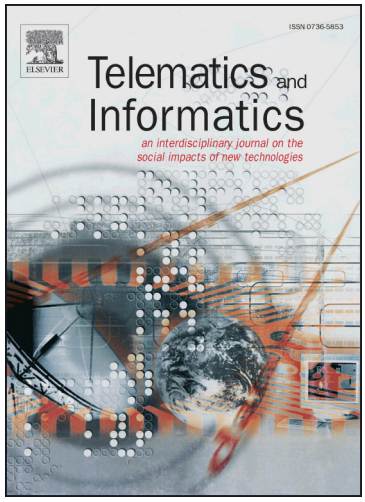

Sustainability of telecentres in developing countries: lessons from union digital centre in bangladesh

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PII: S0736-5853(18)30310-1
DOI: https://doi.org/10.1016/j.tele.2018.05.006
Reference: TELE 1125

To appear in: *Telematics and Informatics*

Received Date: 20 March 2018
Accepted Date: 7 May 2018

Please cite this article as: Faroqi, d.G., Siddiquee, N.A., Ullah, S., Sustainability of telecentres in developing countries: lessons from union digital centre in bangladesh, *Telematics and Informatics* (2018), doi: https://doi.org/10.1016/j.tele.2018.05.006

TITLE: SUSTAINABILITY OF TELECENTRES IN DEVELOPING COUNTRIES: LESSONS FROM UNION DIGITAL CENTRE IN BANGLADESH

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SUSTAINABILITY OF TELECENTRES IN DEVELOPING COUNTRIES: LESSONS FROM UNION DIGITAL CENTRE IN BANGLADESH

ABSTRACT

This study examines operational sustainability of a major telecentre initiative - the Union Digital Centre (UDC) in Bangladesh - from the perspective of public-private-people's partnership (PPPP). Given the rising incidence of dropout of private entrepreneurs causing premature closure of telecentres, it is important to understand and identify key variables that affect sustainability of the scheme. In appreciation of the difficulty associated with operationalisation of the term 'sustainability' in this study we adopt 'operational sustainability' as an alternative to investigate the dynamics of sustenance. We have reviewed key literature about various dimensions of sustainability and their interrelationships in order to develop hypotheses about sustainability of the UDC and factors associated with it. Drawing on data collected from a survey of 538 private entrepreneurs and 41 interviews with government officials we show the extent to which various elements of the UDC eco-system contribute to its sustainability. The application of a structural equation model confirms that both financial and social outcomes of the UDC depend largely on inputs and contributions of various stakeholders. The paper concludes that effective engagement of private entrepreneurs is critical, as is governmental patronage, for ensuring operational sustainability of partnership-based telecentres like the UDC.

Keywords: Telecentre, Sustainability, Digital divide, E-government, Bangladesh

INTRODUCTION

In recent times, telecentres- usually defined as shared access-points for Information Communication Technology (ITC)-based services and applications- have attracted growing popularity around the globe. They are widely seen as an innovative way of tackling the digital divide and of accelerating socio-economic development by providing disadvantaged people

with access to value-added information, knowledge and services. This explains the proliferation of telecentres along with the range of services they offer in both developed and developing countries. Although assessments of telecentres are generally positive, they are not without controversy. At the heart of the current debate about telecentres is the question of whether such experiments are sustainable. This issue is particularly acute in developing countries where telecentres are often external to the communities that they serve and are initiated and implemented with funding from donor agencies. Given this situation, a critical question remains- can these centres sustain their operations into the future when external support from donor agencies is no longer available?

Bangladesh has followed the global telecentre movement. The success of telecentres elsewhere and local NGO operated community-level ICT kiosks inspired the government of Bangladesh to introduce Union Digital Centres (UDC) throughout the country. Conceived and implemented under the UNDP supported A2I program in 2010, the UDCs represent a major attempt at bridging the digital divide and ensuring that the benefits of the ICT revolution are shared widely in the society. The UDCs-located at the lowest level of local government – are equipped *inter alia* with computers, scanners, digital camera, printers and internet connections so that they can serve as 'one-stop shops' for information and services in rural areas. As with telecentres elsewhere, the UDCs are founded on a partnership model which seeks to support local entrepreneurship development and to ensure the sustainability of the scheme (Siddiquee 2016). The principal partners are the government represented by the Access to Information (A2I) program, the Local Government Division (LGD) and the private entrepreneurs. Additionally, the UDC considers local people as partners and brands itself as a public-private-people's partnership (PPPP). As a key partner the government provided the initial set of equipment to the UDC and training to local entrepreneurs. The local government

(UP) provides space for the operation of telecentres and shares initial expenditure involving equipment and furniture.

Each UDC is run by two entrepreneurs -ideally one male and one female - appointed locally by the Upazila Nirbahi Officer. The entrepreneurs receive no salary from the government. They are expected to generate income by charging fees in return for their help with direct or mediated access to ICT and internet-based services. Given the desire of making UDCs sustainable through local enterprise development, the government claims no share of the revenues generated locally. All operational expenses of the UDC are borne by the entrepreneurs.

Since its launch in 2010 the UDC has attracted increasing attention as an innovation in governance and service delivery. Although the general impression about the UDC remains positive, an increasing number of drop-outs among entrepreneurs resulting in the premature closure of many centres in recent years has fuelled speculation about the viability and future of the project. Current evidence suggests that nearly 20% of centres were closed by the end of 2014 (BBS, 2014; Faroqi, 2015). This is quite significant given that the UDC experiment is still at its early stage and it continues to enjoy strong governmental patronage and support. Therefore, one wonders what would happen to the experiment in future especially when external support is withdrawn or reduced considerably. Despite growing literature on e-government in Bangladesh, not much is known about the UDCs. The existing literature is highly descriptive in nature and focuses either on the evolution of e-government or on a chronology of e-initiatives including their problems and potentials in improving governance and service delivery (Bhatnagar, 2014; Rahman & Bhuiyan, 2014; Siddiquee & Faroqi, 2013).There is a paucity of studies that examine operational aspects of the UDC in general and issues of its sustainability, in particular. It is against this backdrop that the present study

seeks to understand the UDC experiment with a specific focus on its sustainability. It draws on empirical data to analyse the UDC model of partnership and the roles and contributions of key stakeholders. However, we begin with a review of relevant literature.

TELECENTRE SUSTAINABILITY: A LITERATURE REVIEW

Although telecentres were first introduced in the developed world during the 1980s, they are more common now in developing countries. The aim of telecentres is to connect underserved groups by giving them access to ICT tools and the internet, information on economic activities and education (Harris, 2001). Based on the level of ICT and the range of services they offer, Jensen (2002) classifies telecentres into four types namely: (a) micro or standalone telecentres (akin to phone shop or ICT centre providing some basic services); (b) mini; (c) basic and (d) full service centres. As the number of technologies increases, the type upgrades to serve ultimately a variety of purposes such as the multipurpose community telecentres do.

The discourse on telecentre- especially its sustainability- dates back to the beginning of the concept (Fillip & Foote, 2007). It has assumed increased significance because of the gap around telecentre ecosystem involving relevant stakeholders in managing survival and growth (Shadrach & Sharma, 2011). Generally, an ecosystem is defined as the interconnected and interacting system of a complex network (Morelli, 2011). For a telecentre, the ecosystem may refer to the engagement of stakeholders including patrons or donors, managers, content developers, service and infrastructure providers, operators, civil society and the community at large (Hanna, 2010; Harris, 2002; Shadrach, 2012). As partners they jointly define problems, design possible solutions, collaborate to implement them, and monitor and evaluate the outcomes (Ali & Bailur, 2007).

However, the term 'sustainability' itself is an unrealistic concept and difficult to operationalise especially in the development literature (Ali & Bailur, 2007). The first difficulty stems from the fact that sustainability literally means retaining continuity in a certain state. No condition however can remain stable in perpetuity or be entirely controlled. Sustainability implies a delicate balance between stability and movement (Fowler, 2000 cited in Ali & Bailur, 2007). Another difficulty with sustainability lies in defining what may be essential for it and what might not. The second challenge arises from the difficulty of operationalising sustainability in the field of development. While this goal is appealing in principle it is hard to put into practice. Some scholars (Hemmati, 2002 cited in Ali & Bailur, 2007) define sustainability as a process of dialogue and ultimate consensus building among all stakeholders on matters of continuity and relevance. However, they do not provide specific suggestions for ensuring that such dialogue and relevance are present (Ali and Bailur, 2007). There are questions of what should sustain, why and how yet with no widely accepted answers (Loukola and Kyllonen, 2005; Marshall 2005 cited in Ali & Bailur, 2007). Based on such arguments Ali & Bailur (2007) question whether sustainability is ever possible or whether it is just a "warmly persuasive' notion.

The telecentre literature identifies five main types of sustainability: financial, social, policy, organisational and technological. Though it is not clearly discernible as to what leads to what, it is argued that financial and social outcomes are driven by a combination of policy, organisational and operational aspects of telecentres (Ali & Bailur, 2007; Best & Kumar, 2008; Masiero, 2011; Shadrach & Sharma, 2011). Financial sustainability means the ability of telecentres to continue operations based on resources from service charges and/or donations or in-kind supports (Liyanage, 2009). For Best and Kumar (2008) the income of operators after recurring costs is a key indicator of financial sustainability. It gives operators confidence and satisfaction in the business and thus catalyses entrepreneurial sustainability.

Oestmann and Dymond (2001) state that telecentres in developing countries are well-placed to achieve financial sustainability by generating income from several sources. They can do so by offering basic telecom infrastructure in underserved areas, by receiving block funding from government departments for serving as cost effective outlets and by capitalising on higher demands for ICT-based services from households and businesses. However, financial sustainability remains a challenge for projects due to the possibility of the cessation of external funding and because many projects seek to pursue contradictory objectives of ensuring an adequate income and of serving the poor with minimum cost (Ali & Bailur 2007). The experience of *Drishtee* and *e-Choupal* in India, for instance, has led some researchers (Oestmann & Dymond, 2001; Shadrach, 2012) to conclude that the business approach lies at the heart of financial viability which, once ensured, can generate social outcomes.

Social sustainability requires community acceptance (Hanna, 2010) through buy-in and participation. In developing countries telecentres are designed to cater for people at the bottom of the social pyramid and to offer benefits to low income and marginalised groups (Liyanage, 2009; Oestmann & Dymond, 2001). In addition to ensuring equitable access they also seek to align their goals with the needs of local community members. Some researchers (Cecchini & Scott, 2003; Kumar, 2011; Kumar & Best, 2006), however, note that telecentres fail to provide benefits to the disadvantaged sections of the community. Therefore, despite the challenges that arise in determining social impact due to its inherent complexity and the lack of appropriate indicators (Ali & Bailur, 2007) it is important to consider the characteristics of service users as indicators of social sustainability (Oestmann & Dymond, 2001).

Both financial and social outcomes, however, are dependent on other dimensions of the ecosystem involving policy, organisation and operational matters (Best & Kumar, 2008;

Shadrach, 2012). Generally, the policy environment is steered by visionary leaders who champion the introduction and diffusion of telecentres (Kumar, 2007). Otherwise known as institutional sustainability, it emphasizes ownership by key institutional players. Since the implementation of ICT for development is a highly political process, the introduction of telecentres needs acceptance and institutionalisation by political actors. Often, central agencies headed by the chief information officer play crucial roles in developing strategic goals, benchmarks, resource mobilisation, process reengineering, application and partnership development and impact assessment (World Bank, 2004).

Organisational sustainability entails aspects like effective management practices, model choice, financing, monitoring and evaluation (Harris, 2007; ICTA, 2010; Shadrach, 2012). Systemic planning in all aspects of operations is an integral part of effective management (Liyanage, 2009). Coordination among organisations and sectors related to finance, technology, services, training and monitoring is a complex task. Bringing them to a single goal and accommodating different interests requires the highest policy commitment. At times, it may be necessary to reorganise the entire setting. Clear specification of objectives is necessary to avoid a situation where different stakeholders interpret goals differently (Freeman, 1984; Hudson, 2001).

However, investment or efficiency gains, from home grown private entrepreneurs of developing countries are more easily said than achieved (Kuriyan & Ray, 2009). Therefore, telecentres need external funding support until they can attain sustainability (Oestmann & Dymond, 2001). This is not just for buying equipment but also for staffing, training and system operations (Jensen & Walker, 2001). Local entrepreneurs need to be supported and groomed for the viability of a telecentre. Best and Kumar (2008) found that the duration of kiosk operation was dependent on the levels of computer training of operators and of technical and operational support from the project management. For monitoring and

evaluation of telecentres the government often employs local administrative units or specialised agencies (ICTA, 2010). Various online and offline tools are used to check whether the project can provide the intended benefits. Effective policy and organisational supports are prerequisites for efficient operations (Jensen, 2007; Shadrach, 2012; Shadrach & Sharma, 2013)

Key aspects of technological sustainability include the existence and performance of technology, connectivity, services and skills of operators (Hudson, 2001; Jensen & Walker, 2001; Liyanage, 2009, p. 9). A common focus of all telecentres is to use technologies that enhance connectivity, bridge the digital divide, and promote social and economic development (UNDP, 2007). Hence, technologies need to be up-to-date, economically viable and socially appropriate (Jensen & Walker, 2001; Liyanage, 2009). The telecommunication technology that facilitates connectivity includes telephone lines, telephone, fax and most importantly, the internet (Jensen, 2007; Jensen & Walker, 2001). While the shift from dial-up to fixed broadband has been rapid in the developed world the pace is slower in developing countries. A great majority of connections rely on wireless, often assisted by mobile phone companies (Ergen, 2009; ITU, 2014). Some of the obstacles they experience include deferral in connecting to the central network, narrow bandwidth, inadequate reliability and high prices (Wellenius, 2003).

Equipment and internet, however, may remain underutilised if they are not associated with the right mix of service supply and the ability of operators to utilise them (Oestmann & Dymond, 2001). Services can only generate demands if they are consistent with community conditions and needs (Bhatnagar, 2009; Madon, 2009). The combination of both government and developmental services alongside office services enables telecentres to reduce the level of competition with other providers (ICTA, 2010; UNDP, 2007).

Finally, sustainability requires time for telecentres to evolve and mature in institutional and functional terms. Partnership telecentres in developing countries usually take three years to reach financial independence by overcoming the performance fluctuations from piloting or initial operations. Some might attain the target of both financial goals and social impacts in the medium to long term within five to seven years (Liyanage, 2009; Oestmann & Dymond, 2001). However, during this period it is important that telecentres continue to receive support from political patrons and the administrative leadership (Best & Kumar, 2008; Bhatnagar, 2009). With the transfer of architect officers which meant inadequate institutional support, telecentres like *Gyandoot* and SARI in India have experienced a decline in operator's income and visits by people (CEG-IIMA, 2004; Kumar & Best, 2006). Kumar and Best (2006) argue that telecentres are doomed to fail without continuous institutional, operational, and technical support.

The discussion above involving various dimensions of sustainability and the lack of precise measures make it clear why sustainability is difficult to operationalize and maintain. This also helps to understand why a large majority of ICT development projects are found to have failed (Heeks, 2003). As innovations are not always welcomed by implementing actors, Ciborra (1992) suggests that bricolage i.e. tinkering through the combination of available resources may be an appropriate concept for sustainability. To him, many ICTD projects go through unintended changes, trial and error, tinkering and even negligence. Bricolage can leverage the emerging situation and practices and support new applications to solve new problems by local people. Ciborra (1994, p. 16, cited in Ali and Bailur, 2007), maintains that "no general scheme or model is available: only local cues from a situation are trusted and exploited in a somewhat blind and reflective way, aiming at obtaining ad hoc solutions by applying heuristics rather than high theory".

Given the plausibility of bricolage we offer another similar concept 'operational sustainability' in this research as an alternative to sustainability. Such a concept will capture features of bricolage and improvisation of technology and will serve the purpose of maintaining stability while still enabling the project to progress. Keeping aside the assessment of longer term impacts, the operational sustainability will focus on current dynamics of stakeholders' involvement and issues critical to sustaining the UDC operations. We presume that effective engagement of all stakeholders can promote multidimensional operational sustainability that broadly relates to policy, organisation and technology, finance and social outcomes.

However, while the existing literature has defined sustainability in terms of financial and social dimensions and identified its underlying factors, it fails to specify how they give rise to sustainability outcomes. Also, the literature does not locate such explanatory factors within a single framework that can explain sustainability. We, therefore, propose an explanatory model that depicts the different causal factors that underlie the operational sustainability of telecentres under PPPP and the causal relationships that exist between them (see Figure 1). Such a framework, subject to empirical validation, will be useful in explaining the failure of telecentres in developing countries. It identifies how inputs from relevant stakeholders can

affect both financial and social outcomes.

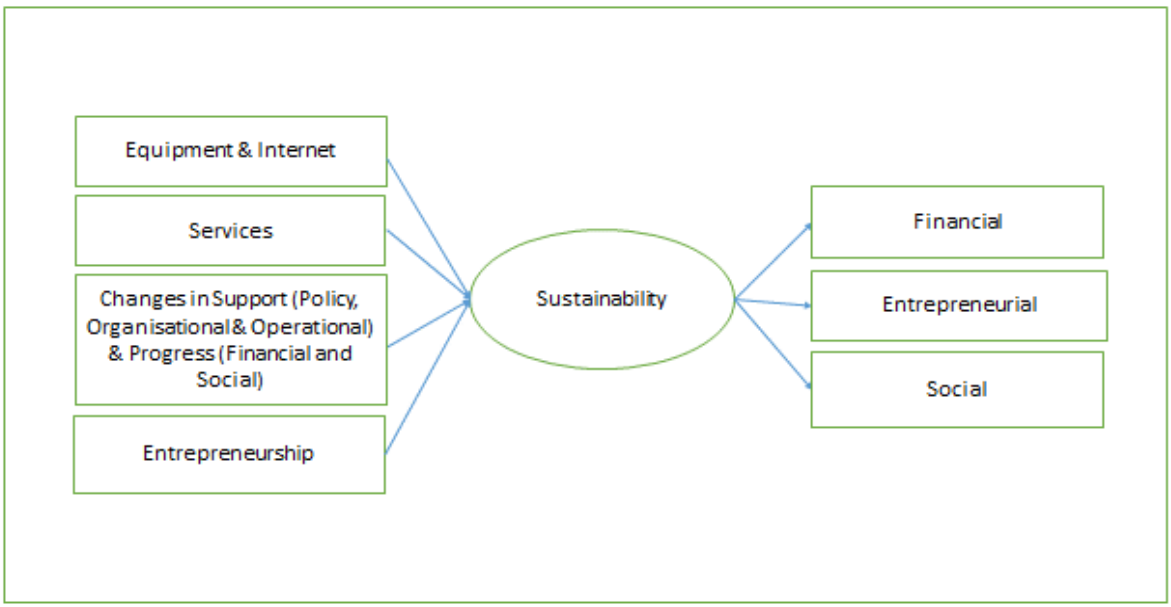


Figure 1: Operational Sustainability Framework of Telecentre under PPPP

This paper identifies key parties of the UDC as a partnership model together with their nature of involvement and contribution to UDC seeking to ascertain their impact on sustainability outcomes. In view of contributions in terms of inputs and supports provided by various partners, we make the following hypotheses.

(1) *Equipment and Internet have positive impacts on operational sustainability (Financial, Entrepreneurial and Social).*

(2) *Services have positive impacts on operational sustainability*

(3) *Changes in support (policy, organisational and operational) from government and people and subsequent progress over time have positive impacts on operational sustainability.*

(4) *Entrepreneur's involvement has positive impacts on operational sustainability*

METHODS AND DATA

The field research was undertaken over a period of two months (July-August, 2013) and comprised two parts. First, an online survey was conducted nationwide using the UDC blog (an online platform frequently visited by approximately 3000 entrepreneurs). Entrepreneurs were asked questions relating to dimensions of sustainability and social outcomes including participation of the disadvantaged. In the questionnaire some continuous variables are framed in a 5-point Likert scale considering the time and level of understanding of the target population. Some variables are categorised for the convenience of respondents (DeVellis, 2012; Kumar, 2011). The dependent variable "operational sustainability" is constructed using three observed variables (proxy for social and financial dimensions of sustainability) namely 'number of service users' and 'entrepreneur's income' and his/her 'satisfaction with the income'. Three independent latent variables are constructed using scales on types of 'equipment' and 'services' (representing technological and organisational dimensions) and ''changes in stakeholders' involvement and progress' in a year (time dimension). These latent concepts are named as 'equipment', 'services', 'change in one year' in the empirical model presented later. Other independent observed variables are 'entrepreneur's investment', his/her satisfaction with 'reduction of time and cost in delivery' (proxy for entrepreneur's involvement) and the 'internet connection type'.

Second, a total of 41 individual interviews were conducted with various stakeholders using semi-structured interview schedules to know more broadly about issues incorporated in the survey. The interviewees comprised 19 entrepreneurs, 12 supervisory officials and 10 Chairmen and members of the UP. Most of these interviewees came from 4 districts located at 4 different administrative divisions. The districts are *Comilla* from *Chittagong* division, *Jessore* from *Khulna*, *Bogra* from *Rajshahi* and *Rajbari* from *Dhaka* division.

The survey data are analysed using SPSS and AMOS version 21 (SPSS, 2012). Given the lack of past reported effect sizes, the interpretation of all effect sizes is presented as per Cohen's (1988) classification. The Structural Equation Model (SEM) is used to incorporate all the structural components and measurements (Buhi, Goodson, & Neilands, 2007; Garson, 2013; Gray & Kinnear, 2012; Pallant, 2012). Applying the SEM, the operational sustainability is predicted from both latent constructs and observed variables. Latent concepts, as mentioned earlier, are developed following the literature and/or Exploratory Factor Analysis (EFA) and Cronbach's alpha. Composite means from each of the concepts are used in calculating correlations and SEM. The results and discussion are founded primarily on the survey data complemented by interview findings and secondary documents.

RESULTS

Response rate and Missing data

A total of 538 entrepreneurs have participated in the online survey from all seven administrative divisions. The response rate is 27%, which is consistent with the typical response rate of other online surveys (Nulty, 2008; Shih & Fan, 2008). Despite having a large sample size (538) it is found that for all possible values 18% had missing values. The missing values are assessed in the SEM model by the use of Full-Information Maximum Likelihood (FIML) that provides accurate standard errors and better estimates (Abraham & Russell, 2004; Graham & Coffman, 2012). Moreover, in order to allow bootstrapping on 500 samples a separate analysis is undertaken with the data set imputed to start with by Expectation Maximization (EM). However, the results from data with missing values replaced with EM show no noticeable differences in terms of regression weights, standard errors and significance levels from the solution based on original data. Hence, the SEM solution based the on original data is accepted.

Factors of UDC sustainability

Equipment

The percentages of available equipment are presented in Table 1.

Table 1: Percentage distribution of working conditions of equipment.

Equipment	Good working condition n (%)	Moderate working condition n (%)	Out of order n (%)	Not being used for UDC n (%)	Not present in the UDC n (%)
Internet modem	331 (61.5)	151 (28.1)	16 (3.0)	8 (1.5)	32 (5.9)
Scanner	417 (77.5)	32 (5.9)	17 (3.2)	4(0.7)	68 (12.6)
Desktop computer	324 (60.2)	92 (17.1)	31 (5.8)	15 (2.8)	76 (14.1)
Laptop	344 (63.9)	60 (11.2)	35 (6.5)	20 (3.7)	79 (14.7)
Digital camera	314 (58.4)	65 (12.1)	68 (12.6)	6 (1.1)	85 (15.8)
Colour printer	262 (48.7)	102 (19.0)	79 (14.7)	2 (0.4)	93 (17.3)
Projector	308 (57.2)	49 (9.1)	61 (11.3)	9 (1.7)	111 (20.6)
Laser printer	218 (40.5)	48 (8.9)	108 (20.1)	2 (0.4)	162 (30.1)
Photocopier	193(35.9)	65(12.1)	63(11.7)	0 (0.0)	217(40.3)
Solar panel	68 (12.6)	24 (4.5)	21 (3.9)	3 (0.6%)	422 (78.4)
Generator	65 (12.1)	19 (3.5)	23 (4.3)	4 (0.7)	427 (79.4)
Nebuliser	24(4.5)	8 (1.5)	5 (0.9)	0 (0.0)	501 (93.1)

About 60% UDCs have such equipment as internet modem, scanner, desktop computer, laptop, digital camera and multimedia projector in 'Good working conditions' (Table 1). Less

available equipment for operations are photocopier (48%), solar panel (17%), generator (16%) and nebuliser (6%). Entrepreneurs use a few basic software programmes such as MS Office, Adobe, Photoshop and Antivirus, while the operating system is either Windows XP or Vista, as found through the interviews. The equipment-set currently available at the UDC is classified into three types:

(a) 'Basic Equipment' includes desktop computer, laptop, laser printer and internet modem.

(b) 'Picture Equipment' comprises digital camera, colour printer and scanner.

(c) 'Advanced Equipment' consists of multimedia projector, photocopier, solar panel, nebuliser and generator.

The latent construct 'Equipment' is made up of these three concepts and used in the SEM.

Internet

The most available equipment (Table 1) is the internet modem which is used for dial-up or mobile internet connection. The types of internet are the subject of a separate question and the percentage distribution shows that only 10% UDCs have broadband while the rest rely on dial-up (22%) and mobile internet (68%).

Services

The UDC provides a range of services (Table 2).

Table 2: Percentage Distribution of Frequently asked services from the UDC

Services/Information (ranked)	Very Often n (%)	Quite Often n (%)	Seldom n (%)	Never n (%)
Certificates	382(71.0)	106(19.7)	28 (5.2)	22 (4.1)
Computer compose	358(66.5)	128(23.8)	26 (4.8)	26 (4.8)

Photocopying	291(54.1)	88(16.4)	41 (7.6)	118 (21.9)
Email/Internet browsing	274(50.9)	153(28.4)	87(16.2)	24 (4.5)
Photoshoot	272(50.6)	122(22.7)	89(16.5)	55 (10.2)
Education Services	200(37.2)	142(26.4)	145(27.0)	51 (9.5)
Computer training	193(35.9)	142(26.4)	114(21.2)	89 (16.5)
Passport	155(28.8)	109(20.3)	185(34.4)	89 (16.5)
Job search/application	146(27.1)	118(21.9)	177(32.9)	97(18.0)
Mobile banking	130(24.2)	75(13.9)	136(25.3)	197(36.6)
Copy of land records	130(24.2)	77 (14.3)	122(22.7)	209(38.8)
Phone call/projector rent/song load	120(22.3)	83(15.4)	182(33.8)	153(28.4)
Electricity bill pay	117(21.7)	43(8.0)	35(6.5)	343(63.8)
Others	116(21.6)	68(12.6)	72(13.4)	282(52.4)
Information on education/health/agriculture	91(16.9)	90(16.7)	240(44.6)	117(21.7)
Telemedicine	22 (4.1)	19(3.5)	101(18.8)	396(73.6)

Certificates (91%) and computer compose (90%) are the most common services, followed by email/internet browsing (79%), photoshoot (73%), photocopying (71%), education services (64%), and computer training (62%). Less frequently demanded services include telemedicine (8%), electricity bill pay (30%), information on education/health/agriculture (34%), copy of land records (38%), mobile banking (38%), passport application (49%) and job search (49%).

Based on literature, EFA and Cronbach's alpha (produced in the Appendix table 1) these services are categorised into three types:

(a) 'Local Government Services' include certificates (birth), computer compose and photocopying.

(b) 'E-government Services' consist of electricity bill pay, copy of land records, mobile banking, passport and information on education/health/agriculture, telemedicine and

(c) 'Commercial Services' include email/internet browsing, education services (admission/registration/result check), photoshoot, job search/application, computer training, phone call/projector rent/song load and others (flexi load, data entry, laminating, mobile servicing, laminating, video conference, etc.)

The latent construct 'Services' is made up of these three concepts and used in the SEM.

Recent support dynamics and outcome change (July 2012-June2013)

In the internet survey, entrepreneurs were asked as what changes they had noticed in support services and consequent changes in outcomes compared to the same month in the previous year. The aim was to understand the continuity of policy, organisational and operational support from the government and their corresponding effects on sustainability in a year period. Their ratings are presented with percentages and scale (1 = Significant decrease to 5= Significant increase) mean in Figure 2.

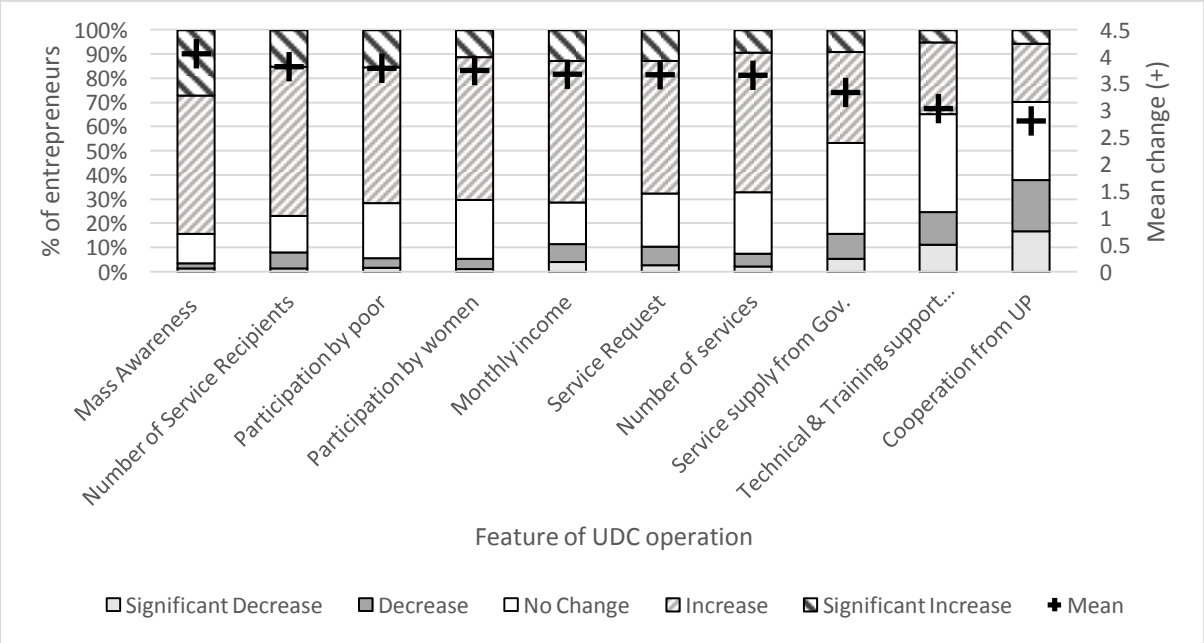


Figure 2: Change in stakeholders' involvement and progress in one year.

Service supply and technical and training assistance from the government have increased slightly over the past year (Figure 2). Cooperation from the UP has remained stable. The most noticeable increase has been reported in mass awareness, number of service recipients, and participation by the poor and women. These changes correspond with an increase in monthly income, service requests and number of services delivered. Three concepts of change are developed from these variables using EFA and Cronbach's alpha (Appendix Table 2).

(a) 'Service and income' consists of variables such as number of service recipients, service requests, number of services and income.

(b) 'People's participation' is indicated by mass awareness and participation by poor and women.

(c) 'External supports' are demonstrated through service supply from government, training support from local administration and cooperation from the UP.

The latent construct 'Change in one year' is made up of these three concepts, used in the SEM approach. Until now, we have described external support from the government and UP and recent changes in stakeholders' involvement. However, the contributions of the private entrepreneurs in the project should not be overlooked.

Entrepreneur's involvement

Rather than involving qualified entrepreneurs with investment assets and the attribute of efficiency, the government has engaged home grown local youths who are mostly weak on both criteria. Only 10 % of the internet survey respondents were female entrepreneurs, indicative of the general lack of female entrepreneurs. Data reveals that 45% of entrepreneurs are serving without any contract. Regarding computer training, essential for efficient operation, 32% have less than 6 months training. Only 7% are operating without any

computer skills. Most of the field level entrepreneurs have received some basic training on computer operations while a few have received extra training on e-service delivery and enterprise management. Given these circumstances, the investment made by entrepreneurs is considered as an important indicator of their engagement in the UDC.

Table 3: Percentage of entrepreneurs for investment

Investment categories in Taka	n(%)
No investment	49 (9.3)
Less than 20000	199 (37.8)
20000-50000	156 (29.7)
50001-100000	72 (13.7)
100001-150000	32 (6.1)
150001-200000	7 (1.3)
200001 and above	11 (2.1)

Although the UDC was in its third year at the time of survey, more than three quarters of entrepreneurs (76.85%) contributed an investment that was less than the minimum threshold of Taka 50000 (USD 650)(LGD, 2010) (Table 3).With the increment of investment, the percentages of entrepreneurs are dropping in general (Table 3).However, this investment excludes the day-to-day costs of operation and includes business investment such as purchase or maintenance of equipment. A number of variables described earlier are associated with the investment such as computer competency (rho [501] = .141; $p<0.01$) and contract with the UP (χ^2 = 15.25 [Fisher's Exact test]; $p<0.05$, Cramer's V=0.172; a small effect). Female entrepreneurs tend to invest less than that of their male counterparts (χ^2 = 15.49 [Fisher's Exact test]; $p<0.05$, Cramer's V=0.173; a small effect).

Another important value of PPP is the efficiency gain (Abelson, 2007; Hodge, 2004). Hence, it is important for entrepreneurs to be efficient in delivery of services in terms of reduced time and cost to thrive in the competitive market. Measured on this, 31% entrepreneurs are dissatisfied while 21% are neither dissatisfied nor satisfied. Dissatisfaction is due to slow internet and electricity blackouts causing delays and extra cost. On the other hand, 48% are satisfied or highly satisfied resulting an overall average of 3.28 in a scale of 5. Efficiency in time and cost has implications for income and daily turn out of clients.

Sustainability outcomes

Financial

Monthly income of entrepreneurs is a crucial determinant of financial sustainability because it excludes operating costs. It also adjusts the fluctuation as it is a perceived average from three months. Figure 3 shows the percentage distribution of monthly income of entrepreneurs.

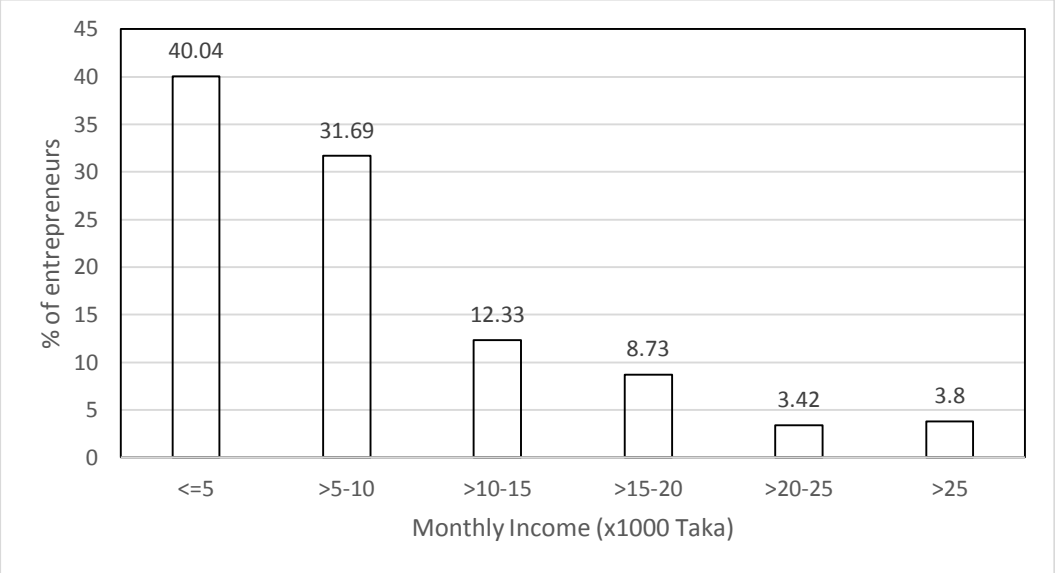


Figure 3: Percentage distribution entrepreneurs with monthly income

Of all entrepreneurs 40% earn a monthly income of Taka 5000 (65 USD) or less (Figure 3). Compared to monthly salary of UP secretaries and the market this income is certainly low and not sufficient for sustainability. UP secretaries are permanent government employees,

their monthly salaries range from Tk5200 to Tk.11235(LGD, 2014). However, nearly ⅓ of entrepreneurs' income is within the range of Taka5001 to 10000 while the remaining 28% earn above Taka 10,000 per month.

Entrepreneurial

Entrepreneur's satisfaction on income is considered as an indicator of entrepreneurial sustainability. This is also supported by interviews that suggest that among entrepreneurs with low income the satisfaction is very low and they tend to leave the UDC. The survey data shows that 11% entrepreneurs are highly dissatisfied, 26% dissatisfied, 21% uncertain while 33% are satisfied and the remaining 9% are highly satisfied. The average value for the scale is 3.04. The satisfaction on income is also correlated moderately with monthly income (rho [297] = .330; $p < .01$).

Social

Given the UDC was designed to bridge the digital divide, the number of people visiting the centre could be considered as an indicator of social sustainability. The reported number of service recipients adjusts the fluctuation as it is an average from three months.

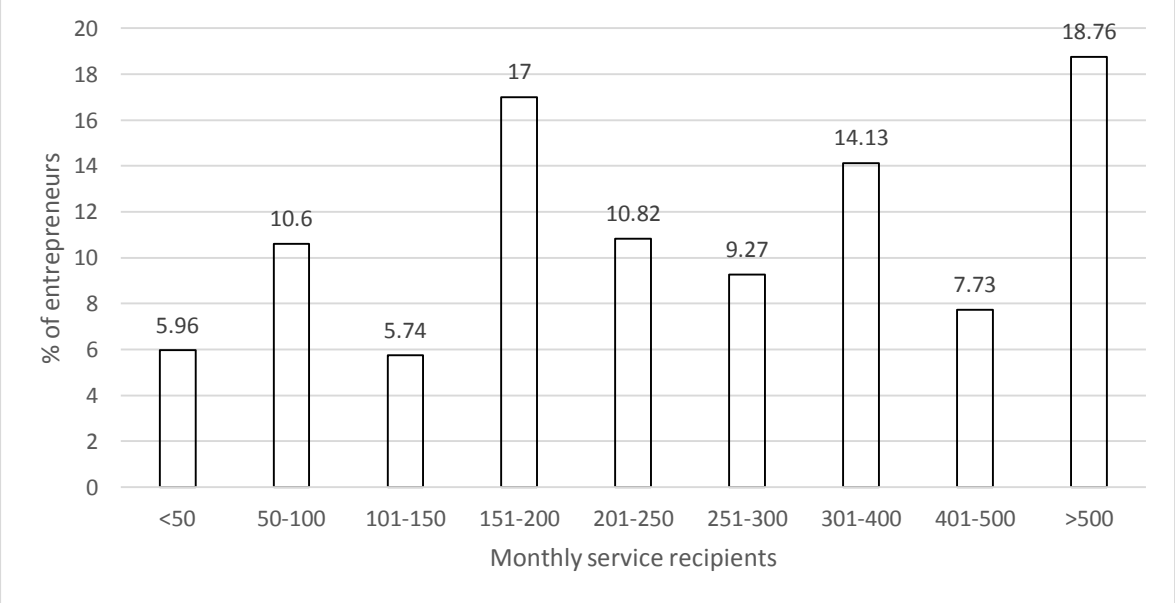


Figure 4: Percentage of entrepreneurs with service recipients per month

About 50% of entrepreneurs have visits by 250 or less service recipients. The remaining 50% are attended by more than 250 people. It is important to examine the composition of these people to ascertain whether the UDC can reach the disadvantaged. In this regard 50% entrepreneurs consider that women consist of 30-40% of their total recipients. 32% find it below that range while the rest 18% consider it 50% and above. 52% entrepreneurs estimate that the poor (men and women) comprise 30-50% of recipients; 30% consider it to be 60% and above while only 18% consider it to be 20% or less. Similarly, 50% entrepreneurs consider that 30-50% of recipients are illiterate, while 14% perceive that the figure is 60% and above.

The latent construct 'Sustainability' is made up of these three variables and used in the SEM.

Association between factors and outcomes

Pearson correlation coefficient is used between outcome variables and independent factors discussed earlier. Categorical variables such as income, investment and people's participation along with the composite variables are treated as continuous and midpoints of categories are used to calculate the correlation. Assumptions of Pearson *r* are checked and found to be correct (Gray & Kinnear, 2012; Pallant, 2012).

The correlation between equipment categories with monthly income is presented in Figure 5.

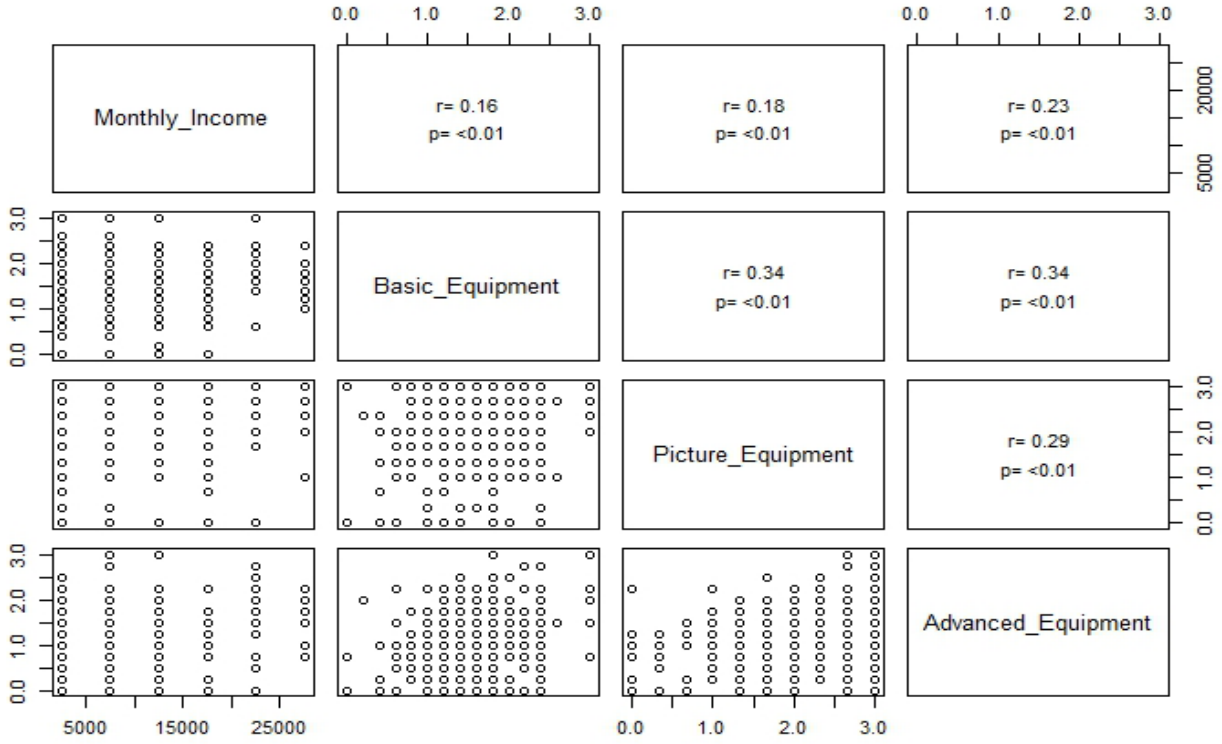


Figure 5: Correlation coefficients with scatterplots between categories of equipment and monthly income.

Picture equipment is significantly correlated with income with higher effects followed by advanced equipment and basic ones (Figure 5). The association between internet connection type and income is explored. The cross distribution of internet connection type and monthly income (not shown here) demonstrates that percentages are higher for broadband as the income categories progress. The association between them is found to be significant (χ^2 =10.80; $p<0.05$; Cramer's V = .165, a smaller than typical effect).

Usually, entrepreneurs with high income provide the greater number of services (Figure 6).

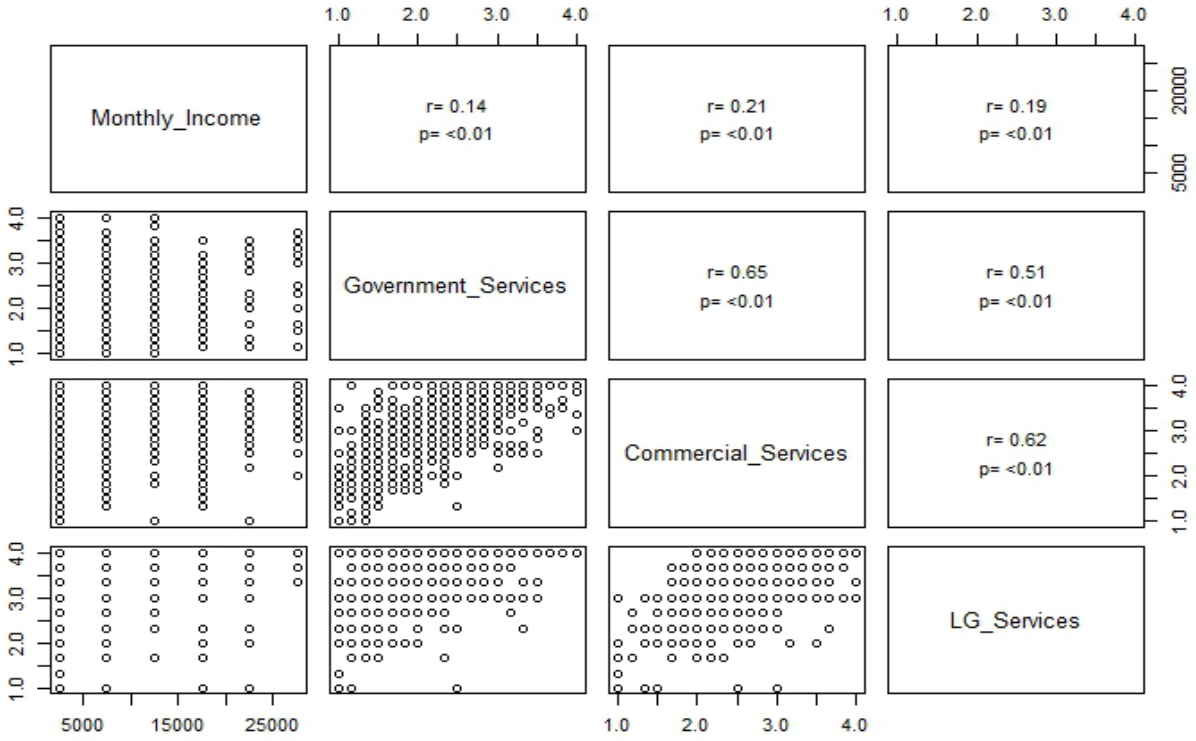


Figure 6: Correlation coefficients with scatterplots between categories of services with monthly income.

Local government services are significantly correlated with income with higher effects followed by commercial and government services (Figure 6).

The percentage distribution (not shown here) demonstrates that monthly income is higher for entrepreneurs having a contract with the UP. The association between them is found to be significant ($\chi^2 = 11.41$; $p<0.05$, Cramer's V=0.148; a small effect).

The income is also correlated with the money investment by the entrepreneurs and people's participation as presented in Figure 7.

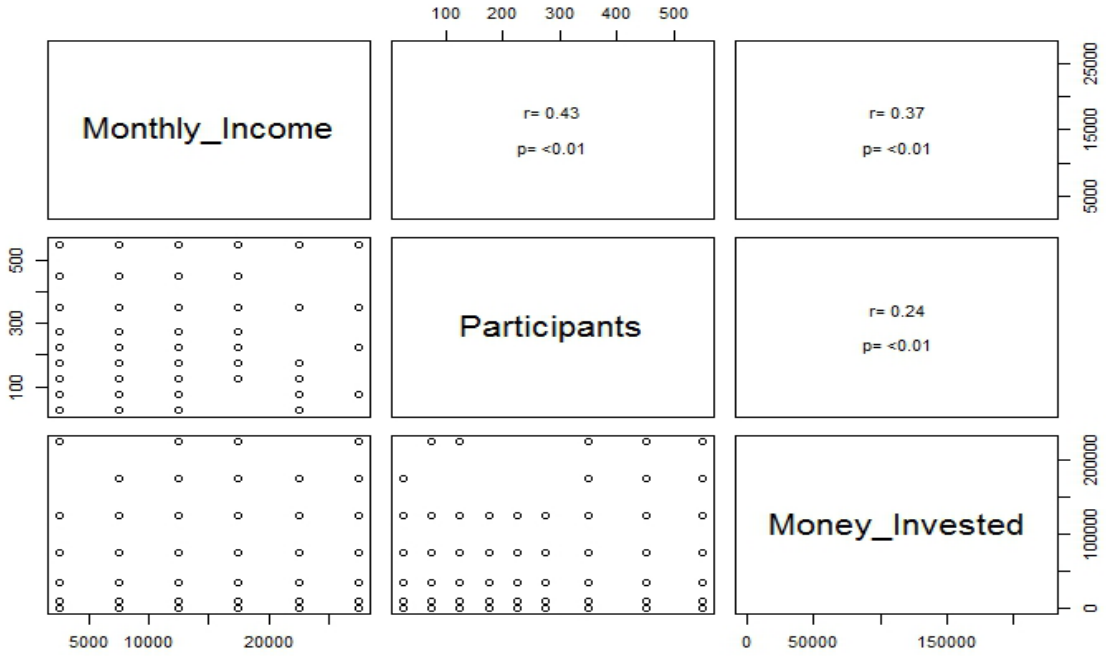
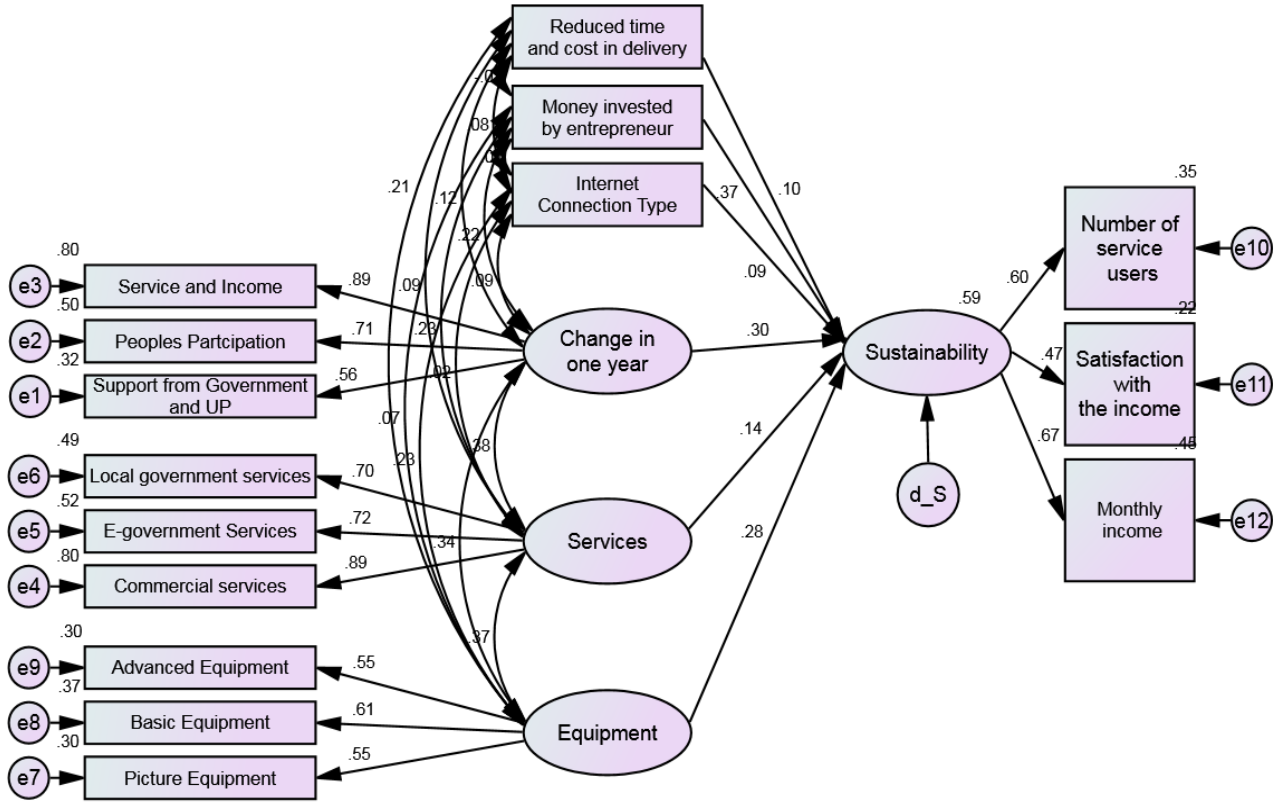


Figure 7: Correlation coefficients with scatterplots between investment, monthly income and people's participation.

The correlation between investment and income is significant with a medium effect (Figure 7). This correlation, however, is moderated by the internet connection type. For Dial-up or Mobile internet: r (417)= .326; $p < .01$; a medium effect. For Broadband: r (47) = .618; $p < .01$; a large effect.

These sustainability outcomes are predicted from factors discussed earlier using the SEM and presented in Model 1.

Model 1. Structural Equation Model of the UDC sustainability (standardised solution).



Model 1 demonstrates that 'equipment', 'services', 'change in one year', 'internet', 'entrepreneurship' contribute to 'UDC sustainability' (financial, entrepreneurial and social) by explaining 59% of total variance of it. While the χ^2 value produced by the model is significant [χ^2 (72) = 150.68. p<.000], this is justifiable given the large sample size. Other measures of model fit (CMIN/DF = 2.09; NFI = .91; IFI = .95; CFI = .95; TLI= .92; RMSEA = .045) are within the acceptable thresholds (Buhi et al., 2007; Hooper, Couglan, & Mullen, 2008).Since these factors are components of partnership our broad hypothesis that inputs from relevant stakeholders lead to UDC's sustainability is partially supported; all regression paths in the model except that of 'reduced time and cost' are significant at p< .05 as presented in Table 4.

Table 4: Results of SEM on Effects of Predictors on Sustainability

Construct	Beta	SE	P	Remarks
Equipment	0.280	.058	***	Significant
Services	0.138	.052	.032	Significant
Change in one year	0.301	.040	***	Significant
Internet connection type	0.092	.061	.088	Marginally Significant
Money invested by entrepreneur	0.371	.062	***	Significant
Reduced time and cost in delivery	0.096	.066	.235	Not Significant

In terms of unique contribution, the highest and the lowest factors are 'investment' and 'internet connection type' respectively (Table 4). The effects of all factors are elaborated in the discussion.

DISCUSSION

The study has examined sustainability of the UDC with a focus on the current state of affairs and the contributions of key actors assessing their impacts in financial, entrepreneurial and social terms. The major findings are detailed below:

Equipment and Internet

To begin with operational inputs, there is a difference in the scale of equipment with respect to both their number and types across UDCs (Table 1). Whilst basic equipment is common, picture and advanced equipment are only partially available. A combination of equipment is associated with the generation of increased income by serving a greater number of clients (Figure 5). Equipment is, thus, one of the dominant factors that underlies sustainability with a

regression value of 0.28. This means that when the presence of equipment with good working condition goes up 1 standard deviation the sustainability goes up 0.28 standard deviations. This is also relevant to all regression values (Table 4). The literature (Jensen & Walker, 2001; Wellenius, 2003) suggests that generally telecentres are expected to have ICT and other office equipment such as computers, printers and photocopiers, scanners, CD writers/burners, digital camera/video cameras, projectors, radio and TV. A multi-computer environment is necessary for internet access, ICT training and other services. Telecentre being primarily a technology outfit (Liyanage, 2009), appropriate choice of ICT equipment and associated software is critical for multimedia services (Oestmann & Dymond, 2001).

Also, UDCs vary in terms of internet connection type; those with broadband are able to provide an increased number of services. There are significant correlations between 'internet connection type' with 'equipment' and benefits of 'reduced time and cost' ($r = .28$ and $.08; p < .05$, respectively) (Model 1). In other words, broadband allows efficient use of equipment thus making quicker delivery, reduction of cost and transaction of greater volumes possible. However, lower magnitude of contribution (Beta = .09) from the internet to sustainability can be attributed to the country's overall fragile internet infrastructure which is unable to provide speedy connection even with broadband (UN 2014). Only 100 UDCs are given wired broadband connection under a World Bank project. The other broadband users are to rely on mobile broadband which is relatively slow, a fact confirmed by interviews. More recently, UDCs that are within the vicinity of district/sub-district headquarters have come under the coverage of 3G wireless broadband. Yet, most entrepreneurs do not use this form of connectivity because of higher cost and lack of skills to provide internet-based services. Our interviews confirm that both dial-up and mobile connections are slow and inadequate for video streaming or data sharing. Some UDCs depend on stand-alone computer based services which restrict their income potential.

Services

As with equipment, service supply from stakeholders varies across the board (Table 2). While some UDCs provide government services and thus have a wider clientele base, others are restricted to providing UP service or certificates and a few ICT based commercial services. Most of the e-government services are yet to be available countrywide. Out of four districts, considered for interviews, only *Jessore* offers full range of government services. Thus, despite having ICT hardware, some UDCs suffer from lack of associated services to optimise the use of equipment. For instance, though multimedia projector is available in 66% UDCs (Table 1), it remains mostly underutilised for lack of display initiatives. Similarly,

contrary to one of UDC's most important goals, there are very few instances of developmental services such as education, health or agriculture that can promote people's improved livelihood being provided (Hanna, 2010). 'Services' are contributing to the sustainability in a smaller magnitude (Beta = .14). However, it is correlated with 'equipment' and 'change in one year' with medium effects as shown in the sustainability model ($r = .37$ and.38, $p < .05$ respectively) (Model 1). This finding supports the theory that a multiplicity of equipment facilitates a variety of services (Oestmann & Dymond, 2001) and both of which had been on increase in one year, as supported by public partners (Figure 2). Other variabilities in levels of training, monitoring and supervision by the government become evident through both survey (Figure 2) and interviews. However, such variabilities in the external inputs are not the only factors responsible. The private entrepreneur's involvement also plays a significant part to the sustainability.

Entrepreneurship

As a single factor, an entrepreneur's investment contributes to the sustainability the most (Beta = .37). A larger effect from investment validates the strategy for partnership with

private individuals under PPP for investment. It also indicates the importance as well as the necessity of investment by entrepreneurs for those UDCs which are yet to achieve financial and social benchmarks. We have noted in the field that entrepreneurs who made higher levels of investment added extra equipment; rented separate shops to provide training; organised a greater number of awareness campaigns and purchased better quality internet. The interviews with entrepreneurs suggest that savings from their personal income serve as the primary source of investment in the absence of any loan from the government. This indicates that the UDC can play a role in enterprise development in rural areas.

However, many UDCs are without full time entrepreneurs (especially female), mostly due to insufficient income opportunities for two entrepreneurs (Faroqi, 2015). Also, entrepreneurs could not demonstrate high efficiency, as could be seen from the insignificant contribution made in terms of 'reduced time and cost' in delivery' (Table 4). This might be due to a lack of skills among entrepreneurs in addition to slow internet and electricity problems. Thus, entrepreneurs with higher investment could not even make any difference in efficiency, also supported by insignificant correlation ($p<.05$) between 'investment' and 'reduced time and cost' (Model 1). These issues, together with poor relationships with local UP explain high dropout rates among entrepreneurs.

Policy and Organisational Support

Governmental policy and organisational support in areas like recruitment and training of entrepreneurs and the monitoring and evaluation of the UDC are less evident. While lack of funding is used as an excuse for limited investment in the UDC, the government is yet to make use of approximately US$ 500 million Social Obligation Fund (SOF) collected from telecom providers (Hasan, 2014). The government appears to be slow in making its own services available through the UDC or in forging partnerships with other service suppliers. Unavailability of skilled candidates in the market as well as fear of retention, if found, are

used to justify the recruitment of weak entrepreneurs. The UDCs certainly do not receive the same level of support and cooperation from the local UPs. Nevertheless, the entrepreneurs, consider that the support from the government and the UP over a year period has seen a modest increase (Figure 2).

Despite such limitations, the UDC is increasingly becoming popular reflecting demands for ICT-based services at the grass roots level (BBS, 2014; Prothom_Alo, 2014; World Bank, 2015). We have seen the most noticeable upsurge in people's participation in a year period compared to supply of services, technical and training assistance from the government and cooperation from the UP (Figure 2). An increase in people's participation along with policy continuity, organisational, and operational support from government is the second largest contributor (Beta= 0.30) to sustainability (Model 1). This indicates how important it is for the UDC to receive continuous support from the government, besides increased people's participation as service recipients.

CONCLUSION & POLLICY IMPLICATIONS

This study has examined the UDC as a partnership model of telecentre. It shows that although not all UDCs offer the whole range of services as envisaged, the UDC model has some major strengths. These include the presence of vital ICT infrastructure including the internet, availability of multiplicity of services, generous governmental support and entrepreneurial engagement in terms of investment and skills. It also shows that the involvement of and supports from key partners have significant bearing on operational sustainability of the UDC, although there are significant variations among them in terms of their contributions and impacts. Furthermore, the study shows the areas where the UDC performance has fallen short of expectations, perhaps not surprising given the current stage of its development.

The findings of the study highlight several implications for policy and practice. As the UDC is still at its early phase strong policy and organisational support would be vital to ensure smooth operations and services that ultimately determine the sustainability of the project. Hence, it requires continuing guidance from above in the form of clear policy framework, organisational as well as operational support until the system matures and entrepreneurship takes root in rural areas. As a leading actor in the UDC model of partnership the government is required to do lot more than devising policy directives and supplying basic ICT equipment and tools. While all this serves as building blocks for UDCs allowing them to get off the ground, the need for local capacity building and development of entrepreneurship cannot be overemphasized. The current approach seems to be inadequate in effectively engaging the local entrepreneurs and in keeping them in business. As investment by local operators is the biggest change maker which enables telecentres to grow and increase their range of services, it is vital that alongside training they be given access to credit for increased investment coming from the entrepreneurs. It is important that the UDC operators are better linked with local administration including the Union Parishad and Upazila administration so as to ensure smooth running of UDCs through integration of services and through effective monitoring and oversight.

Equally important is the need to widen the range of services available throughout the country to enable the UDCs to become truly a multipurpose community telecentres. Likewise, without adequate coverage and affordable broadband in rural areas the UDCs are unlikely to make much headway in providing seamless delivery of services as envisaged in the plan. Therefore it is an imperative that the UDCs throughout the country be connected to fast and reliable broadband as soon as practicable. On their part UDCs should acquire variety of socially appropriate equipment that are in good working condition. Especially, low cost and easily maintainable equipment, like a camera, scanner and printer, can help raise their

incomes significantly. Acquisition of reconditioned items and local level repair arrangement can reduce costs yet providing sustainable solutions. To become a multipurpose community hub telecentres must offer all types of services ranging from private, commercial to governmental ones. Of particular significance are governmental services that currently remains extremely limited in most cases. Availability of governmental services is not only vital for operational sustainability of the UDC, it has implications for the broader objectives of socio-economic development. Therefore, even though the UDC model of telecentre has shown promising signs, moving it beyond its current level would require continued and firm commitment on the part of government. Until private entrepreneurs are ready to own and manage the UDCs effectively the government is required to support the project to optimise its financial and social outcomes and to drive it towards sustainability.

The experience of UDC implementation can be qualified to the concept of bricolage or tinkering through the combination of available resources. Like bricolage 'the operational sustainability' enables us to understand the emerging situation, new applications and aberrations from the general model. We have learnt that cues from a situation are more reliable and local solutions can be adopted in a heuristic fashion and reflective way.

The operational sustainability model presented in this study is an attempt to understand the ecosystem of a telecentre by focusing at some of the critical variables that determine UDC's financial and social outcomes. While we endeavoured to take into account some of the most significant aspects there is still room to broaden the scope by considering such factors like time spent by operators, their educational qualifications, closeness of the telecentre to people's usual place of gathering, additional technologies and services to advance the model in future studies. Also, there is scope for using real measures instead of those based on perception (e.g. change in one year). Future research with such focus will help test the

validity of our model and provide further insights on bricolage or operational sustainability of telecentres in developing countries.

APPENDIX

Table 1 Factor Analysis on the frequently asked services and their reliability

Factor	Factor Items	Factor loadings	Cronbach's Alpha
E-government Services	Electricity bill pay	.681	.764
	Copy of land records	.636	
	Telemedicine	.518	
	Mobile banking	.494	
	Passport	.418	
	Information on education/health/agriculture	.373	
Local Government Services	Computer compose	.708	.553
	Photocopying	.399	
	Certificates	.374	
Commercial Services	Email/Internet browsing	.710	.773
	Education services	.653	
	Photoshoot	.624	
	Job search/application	.569	
	Computer training	.508	
	Phone call/projector rent/song load	.488	
	Others	.312	

Table 2 Factor Analysis of variables of perceived changes in one year and their reliability.

Factors	Factor Items	Factor Loadings	Cronbach's alpha
3.Support by Government and UP	Service supply from the Government	.821	.734
	Technical and Training assistance from the local administration	.750	
	Cooperation from the Union Parishad	.538	
2.People's participation	Participation by poor	.746	.880
	Participation by women	.723	
	Mass Awareness	.398	
1.Service and Income	Monthly income from the UDC	.748	.794
	Service requests (per month)	.718	
	Number of service recipients (per month)	.660	
	Number of Services delivered	.588	

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The basic findings of the paper can be summarized as follows:

The study has identified relevant inputs for the UDC that are delivered through partnership ecosystem consisting of government, local government and private entrepreneurs. Application of a structural equation model confirms that both financial and social outcomes of the project are dependent on inputs and contributions of various stakeholders. The paper concludes that effective engagement of private entrepreneurs alongside governmental patronage is required for ensuring sustainability of all UDCs.