The Fuzzy Front-End of Transformation: An Inquiry Protocol for Intervention Design

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Abstract: Donella Meadows' concept of leverage points - places in complex systems where small shifts may lead to fundamental changes in the system as a whole - is gaining attention for developing a 'leverage points perspective' on systems transformation. Distinguishing a 'system of interest' as well as identifying 'where' and 'how' to intervene for 'whom' are all matters of practical relevance which remain to be properly addressed. We contribute an inquiry protocol to identify opportunities for design actions aiming to trigger transformations in complex human systems. Our system of interest for empirical study is the informal trade ecosystem at the borderlands of the East African Community. We describe the rationale and logic for methodological development of an inquiry protocol which sequentially integrates contextual research and user inquiry with open-ended exploration at inception to identify and describe *intervention points*. This deepens a previously contributed study from the same project to DRS 2018.

Keywords: leverage points perspective, fuzzy front-end, inquiry protocol, informal economy

1. Introduction

Opportunity spaces for designed interventions in a system in order to induce change were named leverage points by Donella Meadows (1999). Abson et al. (2017) departed from Meadows (1999) to generate an epistemological positionality (Singh 2021) for taking a 'leverage points perspective' (LPP) on system transformations for sustainable futures (Riechers et al. 2022; Burgos-Ayala et al. 2020). LPP is a relatively novel approach for thinking about complex societal challenges and unstructured problem spaces (sometimes called 'wicked'), and scholars are still developing future research agendas (Riechers et al. 2022; Murphy 2022; Allen & Malekpour 2023; Abson et al. 2017). Operationalizing this perspective for empirical work in sustainability research has just begun (Riechers et al. 2022) and questions of 'where' and 'how' to intervene are being explored with indigenous knowledge-holders (Burgos-Ayala et al. 2020). In design, LPP is a framework (for ex. McKay et al. 2025); a seed for novel theory (Murphy 2022); a driver for transformative co-design (Hakio &

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Mattelmaki 2023) as well as sustainability transitions (von Flittner et al. 2022). However, operationalizing the LPP to identify *where*, *how*, and for *whom* ('users') one can design interventions remains to be developed.
Abson et al. (2017) divide the twelve leverage points identified by Meadows (1999) equally under four types of system characteristics further categorized by effectiveness. Table 1 provides a summary.

Table 1 Elements of a Leverage Points Perspective (Burgos-Ayala et al. 2020, Abson et al. 2017)

Effectiveness	**Type**	**Description**
Shallow leverage points	Parameters	The relatively mechanistic characteristics or physical elements typically targeted by development programs
	Feedbacks	Interactions between elements within a system that drive internal dynamics
Deep leverage points	Design	The social structures and institutions that manage feedbacks and parameters
	Intent	The underpinning values, goals, and world views of actors that shape the emergent direction to which a system is oriented.

This approach to LPP generates a novel epistemological view of systems (Abson et al. 2017; Reichers et al. 2022). Abson et al. (2017) elaborate:

> As such, a 'system' is bounded and defined by the subjective interests and pre-analytic assumptions of the researcher, with all the potential problems this entails. This epistemological approach means that particular importance must be placed on how, and why, the researcher chooses to delineate a system and what implications this has in the context... Following Ison (2008), we use the term 'system of interest' to acknowledge that systems are, in part, defined by the worldviews and concerns of researchers and other actors involved (Abson et al. 2017, Box 1).

Adopting this approach generates agency for design knowledge-making at the fuzzy front-end of transformation. The argument for taking a LPP is that the majority of interventions tend to focus on shallow leverage points which are easier to identify and address yet bring about little change to the overall functioning of the system (Meadows 1999; Abson et al. 2017; Riechers et al. 2022). Instead, a 'focus on perhaps less obvious, but potentially for more powerful areas of intervention' (Abson et al. 2017) such as deeper leverage points which address system characteristics viz., Design and Intent (Table 1) informs a LPP.

Donor-funded development programming such as that designed and implemented by the project client for informal cross-border trade (ICBT) is intended to trigger transformations in the social and economic circumstances of peoples deemed to be underprivileged, economically challenged, and/or otherwise disadvantaged in their societies. In our project, the agenda was to generate empirical evidence through a human-centered lens which would not only provide understanding of the dynamic interplay of informal trade activities in the system of interest but provoke a 're-think' (Abson et al. 2017) for intervention design. Taking a LPP in this situation required adaptation of contextual research as developed for the fuzzy front-end of product development (Conley 2005) and sequencing with user inquiry for a design knowledge-making protocol (Bhan & Tedjokusumo 2025) oriented towards exploration and diagnosis in complex problem spaces and novel operating conditions (Bhan & Rytilahti 2026). In this way, we contribute a deeper dive into the logic and rationale of our methodology, the results of which were published in DRS 2018 (Bhan & Gajera 2018).

2. Theoretical and Conceptual Backdrop

For Abson et al. (2017), there are three realms of deep leverage: Re-structure; Re-connect; and Re-think. *Re-structure* emphasizes research on fostering structural change in institutions and thinking about institution design in novel ways (Abson et al. 2017). An example of such work would be Vink & Koskela-Huotari's (2021) mapping of the invisible social structures in heavily institutionalized contexts which nonetheless remain influential for the success of service design outcomes. *Re-connect* considers the challenge faced by knowledge-makers in the Euro-Western academy whose research paradigms are predicated on a deep and unbridgeable divide between humankind and the rest of nature. Indigenous knowledge systems do not recognize such a divide (see Abdilla et al. 2021), and scholars are contributing novel research paradigms (Chilisa 2019), frameworks (Reano 2020), as well as incorporating the work of Abson et al. (2017) to integrate the leverage point perspective with an indigenous worldview (Burgos-Ayala et al. 2020). *Re-think* looks at 'how knowledge is produced and used' (Abson et al. 2017). The short extract below encapsulates the issues of concern which emerged in our case context and which we address with our inquiry protocol.

> Much of human action is path dependent, building on the way things have been done previously and relying on established, often institutionalized, knowledge. Considering path dependencies in how we perceive and produce knowledge could be a key lever for sustainability transformation. *It is broadly acknowledged that the way in which problems are framed and how knowledge is produced has significant implications for policy development and societal outcomes.* Re-thinking knowledge for sustainability transformations *requires an understanding of how knowledge flows through systems of interest, and how we identify the goals and expectations of sustainable transformations (intent) or select the methods and means that help us to get there (design)*. (Abson et al. 2017)

It is at the front-end of system transformation where we navigate the early stage of uncertainty through exploration and discovery of a complex problem space (Bhan & Rytilahti 2026). Anticipatory design knowledge must be generated to inform 'the way in which problems are framed' and to resist path dependency (Abson et al. 2017), a serious matter of concern in our empirical study. Dominant narratives on ICBT are heavily path dependent on decades of deficit-laden and damage-focused Western scholarship (Kinyanjui 2010; Mkwandawire 2001). In the East African Community (EAC), ICBT was originally recognized as

an unrecorded (informal) livelihood activity, not an illicit one (Ackello-Ogutu & Echessah 1997, 1998). However, at some point over the years, a conflation occurred of licit although unregistered trade with illicit activities such as smuggling and tax evasion. This 'criminalization' of ICBT generates a hostile environment for legitimate traders, particularly for women in trade (client reports). It was clear that a complete 're-think' of knowledge production would be required if we were to successfully meet our own project goals to identify opportunities for intervention which reflected the ground reality at EAC's borderland markets.
Operationalizing LPP for empirical research is discussed in detail by Riechers et al. (2022), however they choose not to focus on how to identify leverage points in specific systems (p.2). Instead they explore how to a) navigate diverse research paradigms in inquiry design; b) choose relevant and appropriate research methods; c) gauge the likely transformative potential of an intervention; to d) possibly implementing such interventions (Reichers et al. 2022).
Our paper fills the necessary gap at the fuzzy front-end of transformation by taking a design methodological approach which frames identifying leverage points as opportunities for future design actions. We call these opportunity spaces 'intervention points' to speak to common understanding.

2.1 Adapting Contextual Research for a Novel System of Interest

Both designers on the team were from the Institute of Design, Illinois Institute of Technology (ID): a graduate school which prides itself on its methods (Wasson 2000; Laurel 2003; Kumar 2012). We shared a holistic and interdisciplinary approach (Wasson 2000) to contextual research and user inquiry at the 'fuzzy front-end' of new product development (Conley 2005) specializing in Design Planning (Wasson 2000; Bhan & Rytilahti 2026). Conley (2005) uses 'contextual research' to distinguish inquiries at the front-end of new product development from those of the social sciences (p. 229). Although 'contextual research is based on the ethnographic methods of anthropology' (Conley 2005, p.231) and is similar in intent to contextual inquiry (Beyer & Holzblatt 1999), it takes a holistic view of the entire ecosystem within which design actions are to be planned. That is,

> A contextual viewpoint broadens what the company looks at in relation to its products or services. The context includes the people involved, activities and processes surrounding the product, inputs and outputs of those activities, other products used in conjunction or simply that are present, and environmental conditions. (Conley 2005, p. 230)

Ergo, we are guided to inquire with a 'context-centric' viewpoint which 'reveals opportunities for improvement' (Conley 2005, p. 231). For mapping a 'system of interest', taking the more epistemological view as described by Abson et al. (2017, Box 1) a holistic context-centric viewpoint would be most appropriate to identify 'opportunities for improvement' (Conley 2005, p. 231) i.e. intervention points in the system.
However, as we found, Western-theorized inquiry methods are rooted in the operating conditions where they were originally developed and/or theorized: developed economies with sophisticated consumer cultures and an abundance of data. They assume access to demographic data including education, employment, income levels, and other attributes for user segmentation. And so, implementing these methods rarely requires any initial exploration or discovery to map and visualize the entire socio-economic system within which

participants will be selected and/or recruited for design inquiries (Bhan & Gajera 2018). Baseline indicators are assumed to exist as a foundation on which to plan, design, and test protocols for user inquiry, and even, contextual research as described by Conley (2005). When faced with the complex human system which describes informal cross-border trade in East Africa's borderlands, our available body of design methods (Kumar 2012) were unprepared for the challenge posed by a complete lack of data. We would have to develop our own protocol for front-end inquiry that was fit for purpose if we were to resist path dependency in knowledge production (Abson et al. 2017).

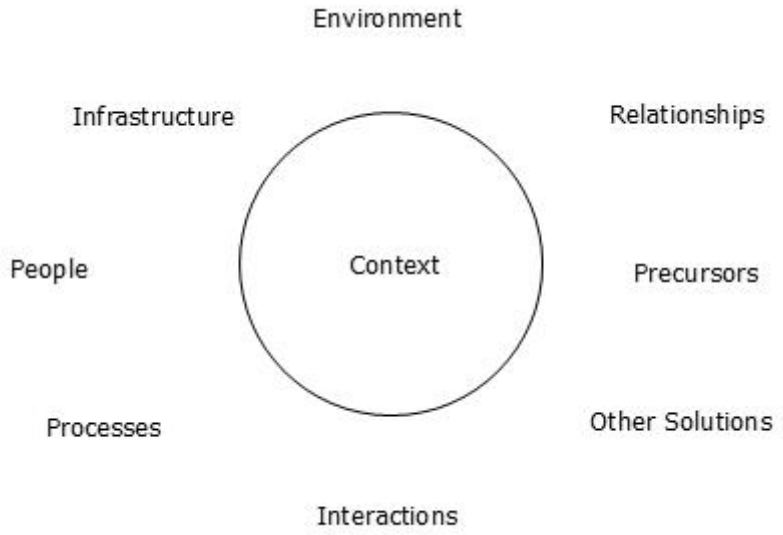


Figure 1 A Context-Centric View of the System of Interest, adapted by Niti Bhan from Conley (2005)

Illustrating the context-centric viewpoint for front-end inquiry, Figure 1 adapts Figure 15.1 from Conley (2005, p. 230) by including *Infrastructure* and *Precursors* in addition to changing the phrase 'Other Products' to state 'Other Solutions'. The additions reflect the explicit need to observe and document differences in operating conditions (*Environment*). The built environment (*Infrastructure*) taken for granted in industrialized countries, such as infrastructures meant for financial transactions, information exchange, communication, transportation, logistics, etc., will be very different in the EAC, and vary from border to border. For instance, the numerous market towns dotting the vast border between Uganda and the Democratic Republic of the Congo (DRC) must bridge a number of systemic infrastructure differences rooted in disparities created by the relative stability of Uganda versus the fragile and volatile eastern DRC. This is very different from borders of Kenya and Tanzania, both relatively stable economies which share Swahili as a national language. That is, borderland 'systems of interest' will each differ in type, quality, variability, and languages for their own peculiar infrastructures, environments, and thus,operating models for systems depending on which two countries in the EAC are adjoining. Without adapting Conley's context-centric viewpoint accordingly, such systemic differences will be overlooked during contextual research thereby adversely influencing design development.
That is, even a broader and holistic context-centric view (Conley 2005) leaves unexamined the assumption that operating conditions are much the same wherever contextual research is to be conducted. While this might be the case between Chicago and San Francisco in the

United States, where the approach was theorized and methodologically developed, it cannot be assumed, even for Paris, France although both countries are similarly developed relative to the EAC. Conley (2005) uses a gym or a supermarket as examples of different environments thus reflecting the implicit assumption embedded in his contextual research approach that the larger ecosystem or operating environment does not require inquiry. Whereas, our work makes clear the need to consider the jurisdiction (the location or place with all its operational systems, infrastructures, rules, regulations and laws) as important a user research factor as understanding the people themselves (Bhan 2009b). In the African context, unexamined assumptions have a track record of expensive design failures, even at the first prototype stage (Patterson, Sim, & Aiyelokun 2009).

Precursors and use of *Other Solutions* (Figure 1) to expand Conley's (2005) original phrase "Other Products" (Figure 15.1, p. 230) reflects the adaptation of contextual research from its commercial roots in new product development for consumer goods manufacturers for complex societal challenges, unstructured problem spaces, and informal socio-economic environments (Bhan & Rytilahti 2026). When adapting human-centric design approaches (process, protocols, methods, and tools, among other things), it is not simply a competitive landscape for introducing a novel product or service in a crowded market which we are aiming to understand but the full complexity of a human social system. Here, the dynamics of the entire operating environment of ICBT must be grasped order to identify touchpoints for intervention design, i.e. the opportunities to intervene in the system in order to facilitate transformation. In our project, the client goals for positive beneficial transformation sought to address what are called non-tariff barriers (NTBs) to boost trade and revenues. The majority of ICBT are women who face NTBs such as sexual harassment, confiscation of trade goods, asymmetry of information, and an overall hostile environment due to criminalization as mentioned earlier. That is, how could the systemic frictions currently experienced in ICBT be smoothened, and how might these interventions be best designed is the motivation. Therefore, the goals of inquiry are re-articulated for an LPP as follows: To identify leverage points in *this* particular system (Meadows 1999) for *these* particular people (Bhan & Gajera 2018), supported by thick description of context and rationale for design of development programming - the interventions intended to trigger a transformation of a particular circumstance (NTBs to trade, for instance) or enhance productivity and prosperity for a particular population group. Thus the points of intervention in this system become design drivers in a human-centered design project.

3. Methodology

The overarching goal of our contextual research was to map the dynamics of informal trade as confined to the peculiar operating conditions of an East African borderland, as a system of interest, and identify intervention points i.e. where, how, and for whom would an intervention be designed. In this study context, we faced two challenges. The first, a lack of differentiation between the illicit and the unrecorded but licit trade which paints the region's entire informal economy with the broad brush of criminality (Bhan et al. 2016, p.14). Not only was there no harmonization between competing definitions of ICBT in the EAC (Bhan 2016) but understandings of the informal economy, as an operating environment, were often contradictory and internally inconsistent (Kanbur 2017). Thus, the second challenge relates to the entire informal economic ecosystem being treated one undifferentiated mass (Kanbur & Keen 2015), and no effort had ever been made to distinguish or segment ICBT in

any way other than to count heads by gender, geography, and various damage-focused indicators (Bhan 2016). For the client's purposes, this existing body of knowledge reflected the path dependency and its drawbacks as described by Abson et al. (2017) as it perpetuated stereotypes and raised barriers to recognition of trade as a profession (Bhan et al. 2016; Bhan 2016) and thus its de-criminalization as a means to diminish NTBs. There was little evidence of understanding of the informal economy as a commercial environment, such as for ICBT. Interpretations of observed behaviour were made through the lens of the formal economy, whose metrics left the informal economy wanting. Far too many unexamined assumptions were uncovered in the review (Bhan 2016). It was clear a re-think (Abson et al. 2017) was required. This path dependency (Abson et al. 2017) painted a picture of regional ICBT as an undifferentiated mass of humanity, all uniformly underprivileged, with their economic activities nothing more than survival strategies. This is notable even in gender studies: they rarely acknowledge the existence of successful women traders , much less represent them as anything other than hapless victims of their circumstances (Kinyanjui 2010, 2019).

Thus, it was no surprise that solutions and services often did not fit the context and the operating environment of the intended target audience and a 'one size fits all' mentality drove development programming design. Our re-think of knowledge production (Abson et al. 2017) would have to begin from scratch to facilitate understanding of the borderland's informal trade ecosystem well enough to generate concepts that were fit for purpose, much less identify the key actors in the system for deeper user inquiry (Bhan & Gajera 2018).

3.1 Protocol Sequence: Logic and Rationale

However, as mentioned above, the lack of available data and the need to resist path dependency meant we had to begin with exploration and discovery before we could even identify our 'users'. At inception, our working hypothesis was informed by previous observations in informal rural agricultural ecosystems (Doorneweert et al. 2014; Bhan 2009a) that the economic activity of the borderland ecosystem, while distinct from the surrounding region, linked back to the hinterlands through relationships and social networks, informal trade flows, and value transactions (Bhan & Gajera 2018). We expected to find a complex web of value exchange (Doorneweert et al. 2014), underwritten by trust and kinship (Hart 2000), at the last mile of trade. The hypothesis assumed existence of ICBT actors whose reach and impact on their communities and local economies were relatively much greater than that of others (see details in Bhan & Gajera 2018). Our logic was that if we were able to discover and map these key nodes in the system of interest, we could identify the touchpoints for interventions that would offer an optimal return for resources invested, as commissioned. It is these actors we aimed to discover during this first phase to generate user profiles for more indepth inquiries in the next phase. By doing so, we would also validate our hypothesis.

Figure 2 below illustrates the inquiry protocol we used, where framing and discovery took place simultaneously for exploring the system of interest. Desk research cooperated side by side with field observations, as the small team of three (Bhan, Gajera & Kimani 2016) operated in two research streams while remaining coordinated through phone calls and various digital platforms. For example, if literature mentioned the importance of market intermediaries such as brokers, our team member exploring the borderland would try to find

a broker and speak to them. In reverse, if they observed that cargo yards for long distance trucks were important for ICBT facilitation, this generated a direction for literature search. In this way, primary and secondary research were integrated for a holistic approach to mapping the system of interest prior to the full team immersion in the next phase.

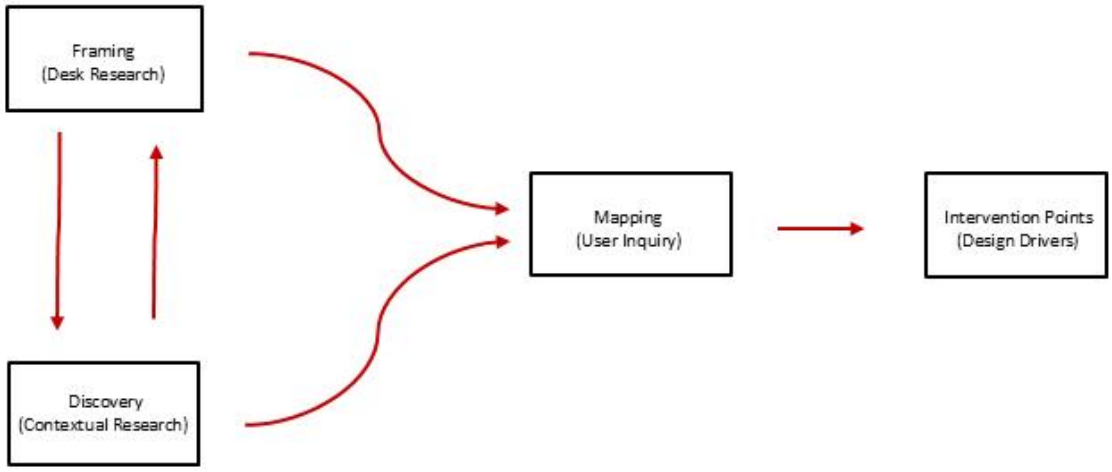


Figure 2 Inquiry protocol for the fuzzy front-end of transformation by Niti Bhan

This front-end phase of exploration is where Chuck Owen's 'right mountain to climb' is identified before planning design actions (Bhan & Rytilahti 2026). We used a short and structured questionnaire to conduct surveys that aimed to sample different likely looking actors - service providers like transporters and mobile money agents; traders of all shapes and sizes; as well as intermediaries like brokers and transport coordinators - in the borderland trade ecosystem. Such an approach is also known as 'guerrilla interviews' (Gold 2019; Caldwell et al. 2015). Our survey reached 60 people to generate a baseline study of demographic indicators like education, age, gender, and number of years in this line of work as well as extras like did they move here for trade opportunities from somewhere else, and if so, where? Our goal was not only to circumscribe the bounds of our system of interest but also map and visualize the regional dynamics of informal trade (Bhan et al. 2016).

3.2 Mapping the system of interest and identifying its key actors

Visualization of the evolution of our understanding of the system of interest - the dynamics of the borderland's informal trade and the key actors (or institutions) involved - over multiple subsequent analyses of this data is shown in Figure 3. Project team members Rinku Gajera illustrated each stage of analysis developed together with Michael Kimani. For such a complex operating environment, scoped within a geographically constrained borderland market economy, it would be rare to generate a dynamic map of value flows and exchanges in the first instance. Nonetheless the very first diagram was sufficient to identify key user profiles (nodes in the system) for indepth inquiry. In the Mapping phase (Figure 2), the full team went to the borderland circumscribed by the market towns of Busia and Malaba in Kenya and Uganda. The Mapping phase comprised indepth interviews, market observations, a 'day in the life' shadowing in addition to tracing flows of goods into the hinterlands. The

outcomes are illustrated in Bhan & Gajera (2018), including segmentation attributes for the hitherto undifferentiated ICBT.

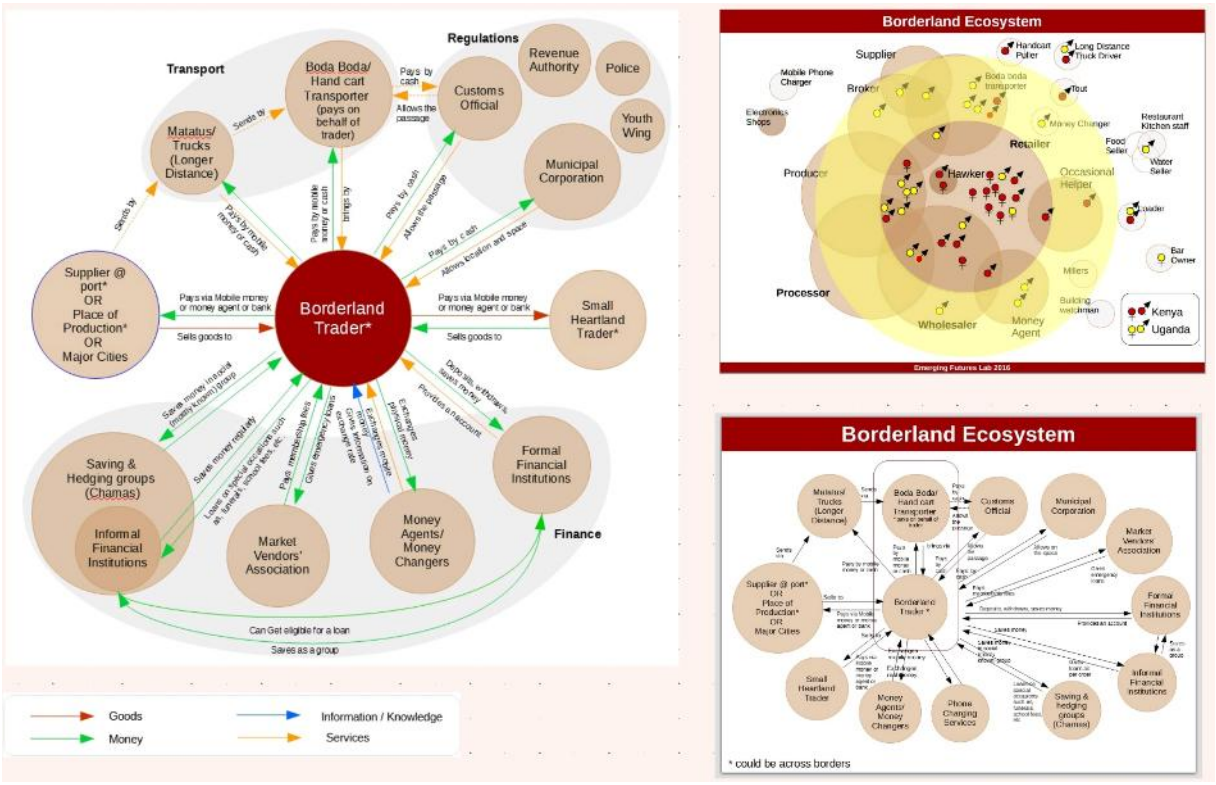


Figure 3 Iterative rounds (clockwise) of mapping a 'system of interest', visualizations by Rinku Gajera

Here, Figure 3 makes clear how our inquiry protocol (Figure 2) informs our work on mapping the dynamics of borderland trade, its flows, and thus, the system of interest, exactly as described by Abson et al. (2017). Visualizing traders' value webs of flows of goods, services, information, knowledge, and money (Bhan & Gajera 2018) helps identify different segments, contributing directly to answers 'for whom' an intervention should be designed for optimal systemic impact (Bhan, Gajera, & Kimani 2016).
In Results section three intervention points are briefly introduced as exemplars of work done in the last phase of the sequential inquiry protocol introduced in Figure 2.

4. Results - Intervention points to inform planning of design actions

We consider these insights generated from one borderland insufficiently thick or detailed for region-wide intervention planning (see Bhan & Rytilahti 2026). They were the outcome of developing a bespoke inquiry and methodological fieldwork guide for borderlands as client deliverable (Gajera & Bhan 2016). Nonetheless, the following three are selected to illustrate actionable system intervention points (see Bhan et al. 2016) which aim to answer where, how, and for whom to intervene in a system of interest.

4.1 Opportunity and inclusivity attracts visitors and newcomers

Any major borderland market becomes a magnet of opportunity attracting a constant stream visitors and newcomers intending to stay and trade (Bhan et al. 2016). A borderland is also significantly more diverse. At Busia-Malaba border markets we found Somali and South

Sudanese traders mingling with South Asians, Ugandans, and Kenyans. Busia - which straddles both Kenya and Uganda - attracts wheelchair users from across Uganda, making it uniquely inclusive for trade. Through years of negotiated agreements with local authorities, they are able to trundle small goods through customs with minimal harassment.



Figure 4 View of Busia One-Stop Border Post built by Trademark East Africa with one of Busia, Uganda's wheelchair traders in the foreground. The lady in red has hired a boda boda - cyclists who specialize in ferrying passengers across the border ("border border"). Photo by Michael Kimani for Emerging Futures Lab.

The majority relocate to a borderland for a better life. Only 19 of the 60 in our baseline survey were local-born. Traders might be novices, seasonal migrants, or second generation sent to expand family networks. We also observed truck drivers seeking amenities, as well as information on new products and services. Borderlands welcome newcomers as we discovered. Many respondents shared their experiences of entering the trading business (or their current occupation), how they settled in, who helped them and how (information facilitation) and the challenges that they had to overcome at the outset. Table 2 elaborates Meadows (1999) leverage points which Abson et al. (2017) cluster as under Design and Intent as facilitating less visible but deeper leverage (see Table 1). If we identify this feature of the borderland - *a regional magnet for inclusive opportunity* - as an intervention point in this system of interest, then it becomes clear that we are speaking to deep leverage points such as numbers 6, 5, 4 and 3 (Table 2). In turn, intervention design planning might include

developing information hubs, storage and ablutions facilities, currency exchange, signage, and navigation apps. It also facilitates Feedbacks (Table 2).

Table 2 Leverage Points Taxonomy (Abson et al. 2017 from Meadows 1999)

Type	Description	Leverage Points
Parameters	The relatively mechanistic characteristics or physical elements typically targeted by development programs	12. Constants, parameters, numbers (eg. subsidies, taxes, standards) 11. The sizes of buffers and other stabilizing stocks, relative to flows 10. The structure of material stocks and flows (such as transport networks, population age structures)
Feedbacks	Interactions between elements within a system that drive internal dynamics	9. The lengths of delays, relative to the rate of system change 8. The strength of negative feedback loops, relative to the impacts they are trying to correct against 7. The gain around driving positive feedback loops
Design	The social structures and institutions that manage feedbacks and parameters	6. The structure of information flows (who does and does not have access to what kinds of information) 5. The rules of the system (e.g. incentives, punishments,constraints) 4. The power to add, change, evolve, or self-organize system structure
Intent	The underpinning values, goals, and world views of actors that shape the emergent direction to which a system is oriented.	3. The goals of the system 2. The mindset or paradigm out of which the system arises– its goals, structure, rules, delays, parameters 1. The power to transcend paradigms

4.2 Discoverability and growth of trade incomes

Lack of a fixed address has a direct impact on revenue growth and new business development. Depending on the locale, traders may or may not have fixed premises for trade, thus hampering their ability to build relationships and references. This was observed to have a direct relationship to their income generation ability as well cash flow stability (Bhan et al. 2016). Predictability and discoverability were also important to the support network of money agents, transporters, as well as intermediaries like brokers and clearing agents (Bhan & Gajera 2018). It was observed that there was a relationship between location and the ability of the traders to grow the business and incomes - one of the beneficial aims of planning interventions. Therefore *discoverability* is identified as an intervention point that

speaks to the flows and nodes of this system of interest and cuts across all four types of leverage points (Abson et al. 2017; also see Table 2). At the same time, informal trade relies on building and maintaining stable relationships - a value web of supply and demand (Bhan & Gajera 2018). Here, planning intervention design would contribute directly to 'increase in prosperity through trade' agenda of the client as well as directly boosting incomes not only of the selected segment of traders (value creators, see Bhan & Gajera 2018) but also trigger ripple effects of revenue growth throughout their commercial networks. Examples would be geo-location solutions which facilitate discoverability and a 'fixed address' lowering barriers to access for numerous financial tools and business development services.

4.3 Uncertainty of trade revenues

The operating paradigm of uncertainty acts as a design driver for informal traders' own business development and revenue management strategies (Bhan & Gajera 2018; Bhan et al. 2016). They focus on building loyal customer networks where relationships built over time allow for negotiability and flexibility when time and money cannot always be counted on due to the unexpected and the unplanned (Bhan 2009a). Uncertainty of the cost of doing business is faced across the entire informal economic ecosystem at the borderland and beyond. Many actors mentioned volatility of currency as one of their main business challenges, while others mentioned the unpredictable amounts to be paid to authorities during transportation, both cross border and national. Lack of risk mitigation services such as insurance products designed to meet their needs add to unknown costs. Breakage losses were particularly felt by egg traders who shipped large quantities from Uganda to various towns and cities in Kenya.

We identify *unpredictable income streams and irregular cash flows* as a crucial intervention point in informal economic systems of interest (see Bhan 2009a). Recognizing this system-wide attribute helped us uncover the means to viably and feasibly segment traders (Bhan & Gajera 2018). Traditional metrics like revenues earned in a fixed calender period may not be relevant or appropriate (Bhan 2009a) for entrepreneurs operating in economic informality (Kinyanjui 2019). On the other hand, every trader is aware of their investments made in inventory, and could give us a rough idea of the periodicity of new stock purchases even if they could not predict or estimate their incomes any given calender period. This intervention point would guide developments for the entire system of interest, and speaks to both deep and shallow leverage points as seen in Table 2.

5. Concluding Discussion

In our study, we introduce and discuss a human-centered design inquiry project commissioned by a multi-donor funded regional non-profit company established for the purpose of boosting prosperity through trade in East Africa. Following Abson et al.'s (2017) leverage points perspective (LPP) allows us to to delineate informal trade activities at any given borderland of the EAC as a 'system of interest', describing an operating system as well as a geographically bound ecosystem with linkages to the region's informal economy (Bhan et al. 2016; Bhan & Gajera 2018; Bhan 2016; Gajera & Bhan 2016). Very little is known about the dynamics of ICBT and as user researchers, we had to begin by first mapping (Figure 3) our system of interest (Abson et al. 2017; Ison et al. 2008) to identify opportunities for

transformative interventions for boosting system wide incomes through enhancing trade revenues. In order to do this, we had to develop our inquiry protocol for the fuzzy front-end of transformation from scratch (Figure 2), adapting existing human-centered design approaches for contextual research and user inquiry (Conley 2005; Wasson 2000; Kumar 2012). In this way we contribute our design methodological development for operationalizing the LPP. *Re-think* is one of the three realms of deep leverage (Abson et al. 2017), where 'path dependencies' in knowledge are interrogated as 'lever for sustainability transformation' (ibid).

What our three examples of intervention points demonstrate is the interconnectedness of leverage points - both shallow and deep - in complex human systems of interest. That is, taking an LPP generates a holistic systems view for design planning (Bhan & Rytilahti 2026) of an interconnected set of programs, products, services, and solutions which would aim to work then together to facilitate system transformation. Such a set of design concepts was proposed to the client to boost productivity and incomes, while lowering NTB frictions for any particular borderland.

Subsequently, the inquiry protocol seen in Figure 2 has been extended to accommodate change of research paradigm - the deepest and most powerful leverage point (Table 2) - in order to fit systems of interest where epistemological pluralism characterizes conditions for co-creation of interventions (for ex. Bhan & Tedjokusumo 2025). However, this protocol as introduced (Figure 2) has been robustly tested over the past decade for the fuzzy front-end of transformation. That is, the front-end inquiry protocol is agnostic of design methodology (Sanders 2008) and therefore generally applicable to plan and design interventions for system transformations.

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