adam Smith aptly summarized human tendency to co-operate in his quote “ humans have a disposition to truck, barter and exchange”(Smith 1981) . Co-operation has been the backbone of the evolution of civilization. Co-operation and sharing utilizes the fact that all humans are different with differing skill sets and resources at our disposal. Although counter-intuitive, the fact that we are different plays a huge role in our ability to share. Consider two individuals; a person could be a good chef and the other a musician. They are in a better of position when they specialize. And then by trading their shared skills through

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<sup>3</sup> <https://www.eesi.org/papers/view/fact-sheet-biogasconverting-waste-to-energy>

offering services to each other they are able to get access to their needs. To do this however requires co-operation.

Co-operation is the nucleus of the “market” under most circumstances. However, the market is not always efficient in facilitating co-operation.

One of the major barriers to co-operative exchange is the cost of transactions. Cost of a transaction is usually measured in terms of a medium of exchange. However, there is also a physical, emotional and psychological cost of transactions that are cumulatively valued in the medium of exchange.

Munger mentions three components of a transaction cost that are hard to negotiate (Munger 2018). Triangulation, Transfer and Trust. **Triangulation** is defined as information about an effective system to verify, identify, locate and agree on terms, including the price of the entity to be exchanged. **Transfer** is then defined as a method of completing payment and exchange of goods that is instant and as invisible as possible. **Trust** refers to a way of outsourcing assurance of honesty and performance of the terms of an agreement. By coordinating effectively these three components, an individual or entity can effectively foster co-operative transactions. With the advent of the sharing economy over the last decade, companies like Airbnb and Uber have created a culture of sharing and generated billions of dollars in revenue in the process. However, these facilitations are all based on the fiat currency. It is evident that in as much as these companies foster co-operation they are not accessible to people from all walks of life and ability to join and benefit from the network is dependent on financial status (Flores and Rayle 2017). With fSM, all users can participate in the network. One of the goals of Science Walden is to build a network so as to effectively incorporate these three components locally while also achieving triangulating on a global scale.

### 1.3.2 THE MECHANICS OF fSM

Feces standard money is meant to be used in parallel with other legal tenders. fSM is a virtual currency issued to users on a daily basis. All participants on this virtual platform receive a daily *basic income* endowment of 10 “ggool”. Ggool is the unit of account of fSM; Korean for Honey. In the fSM system, the representation of value creation is energy and biogas generation from feces. The Science Walden team designed a water saving toilet that produces bioenergy from feces and uses about 0.6 liters of water compared to the 4 liters that conventional toilets use. As an added feature research and source of value, research is undergoing to analyze urine and feces with the Beevi toilet (Bae and Lee 2018).

The toilet is aptly named “Beevi Toilet” represents “A Bee with a Vision”- a vision to create a happy world though ggool. Dried forms of feces generated by the toilet is fed into an anaerobic digestion bioreactor. This system has been installed in the Science Cabin at the Ulsan National Institute of Science and Technology (UNIST). The Science cabin is a convergence of science and arts center, a workspace

where artists and scientists can co-exist and co-operatively tackle problems and find innovative solutions.

Users of the Beevi Toilet also receive an additional 10 ggool every time they use the Beevi Toilet. This is termed “Human income”. The human income component refers to ggool that is earned through activities, transactions with other users and conscious contributions towards the society. The basic income is not merited but given unconditionally as a testament to the value of human life and human dignity.

### 1.3.2.1 fSM SHARING

All users are required to share 3 out of the 10 ggool received daily with other users. This is to incentivize sharing in the network and to create ties- knots- amongst individuals in the society. Members are free to share the 3 ggool with whomever they choose in the network. 3 ggool out of the human income is also expected to be shared with others. There is no restriction on the number of people users can share with. By sharing, individuals are also able to contribute towards the building of social capital in the network. When a user receives ggool from others, this ggool is considered as human income. In the case a user does not choose any friends to share with, 3 ggool is automatically deducted from their balance but not shared with anybody else in the system.

$$\text{Amount of ggool shared} = \frac{3}{\sum \text{total number of ggool friends}}$$

*Equation 1. Amount of ggool shared*

### 1.3.2.2 DEMURRAGE

Demurrage or negative interest is an economic policy where money kept in an account does not gain interest but instead depreciates. There has been instances in history when economies have used this policy to disincentivize accumulation of their currency as a store of value. The longer one holds on it the more it depreciates. Evidence suggests that demurrage contributed significantly to long periods of prosperity in Dynastic Egypt and during the Central Middle ages in Europe(Lietaer 2000). The fSM system institutes a 7% daily demurrage levy on both basic and human income. This is to increase circulation of the currency and disincentivize hoarding. Additionally, fSM is not interconvertible with any legal tenders because it embodies a different conception of value.

### 1.3.2.3 ALTRUISM

In spite of the fSM’s insightful radical take and approach to an alternative economy and money, it is still subject to the economic systems of the current times. Like any other complementary currency, it



needs to circulate and facilitate a healthy volume of economic and financial activity. If fSM strives to be a medium of exchange there has to be a pool of resources that it can facilitate exchange of.

Yet, evidence shows that despite several studies and numerous experiments, complementary currencies struggle to find success. The few successful ones include the WIR in Switzerland, Chiemgauer in Germany and Sardex in Italy (Lietaer and Hallsmith 2006).

Considering that Science Walden’s water saving toilets are only present in one institution, it is not expected that users of this platform outside of UNIST will have access to them in the near future. This leads to a monetary system based on the assumption that people can conceptualize the value of a feces Standard leading to altruism. In order to examine this assumption an experiment was carried out to hold a flea market using items that others voluntarily offered.

#### 1.3.2.4 FLOWING GGOOL

UNIST students primarily reply on social media, predominantly: Facebook and Instagram, to disseminate and share information. Information and communications technologies (ICTs) have enabled the rise of “Collaborative Consumption”: the peer-to-peer-based activity of obtaining, giving, or sharing access to goods and services, coordinated through community-based online services. Collaborative consumption has been expected to alleviate societal problems such as hyper-consumption, pollution, and poverty by lowering the cost of economic coordination within communities (Hamari, Sjöklint et al. 2016).

UNIST also has a vibrant collaborative consumption community. Students regularly use two Facebook groups: “유니스트 다반다 ” and “ 인력시장 “ to sell, buy and exchange items with each other. On average there are more 20 posts a day, about 5 of which include free items.

As a small experiment to explore user’s ability to conceptualize the value embodied by a feces standard, a series of events were held to explore the willingness of members of the community to share resources through fSM. Internal and external researchers of Science Walden were asked to contribute items that they had no use for or items that they would like to share with other members of the UNIST community towards a flea market. In an effort to understand what members of the UNIST community thought about fSM, a survey was administered on a sample of students taking the Science and Humanities class in the spring of 2018.

#### 1.3.2.4.1.1 DRAFTING THE INTERVIEW QUESTIONS

The interview questions were meant to get a general overview of the sentiments of the students around fSM. The survey was divided into two major sections. The first part solicited responses on fSM and respondents understanding of the philosophy underpinning fSM. The second was on their past participation in the UNIST collaborative consumption community and the willingness to use fSM.

##### 1.3.2.4.1.1.1 Questions

#### FECES STANDARD MONEY

- 1) *How familiar are you with fSM?*
- 2) *When you think of fSM, what comes to mind?*
- 3) *Science Walden proposes fSM as a basic income. Do you think basic income is a necessity?*
- 4) *fSM emphasizes the value maximization of under-utilized resources like feces. Do you think feces has any value?*
- 5) *What is the value of feces? (there is no standard for valuation)*

#### COLLABORATIVE CONSUMPTION

- 6) *Do you think there are other under-utilized resources whose value can be maximized?*
- 7) *What do you do with something that you own but consider to be under-utilized?*
- 8) *How often do you give items away to other students in UNIST?*
- 9) *How many items have you given away?*
- 10) *What is the biggest reason why you give things away?*
- 11) *How many items have you received for free?*
- 12) *How many items have you sold?*
- 13) *How many items have you bought?*
- 14) *Would you receive fSM in exchange for an under-utilized item?*
- 15) *Would you give fSM in exchange for an under-utilized item you receive from others?*
- 16) *Would you receive fSM in exchange for something that you want to sell?*
- 17) *What are some of the reasons why you will not use a complementary currency like fSM?*
- 18) *What are your concerns about fSM?*

## 2 EXPERIMENTAL METHOD & MATERIALS

### 2.1 SPONTANEITY GAME

As a project steeped in interdisciplinary fields Science Walden's conceptions of a complementary currency are difficult to grasp for a majority of individuals. It is based on ideas from economics, social sciences, natural sciences and even philosophy. fSM incorporates complex mechanisms, like two types of income i.e. human and basic income, depreciation (negative interest), daily sharing etc. Understandably some first-time users have expressed difficulty to grasp the workings of the entire system. A virtual game application was designed to serve as a test bed for the simulation of the fSM system. The data from the game was then analyzed to gain insights into possible scenarios of fSM use. For details on the game and rules see Supplementary notes in the appendix (Section 7.1.2.1).

### 2.2 SOCIAL NETWORK ANALYSIS

Social networks are at the core of all human interaction. All individuals are members of either a family, a tribe, a country, a club or a social circle. Even nature and culture are categorized into networks. This tendency for us to join groups and to interact in networks means that there is a plethora of information and insights that we can learn from analyzing these networks.

A generic hypothesis of network theory is that an actor's or participant's position in a network determines the constraints and opportunities that he or she will face and therefore by identifying this position we can forecast certain outcomes like behavior or beliefs. (Borgatti, Everett et al. 2018)

Considering social systems as networks allows focused attention on the relationships among the individuals in this system. In network analysis individuals are called nodes or actors. These nodes have characteristics that are referred to as attributes. The relationships between nodes is also referred to as ties.

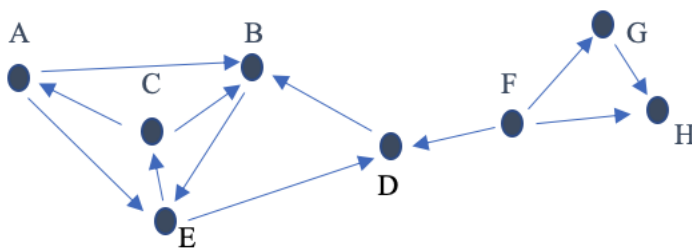
#### 2.2.1.1 GRAPHS

A typical way of conceptualizing networks is as *graphs*. The graph  $G(V, E)$  consists of a set of vertices  $V$  (also referred to as nodes) and a set of edges  $E$  (also referred to as links or ties). These ties connect pairs of nodes. For a tie connecting two nodes  $u$  and  $v$  in a graph  $G$ , we write  $(u, v) \in G$

Usually a graph models the network in such a way that every tie has the same attribute and hence represents the same social relationship.

Two nodes connected by a tie are said to be *adjacent*. When a tie connects nodes A and B and another tie connects node A and C, the two ties are said to be *incident upon A*. The number of edges incident on a node is called the *degree* of the node. A graph can be directed or undirected. In *directed graphs* the ties have direction, like arrows. There is a clear direction in which the tie moves.

Figure 4 A simple directed graph



*Undirected graphs* are those where the ties do not show a particular direction. They are used for relationships where direction is irrelevant or where the attribute is always reciprocated. For instance, ‘is family member of’. In a directed graph, a *path* refers to a sequence of steps along the ties in a graph that never revisits a particular node. For instance, in Figure 4. the sequence *A-B-E-D* is a path, but *A-B-E-C-B* is not a path because it revisits node *A* again. A component refers to the maximum set of nodes in which every node can reach every other node by some path; *A-B-C-D-E* is a component. If we added *F* then everybody would not be able to reach everybody hence the set of nodes *A-B-C-D-E-F* cannot be considered a component. However, if the directions of the graphs are disregarded you find that it is now possible to reach all the nodes through some path. This new set of reachable nodes are now considered a *weak component*. Hence to distinguish them we call the set of nodes from the directed graph the strong components. If the tie between *D* and *F* is removed, the graph is separated into two groups. A tie of this nature is usually called a *bridge*.

Sometimes there are numerical values associated with ties, these can include the strength of the tie such as length of a phone call, frequency of the interaction like number of visits etc. These attributes can be used to determine how close actors are to each other in a network. The measure of closeness is called *dyadic cohesion*. Nodes that are found in the same component tend to be more cohesive. A rumor spreading in one component will eventually reach each member of the component but might take time to reach members of other components. Another measure of closeness of nodes is the clustering coefficient. It refers to the a measure of the degree to which nodes in a graph tend to cluster (Holland and Leinhardt 1971).

In order to analyze networks the data is formatted into a matrix with rows and columns as actors(nodes, vertices )referred to as an adjacency matrix (Scott 2000). Here we use a valued adjacency matrix to represent the value of the relationship where 0's represent no ties, and values represent the strength of ties (Figure 5).

|   |     |    |
|---|-----|----|
| 0 | 50  | 10 |
| 2 | 7.8 | 3  |
| 1 | 0   | 80 |

*Figure 5.Adjacency matrix of interactions*

The fSM economy is modelled as a network where the nodes are individual users and the edges represent currency flow between the actors in the network. Through network analysis of the simulation data we can gain valuable insights into the structure of the network and how it might correlate with the real-world network. We attempt to investigate whether the fSM network creates a system a tight knit network that imbues the system with social capital. We also attempt to use this quantify the effect of this social capital on the effectiveness of the currency. Last but not least, we attempt to quantify the tendency of users to co-operate measured by the reciprocity of transactions in the community.(Mahmoodi, Bahrami et al. 2018)

### 3 RESULTS AND DISCUSSIONS

#### 3.1.1 SURVEY RESULTS AND ANALYSIS

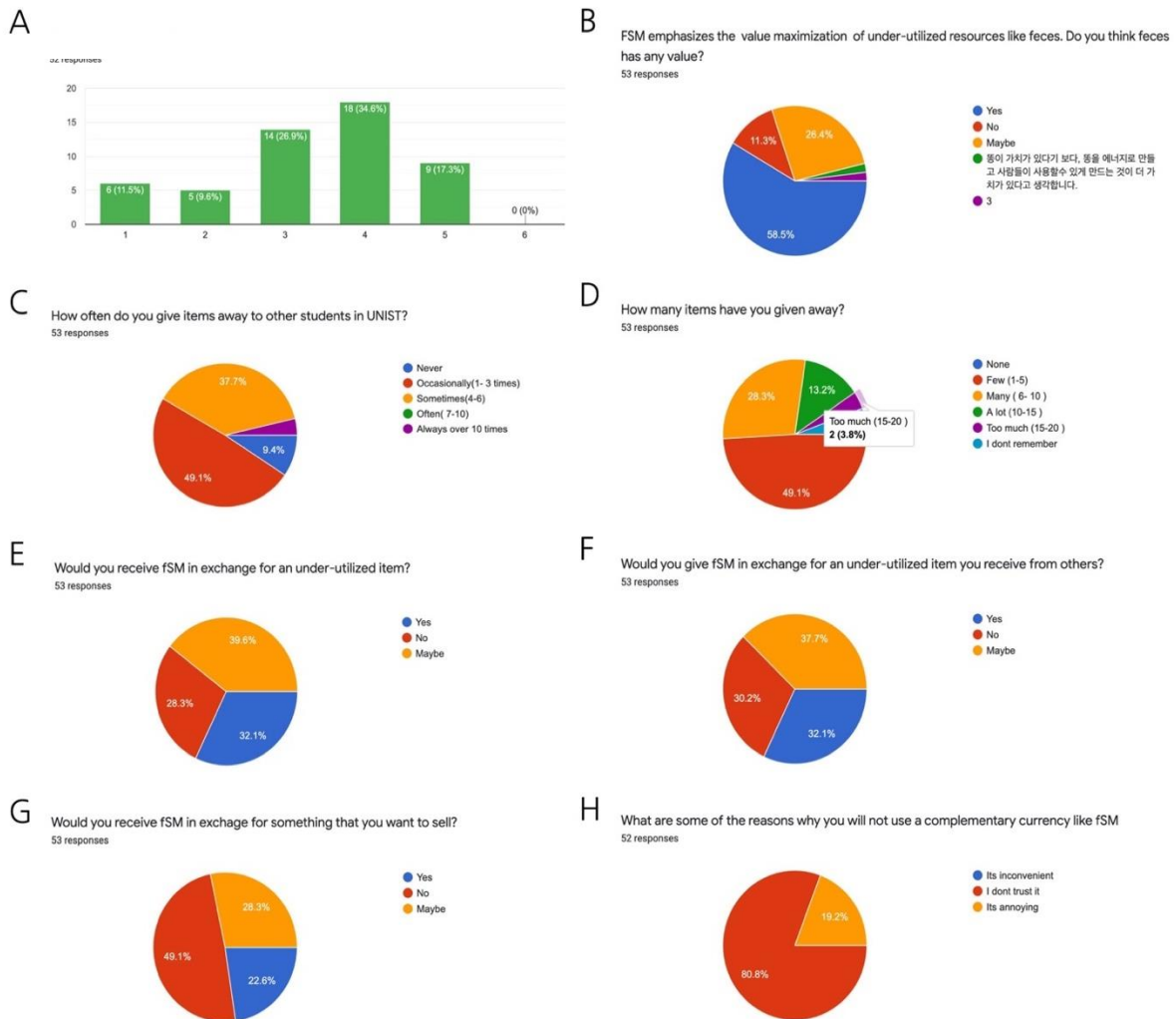


Figure 6. Analysis of survey responses regarding a) Familiarity with fSM b) Perception of value in feces c) Frequency of sharing d) Number of items shared e) Willingness to accept fSM for under-utilized goods f) Willingness to use fSM as a medium of exchange

From the survey responses, close to half of the respondents were fairly familiar with fSM (Figure 6A). This provided a basis to inquire about what sentiments people attached to the concept of fSM. More than half of respondents thought feces had some value (Figure 6B). The major associations that respondents made to feces and value were 1) energy 2) money and 3) resource respectively. It was an indicator that a majority of these respondents had some understanding of the philosophy of fSM.

Regarding the extent to which these students participated in the existent sharing economy on campus, the responses suggested that 90% of the respondents had given away an item to other students on campus (Figure 6C). This goes to support the existence of some form of a sharing network on campus and of the sample space actively participating in it. Over 90% of respondents also reported to have given away at least one item to another member of the UNIST community with over 40% giving items away often (Figure 6D). Over 30% of respondents were willing to receive fSM in exchange for items that they considered under-utilized (Fig 4E). About 38% responded that they would pay fSM to others in exchange for an under-utilized item (Figure 6F). It was expected that people who were familiar with fSM would express more of a willingness to use it in transactions. There was however no correlation between respondents' familiarity and their willingness to use or receive fSM. Nonetheless, all respondents who associated feces with money were willing to accept fSM as a currency in exchange for under-utilized goods. Of these respondents less than 20% expressed unwillingness to receive fSM in exchange for an item that they were looking to sell for fiat money. This shed some light on the need to emphasize the link of feces to money and the viability of feces as a legitimate standard of money.

Respondents were generally more willing to share an under-utilized item using ggool, however, they were less interested in sharing items that they intended to sell for a legal tender through fSM. This might be attributed to the conception of value as based on scarcity and the strong link between fSM and under-utilized goods. Two of the main barriers to the use of complementary currencies is the lack of trust and the inconvenience from a lack of liquidity. From the survey, majority of respondents mentioned trust as the major reason for their unwillingness to use fSM (Fig 4H).

It stems from the survey responses that to make fSM a more viable and legitime form of exchange, users have to understand the link between feces and its legitimacy as a standard of value. There should also be a sense of trust regarding fSM is a legitimate currency.

It is worthy to mention that the students were from UNIST where the Science Cabin has some toilets installed. While the ecosystem is not yet fully functional, the toilets are a material representation of possibility of feces to energy conversion and hence might contribute to the tendency of respondents to associate fSM with money.

It is necessary to mention that the survey was administered to only a small number of respondents and might not be totally representative of the entire population. A closer look that at the economic activity of the fSM platform gives insights into valuation and users conceptualization of fSM.

### 3.1.2 OVERVIEW OF ECONOMIC ACTIVITY IN THE FSM NETWORK

The simulation allowed users to carry out peer to peer exchanges. The largest number of exchanges were carried out during organized flea markets where users could bring items that they wanted to trade.

#### 3.1.2.1 TRANSACTIONS AND VALUATION

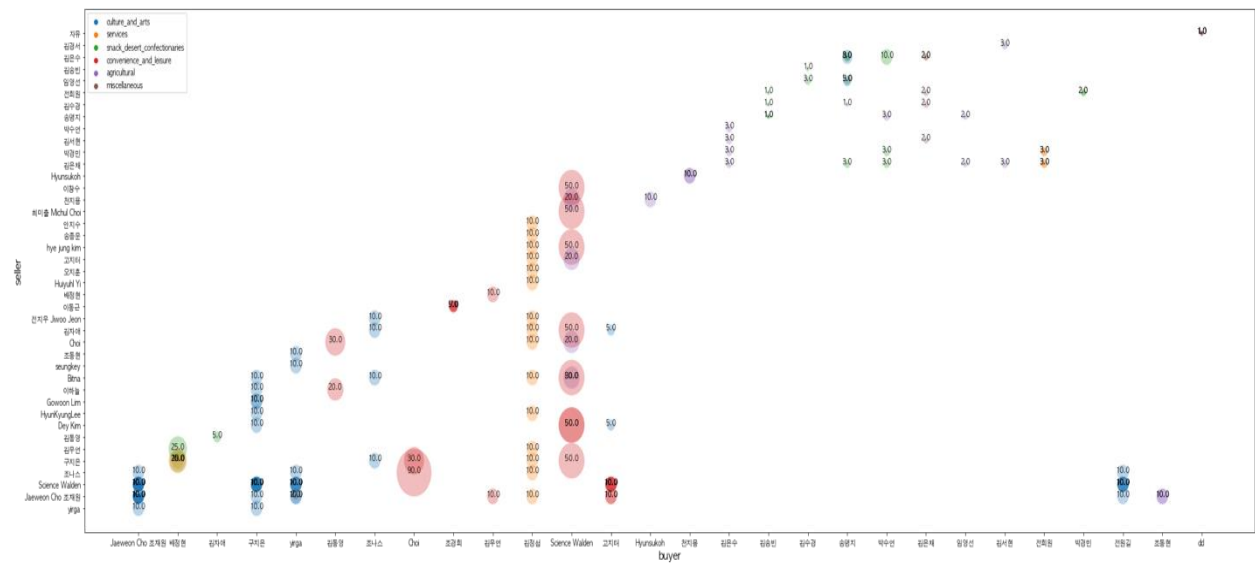


Figure 7. Overview of trading

Figure 7 shows an overview of the trading patterns of users. A closer look at the valuation of offerings shows a pattern where under-utilized resources are generally valued at 10 ggool or lower. Under-utilized resources here refers to items that are either 1) used or 2) fall under the categories of skills or shared offerings (See supplementary information S1. for breakdown of offerings). However, those that are considered new were valued at over 10 ggool. A possible reasoning might be that people make an association between the daily 10 ggool basic income endowment and under-utilized resources. When users feel that an item or service is of higher value, they tend to want to receive more ggool to emphasize the additional value. To better understand the pricing mechanism, the offerings were separated into five categories (Supplementary 7.1.1.1). It is interesting to note that fSM seems to blur the line between intimate relationships and markets. Some offerings like 30 minutes of coffee that would traditionally have been considered inappropriate to sell were paid for using ggool. This shows the potential that ggool



has to create a space where appreciation for intimate relationships and services can be done with more than a simple “thank you”.

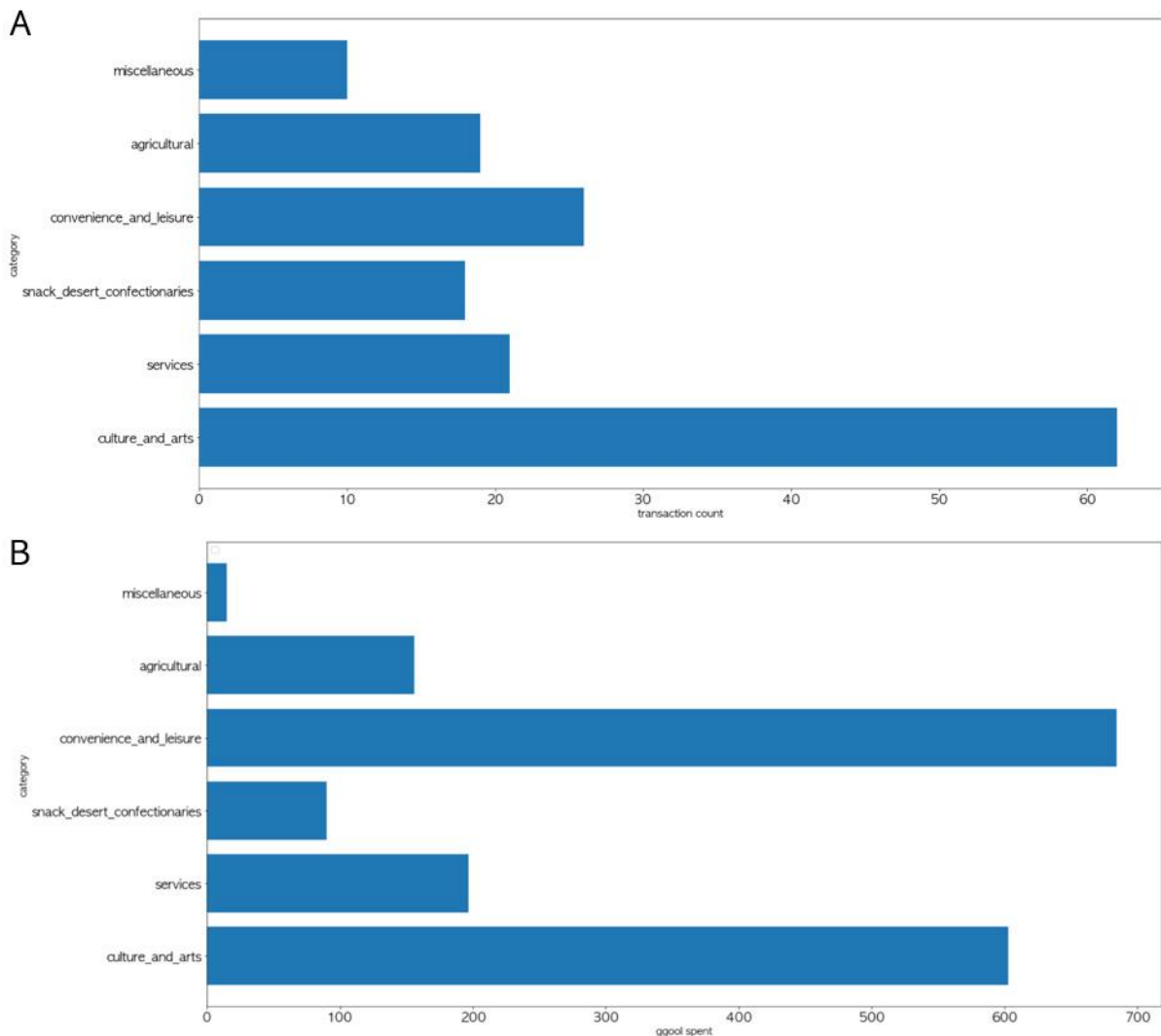


Figure 8. Volume of A) Transaction count for various categories of offerings B) Amount of ggool spent for each category

The largest category in which trading occurred was the culture and arts category. This involved offerings such as photos, art works, music compositions etc. Generally, users decided to receive a maximum of 10 ggool for their respective offerings (Figure 8A).

Even though about 25 different items were sold in the convenience and leisure category, it accounted for the highest amount of ggool transacted (Figure 8B). Most items in this category were new items. They were generally sold for over 20 ggool. Based on the observation that people valued under-utilized

offerings at 10 ggool or lower they did not take into account the fact that they had in actuality just received basic income of 7 ggool. Here 10 ggool has become the *nominal standard* of goods. Nominal value of a good refers to its value in terms of money. It follows that even though feces is a symbolic representation of fSM, 10 ggool has become the nominal standard. This allows us to take a closer look at the macro-economic qualities of the fSM simulation network.

### 3.1.2.2 SNA Results

The sharing and trading networks of fSM were visualized using Gephi (Bastian, Heymann et al. 2009) and statistical analysis was carried out using UCINET (Borgatti, Everett et al. 2002). The nodes represent the actors participating in sharing or trading. The size of the nodes varies with degree and the colors represent the centrality of the actors. The sharing graph shows a dense network of ties (Figure 9) giving a visual representation of the knots. The size of nodes correspond to the degrees while nodes of the same color have the same betweenness centrality measure. The trading graph shows the partition of the nodes into three components (Figure 10) generally constituting Science Walden researchers who trade with each other, students from the science and humanities class and external participants in the game. This could be attributed to the lack of a dedicated platform to co-ordinate triangulation of the offerings. Also, the size of nodes correspond to the degrees while nodes of the same color have the same betweenness centrality measure.

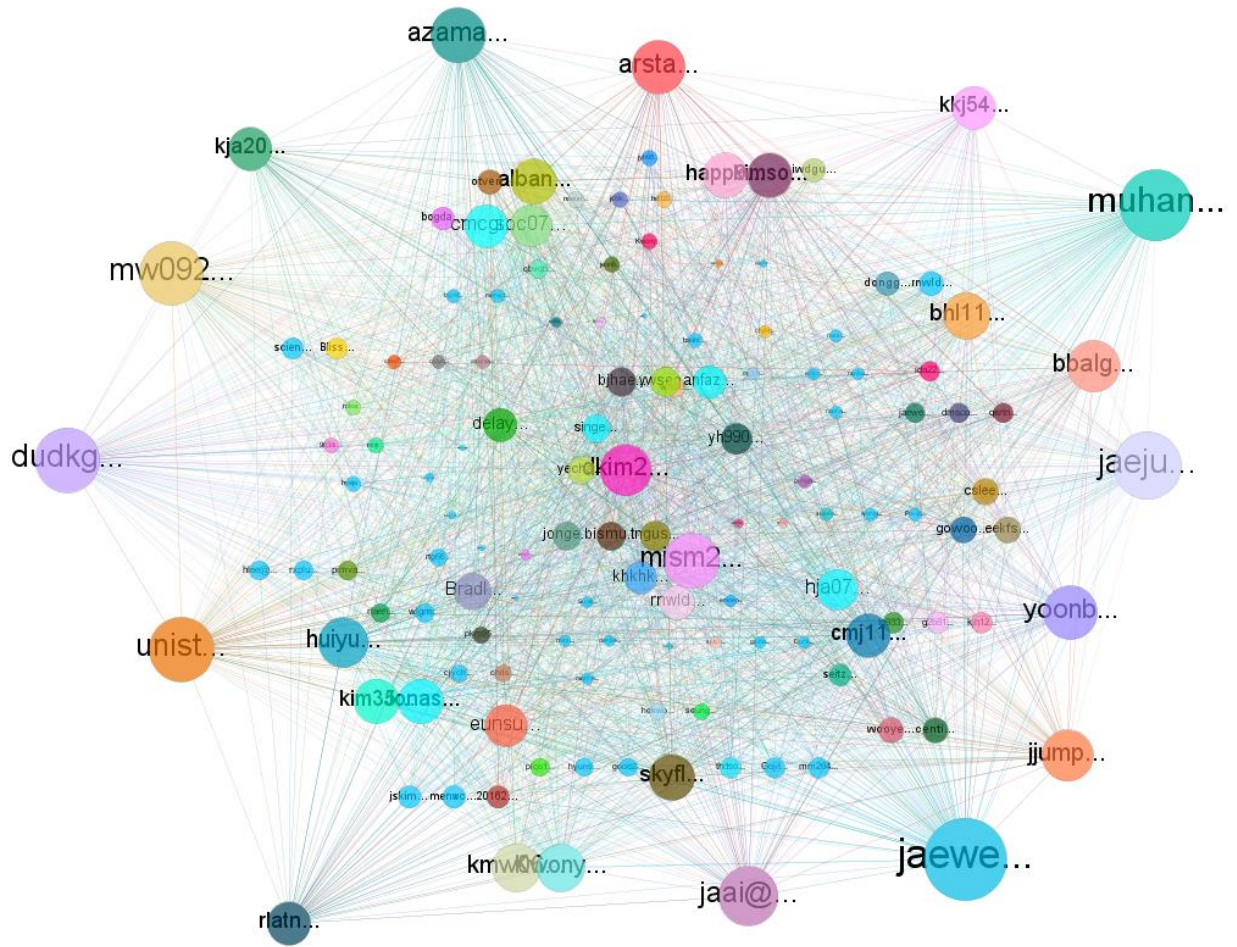


Figure 9. Overview of FSM sharing network. Size of nodes correspond to the degrees and colors correspond to the component.

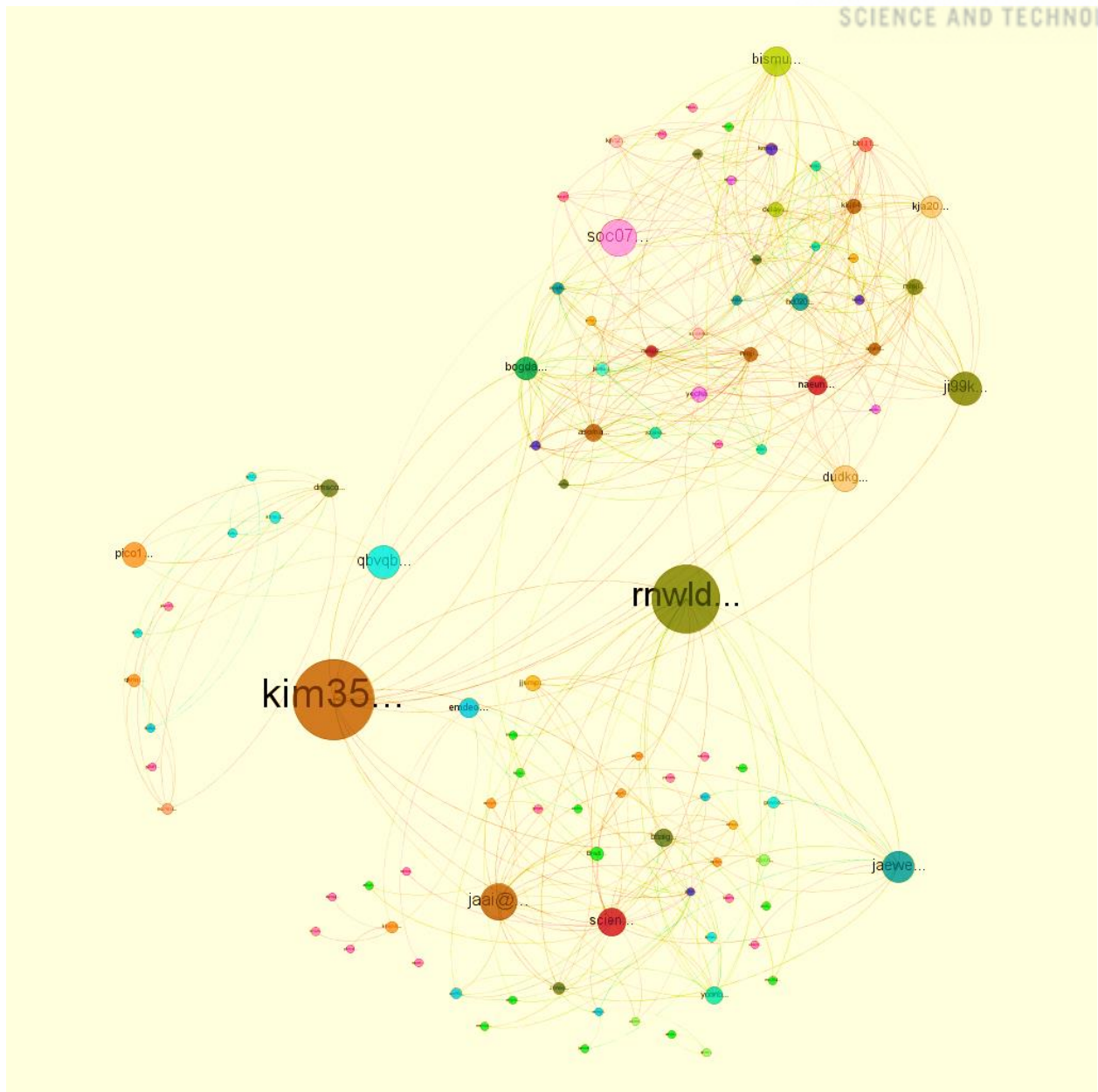


Figure 10. Overview of fSM trading network.

The fSM system was evaluated on the network, dyad and actor level to explore the social and economic implications of the fSM mechanism. To evaluate the overall connectedness, the fSM sharing network is compared to other real-world networks (Kichiji and Nishibe 2008) through their respective clustering co-efficient. A typical way to measure the extent to which a graph shows clustering is to examine all the other actors in its local group (neighborhood) and then compute the density in this neighborhood (while leaving out the actor). We can then characterize the average degrees of this neighborhood as the clustering co-efficient. From the data we observe that while the size of the fSM network was about half that of the other networks, the clustering co-efficient is 5 times greater than those of the comparative

networks. There is also close to a tenfold increase for the fSM trading networks. The fSM networks shows a significantly higher clustering coefficient than the real-world networks. This can be indicative of higher social cohesion in the fSM network. As expected, the sharing network is denser than the trading network. The difference between clustering co-efficient in sharing and trading network can be attributed to the fact that the trading partners might be more susceptible to form a trading component while sharing is more randomized. To get a more microscopic view of the network, we examined cohesion on the node level.

| Network                    | Size | Clustering Co-efficient |
|----------------------------|------|-------------------------|
| <b>fSM Sharing network</b> | 137  | 2.107                   |
| <b>fSM Trading network</b> | 130  | 4.796                   |
| <b>LET-Q</b>               | 287  | 0.494                   |
| <b>E. Coli</b>             | 282  | 0.32                    |
| <b>C-elegans</b>           | 282  | 0.28                    |

Table 2. Comparison of fSM network with other real world

| Metric                        | Sharing Network | Trading Network |
|-------------------------------|-----------------|-----------------|
| <b>Overall C-C</b>            | 2.107           | 4.796           |
| <b>Network density</b>        | 0.774           | 0.538           |
| <b>c-c density /c-c</b>       | 0.632           | 0.88            |
| <b>Weighted overall graph</b> | 1.482           | 2.702           |
| <b>Small world index</b>      | 3.583           | 6.100           |

Table 3. Comparison of fSM sharing network and trading network densities

On the node level, the overall cohesion of nodes was examined. The average number of connections for the sharing network- degree- for an actor was 20.2 representing 14.7% (Table 2.) of the entire of actors while for the trading network it was 4.47 representing 4.47% of the network (Table 3). There was little correlation between indegree and outdegree. It was observed that all individuals shared ggoal with other users but not vice-versa. Despite a statistically insignificant correlation between indegree and outdegree, it seemed that the nodes who selected less than 3 sharing friends were more likely to be isolated in the sharing network. The plot of the degree distribution showed that the degree distribution is skewed (Figure 11) given that majority of individuals only selected a handful of peers while a few actors selected numerous peers. Hence, we see a small dyad reciprocity score of 0.15 for sharing and twice

that for trading since members are more likely to reciprocate trading than sharing. While the sharing network is highly connected, sharing is not equally distributed. This is also typical of real-world networks.

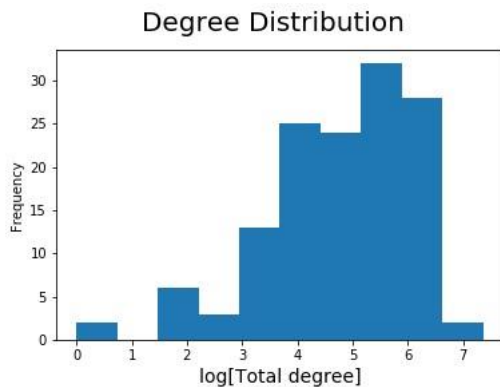


Figure 11. Degree distribution

| Metric           | haring Network | Trading Network |
|------------------|----------------|-----------------|
| Number of nodes  | 137            | 100             |
| Number of ties   | 2776           | 447             |
| Avg Degree       | 20.262774      | 4.47            |
| Indeg Corr       | -0.097625      | 0.045152        |
| Outdeg Corr      | 0.2741888      | -0.02957        |
| Density          | 0.148991       | -0.00952        |
| Connectedness    | 0.704809       | 0.553838        |
| Dyad Reciprocity | 0.1509121      | 0.31085         |

Table 4..Comparison of fSM sharing network and trading network cohesion

It can be inferred that sharing has no direct effect on trading patterns. However due to the high density of the sharing network, ggool is redistributed to actors. This alludes to a possible relationship between indegree and trading. Highly central nodes were more active traders.

It can be concluded that while there is no statistical correlation between sharing (out degree) and trading(outdegree), individuals who do not share with friends have a higher probability to be isolated and that means that they are also less likely to have a lot of connections.

Although, compelling the evidence provided is insufficient to support a formal causality about the assertions made because they are challenging to prove statistically. This would require a randomized controlled trial that while difficult is possible for future studies Thus for this analysis claims are limited to hypothesizing the non-causal and descriptive while relying on a limited suite of statistical methods.

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## 4 INSIGHTS AND CONCLUSIONS

In this study the value of fSM is introduced as a complementary currency that embodies value using a feces standard. We discuss modern economics' conceptions about money and argue that the inability of modern economics to incorporate the social nature of money contributes to a non-inclusive financial system. We then examine the philosophical underpinnings of fSM to understand how the feces Standard can become the basis of a social inclusive monetary system. From survey results we find that users of fSM who associate feces with money, energy or a resource might have a higher tendency to use it as a medium of exchange. These respondents are more willing to use it to access under-utilized resources than new items, alluding to fSM's strong association with "used" or "waste" resources.

Users had the tendency to value items relative to 10 ggool - "used" items were generally valued at 10ggool or lower. Intangible offerings like skills, artwork, photos were also generally valued at 10 ggool or less.

New items were generally valued at 20 ggool or over. Considering that respondents were students at UNIST where there are a couple of BeeVI toilets installed, it can be assumed that it was easier for them to conceptualize the link between feces, energy and money even though they did not directly use the toilets. It will be interesting to examine how other communities conceptualize fSM.

Data from of the fSM system was modelled as a social network and analyzed to examine the results of a simulation of the fSM system. The network was evaluated at the network, dyad and node level for both sharing and trading networks in fSM. The overall connectedness of the of the fSM simulation was compared to other real-world networks. The clustering co-efficient for the sharing network was five times that of the real-world networks even though the size of the fSM network was smaller.

The clustering co-efficient for the trading network was about 10 times that of the real-world networks. There might be attributed the high number of connections and interaction in the components existing in the fSM network.

A direct correlation was not found for the relationship between sharing and trading however, actors who received a lot of ggool from sharing were more susceptible to trade. A major reason why sharing might not have shown any correlation with trading was because of the lack of a dedicated platform for triangulating the transactions. With the recent launch of the fSM platform, these hypotheses can be validated using a more representative network. We see that the fSM system constitutes a tightly knit network from which trade is facilitated. While it is still difficult to measure the social change there are clear signs of its potential to contribute to efforts towards building sustainable wealth and a sustainable environment through its facilitation of shared consumption and wealth redistribution.



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## 6 APPENDIX

### 6.1 SUPPLEMENTARY MATERIAL

#### 6.1.1.1 CATEGORIZATION OF ITEMS

| Agricultural                  | Services                                       | Culture and Arts                | Convenience and Leisure | Snacks Deserts and Confectionaries | Miscellaneous                                |
|-------------------------------|--|---------------------------------|-------------------------|------------------------------------|--|
| 2 rice papers                 | Carpool  | Organizational development blog | Craft Materials Sales   | Cake                               | Ice that melts when you put it in your mouth |
| Strawberries grown by Eun-soo | fSM lecture                                    | leaves on path                  | Air freshener           | Pizza                              | Ice that gently melts in your mouth          |
| 2 kg of excrement fertilizer  | 3d print                                       | TigerButterflyDance             | coaster                 | Shanghai burger set                | Kakashka                                     |
| Pineapple                     | iPad rental                                    | Membrane forest                 | bike lock               | Pasta                              | White Hair (10)                              |
| Peach                         | Source of Convergence Work-Lab Tour            | Music                           | Calendar                | Ice cream                          | Yunji  |
| Honey                         | Massage 5 minutes                              | Concerts                        | Mouse pad               | Nesspreso                          | 냠냠 ↙   |
| Cherry tomato                 | Praise   | Book                            | Monet                   | Cheese                             |  |
| Sesame                        | Harvesting                                     | A story music box               | bamboo toothbrush       | Earl Gray 3 Pieces                 |  |
| almond                        | Coffee Teatime 30 minutes                      |                                 | baked salt toothpaste   | Kim                                |  |
| Chives                        | Time and communication                         |                                 | make up brush           | Sweets set with memories           |  |
| 1 grain                       | Time + communication                           |                                 | handmade fragrance      | Simple rice cake memo              |  |
|                               | Microalgal samples provided / microscope image |                                 | White Garden-rose Moss  | Seller Rice Memo Moon Cake         |  |
|                               |  |                                 | Mask Pack               | Mocha Coffee Pot                   |  |
|                               |  |                                 | 2 fragrance creams      |                                    |  |
|                               |  |                                 | Jeju Sticky Note        |                                    |  |
|                               |  |                                 | Pencil stand            |                                    |  |
|                               |  |                                 | Simple rice cake memo   |                                    |  |

|  |  |  |                       |  |  |
|--|--|--|-----------------------|--|--|
|  |  |  | Masterpiece Pouch     |  |  |
|  |  |  | Cosmetic bottles      |  |  |
|  |  |  | Framed stickers       |  |  |
|  |  |  | Wework Blue Pen       |  |  |
|  |  |  | Wework Pencil Case    |  |  |
|  |  |  | 1 mask pack           |  |  |
|  |  |  | Attaching hot pack    |  |  |
|  |  |  | Guronic acid 1 bottle |  |  |
|  |  |  | Cosmetic bottles      |  |  |
|  |  |  | Lip balm              |  |  |
|  |  |  | Hand cream            |  |  |
|  |  |  | Packing bags          |  |  |

## 6.1.2 THEORETICAL & MATHEMATICAL DEVELOPMENT

### 6.1.2.1 Alternative Democracy

The game titled “Alternative Democracy (named also as Spontaneity)” was played over a period of three months however the analyzed data was collected over a 115-day period from the start of the simulation. The game uses energy choices energy selections and an alternative democratic system to study how incentives and social group thinking translates into politics and elections results individual user behavior.

#### 6.1.2.1.1 RULES

The fSM UNIST game is available for download on android and iOS platforms and the rules for playing were designed to simulate the real-world network. The rules are as follows:

- a) Registered players are paid basic income fSM of 10 Ggool each day. This can be considered a conditional basic income.
- b) Users are also required to pay about 3 Ggool for lunch, using one of 5 different QR codes corresponding to the energy options: thermal, nuclear, bio, wind, and solar energy. Those who

do not simulate payment for lunch using QR codes are not be paid their basic income fSM the next day. The purpose of this is to give users the freedom to consciously participate in the system.

- c) 3 Ggool out of the 10 Ggool should be shared with other players (i.e., peers); otherwise, 3 Ggool will be subtracted into the server. Basic income fSM reduces by 7% per day.
- d) Every day, users have to pay about 3 Ggool on average for class to choose one of 5 different QR codes corresponding to energy options: thermal, nuclear, bio, wind, and solar energy. This metaphorically signifies the user learning so as to contribute to the society. The user receives human income payments based on the energy choice for the class.
- e) Users are informed at 8pm every evening, information on statistics of energy options choices. These are ranked daily and used to determine the price of energy options the next day. Prices vary from 2.6 Ggool, 2.8 Ggool, 3 Ggool, 3.2 Ggool, and 3.4 Ggool for first to fifth rank, respectively.
- f) Users are also asked to select their favorite political party, amongst conservative, progressive, alternative, and anarchism. They are allowed to switch their political party affiliations once a week, on Sunday. They are also informed of statistics regarding the political party selections, together with energy options, at 8 pm every evening. Those who are members of the political parties which have the first and second ranks, are paid 4 and 2 Ggool, respective.

The simulation also allowed members to participate in voluntary exchange of goods and services using the ggool accumulated. A QR code system was implemented that required both parties to be present at a particular location for exchange to occur. This added an extra layer of social connection to a digital platform.

Additionally, the survey was carried out on a section of the game players.

### **6.1.2.2 EXCHANGE AS SOCIAL CHANGE INDEX**

The index presented here attempts to measure of the influence of exchange as a basis for social change. This exchange for social change index (ESCI) takes into account two domains (economic and social capital) with each domain consisting of a number of metrics. Using data from social network analysis we will attempt to compute an index for an individual's contribution.

The ESCI can be used to identify a) environmental and social trends that signal sustainability shifts b) an individual's performance metrics in relation to these sustainability shifts.

It is expected that the ESCI can be further developed to be used for other complementary currencies to estimate the influence of the

The metric that will be used for measuring the social influence is indegree, a measure of how connected an individual is in the network.

The economic aspect of this will be the amount of currency that an individual hold.

The environmental aspect will be based on the number of items that individuals.

| Domain          | Indicator | Metric  |
|-----------------|-----------|---|
| <b>Social</b>   | Knots     | Out -Degree (Sharing)                                   |
|                 |           | Cohesion (Centrality)                                   |
|                 |           | In-degree (sharing)                                     |
| <b>Economic</b> | Valuation | Weighted prices (centered around the 10 ggool standard) |
|                 |           | Centrality (Transactions outgoing)                      |
|                 |           | Trading (degree)  |

$$\text{Average weighted indicator} = \bar{x}_e = \frac{\sum_{m=1}^{n_m} w_i x_{mi}}{n_m}$$

$n_m$  refers to the number of metrics that contribute to the particular indicator at location m.  $w_i$  equals the population weight for the local community  $x_{mi}$  is the metric value for that location.

$$\text{Average weighted domain} = \bar{x}_s = \frac{\sum_{e=1}^{n_e} \bar{x}_e}{n_e}$$

$$\bar{x}_t = \frac{\sum_{e=1}^{n_e} \bar{x}_e}{n_e}$$

$$\text{ESCI} = \frac{\bar{x}_s}{\bar{x}_t}$$

Even though the index uses two domains. It can be expanded to account for more metrics that affect contribute to changing the perceptions of individuals to contribute their offerings towards building a more sustainable wealth system.