International Journal of Systems Engineering
2021; 5(2): 69-78
http://www.sciencepublishinggroup.com/j/ijse
doi: 10.11648/j.ijse.20210502.13
ISSN: 2640-4222 (Print); ISSN: 2640-4230 (Online)

A Compatibility Framework for System Transition Literature

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To cite this article:

Mohammed Hussaini, Miklas Scholz. A Compatibility Framework for System Transition Literature. *International Journal of Systems Engineering*. Vol. 5, No. 2, 2021, pp. 69-78. doi: 10.11648/j.ijse.20210502.13

Received: November 19, 2021; **Accepted**: December 7, 2021; **Published**: December 24, 2021

Abstract: A complex (adaptive) system consists of heterogeneous, autonomous agents that interact with one another. Conceptual theories in the literature of complex systems transition are vast and seem to be discrete. This paper attempts to collect together all concepts of (socio-technical) system transitions to design an all-inclusive compatibility framework for the complex literature in socio-technical transitions. The framework takes the form of a universal system transition model that integrates and harmonises theories and practices on socio-technical transitions to simplify understanding of the complexity and diversity of complex systems transition literature. The framework was designed by appropriately superimposing, streamlining and condensing the existing transition models to produce a single universal model. With the multi-level perspective (MLP) framework as the reference centre, all other concepts could be suitably identified and described without much ambiguity. The other components of the framework include the analytical concepts of the multi-phase perspective (MPP) of transition phases, the stocks-flows concept of transition, and the management concepts of transition design and management process. The various system elements are represented by the three dimensions of actors, rules/institutions, and technical components. The universal transition framework accurately demonstrates and represents the core ideas of system transitions by accurately identifying and matching all the elements in a monolithic typology for instant conceptualisation.

Keywords: Socio-technical System, Conceptual Model, Transition Framework

1. Introduction

The imperative for sustainability transitions has been acknowledged by many governments and businesses [1]. Also, in the near future, the negative impact of climate change [2] might dramatically rise and become unbearable. It follows that the scope of participation in sustainable energy transitions might significantly widen. However, it is important to acknowledge the enormity of the existing body of complex system transition literature.

First, for any system transition, there is the need to have an instant and explicit knowledge of the mechanisms of system transitions under the following distinct but complementary concepts:

1. The content of the MLP framework; the magnitude of the landscape pressure, levels of ongoing innovations that are relevant to the transition, and the stability and attitude of the existing regime to rival niche innovations.
2. The stage of the transition on the MPP; the stage of the transition on the multi-phase perspective model when a goal-oriented transition starts.
3. The possible pathways to the transition visions and images.
4. Second, there is the need to be conversant with the idea of influencing system transitions under the following distinct but analogous processes;

5. The transition design route; the general steps of system transition process.
6. The transition management cycle; the activities, levels, elements and the linkage of the transition management cycle.
7. The transition design process; the steps and processes involved in the design of system transitions.

To this end, this paper emphasises the assemblage of the literature in form of a transition framework to illustrate a summarised form of complex system transitions. The model however is not a substitute to existing transition models, but rather acts as a meeting point of all the concepts to make them readily noticeable. Just like the MLP deals with the analysis of the alignments of activities in a transiting regime, the universal framework deals with alignments of the literature on system transition.

The aim of the paper is therefore to harmonise the seemingly independent and complex system transition theory and practice to simplify the approach to transitions. Core objectives are to group and harmonise the theories, contents and practices to formulate a comprehensive framework that can enable transition concepts to be instantly conceived. The framework combines existing theoretical concepts such as the multi-level perspective, transition pathways, transition management and other related theories. The descriptions of the multitude of concepts are deliberately brief and may serve as an introduction to the topic for readers new to the subject matter.

The structure of the paper is organised as follows. Section 1 introduces the subject matter and the underlying notion upon which the transition framework is built. Section 2 provides a brief overview of what transition and system change is about. Furthermore, Sections 3 and 4 deal with the analysis and management of system transitions, respectively. Section 5 harmonises all the literature on system transition and indicates their pattern of interaction in a flow chart. Section 6 deals with the design of the transition framework of system transition by collecting and articulating all the analytical and practical concepts. Finally, Section 7 draws conclusions on the framework structure, functionality and possible improvements.

2. Transition and System Change

Transitions are long-term transformation processes (usually 25-50 years) as a result of the co-evolution of developments in various domains (such as technology, institution, culture, ecology and economy) on various scales and levels [3]. On the other hand, Rotmans et al. [4] defines transition as a gradual and continuous process of change whereby the landscape of a society or societal system or sub-system transforms. Complex societal (sub-) systems include energy supply, mobility, agriculture, health care and housing. The general perception is that transitions result in fundamental changes of societal systems.

3. Analysis of Transition

The conceptualisation of system transitions has been explained in several approaches, which include the multi-level perspective (which distinguishes three analytical and heuristic levels), transition pathways (resulting from interaction of dynamics among distinct levels), multi-phase perspective (that identifies the phases of transition), and stocks and flows notion (which observes the long-term and short-term developments in system transition). These concepts are discussed in the following sections.

3.1. The Multi-level Perspective

The multi-level perspective (MLP) is a framework of hierarchical levels with heterogeneous configuration of elements that interact [5, 6]. It is multi-disciplinary, combining various fields including but not limited to evolutionary economics, sociology, structuration and neo-institutional theories. The MLP distinguishes between three analytical and heuristic levels for system innovation; namely, the socio-technical landscape accounting for exogenous development, socio-technical regime accounting for system stability and technological niches consisting of slots for the emergence of new innovations [7, 8]. Higher levels are more stable than lower levels with respect to the number of actors and degrees of alignment between the elements [9, 10]. The three levels form a nested hierarchy with regard to local practices [7, 11]. These levels are not ontological illustrations of reality but rather meant as analytical concepts [7]. Transitions in this perspective occurs when innovation at the micro level emerges and penetrates the meso-level to modify the mix up of regimes; ultimately transforming the landscape at the macro level [12]. A detailed form of the MLP framework is shown in Figure 1.

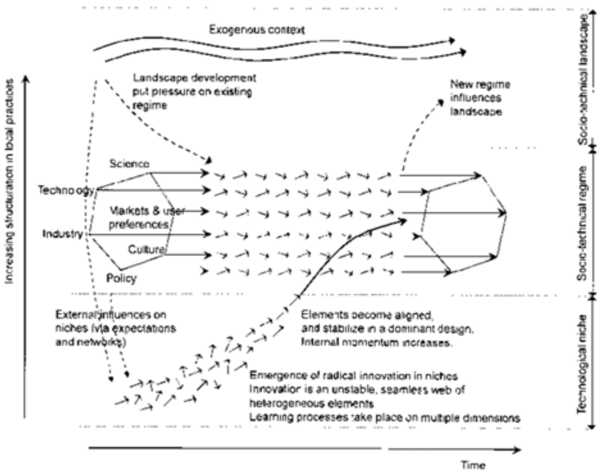

Figure 1. *The multi-level perspective framework of system transition [7, 13].*

3.2. Transition Pathways

The idea of MLP is that transitions occur through interactions among processes at multiple levels: 1) problems at the landscape exert considerable pressure on the existing regime, 2) it is perceived that these pressures cannot be dealt with by incremental innovation in the existing regime, creating opportunities for alternative technologies, 3) innovations in niches are reasonably developed for the adoption in the regime. Therefore, transitions are understood on the MLP framework as the consequence of alignments between developments at multiple levels. The regime is the main level where transitions occur while the landscape and niche are considered as derived concepts. Five transition pathways have been identified, namely 1) Reproduction pathway, 2) Transformation pathway, 3) Reconfiguration pathway, 4) Substitution pathway, and 5) De-alignment/realignment pathway. The distinction among the pathways are the magnitude of the landscape pressure, the timing of the landscape pressure action with respect to the niche technology maturity level, the resulting size of regime change and the MLP levels involved in the transition process [9, 13, 14].

3.3. Multi-phase Perspective

The multi-phase perspective implies that the paths followed by transitions are very non-linear involving different phases that change from one state of dynamic equilibrium to another. Four transition phases can be identified in transition pathways as shown in Figure 2 [4]: (1) Predevelopment phase; (2) Take-off phase; (3) Breakthrough or acceleration phase; and (4) Stabilisation phase.

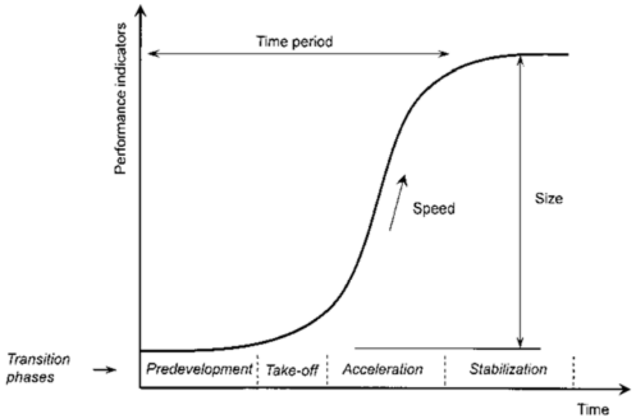

Figure 2. *The multi-phase perspective concept [4].*

3.4. Stocks and Flows Concept

The principle of accumulation conceives every behavioural dynamics in the world as the result of flows accumulating in stocks. According to [4], "the system approach implies thinking in terms of stocks and flows." Complex systems have a hierarchy of levels characterised by higher but slower changing levels, and lower but faster changing levels [15]. Stocks are system elements that "accumulate" in the long-term and can be described in terms of quantity and quality, while flows are the elements that change relatively faster in the short-term [4]. Therefore, stocks and flows can be related to the slow (longer periods) and fast (shorter periods) changing properties of a complex system, respectively. In socio-technical systems, stocks represent the physical infrastructure and institutions, while flows represent activities of actors, movements of goods and services.

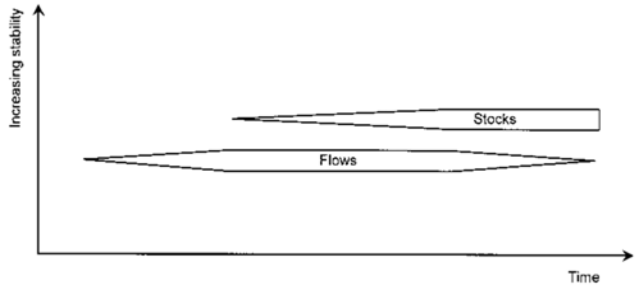

Figure 3. *The stocks-flows concept [4].*

Figure 3 shows the relationship between stocks and flows with respect to time. In the beginning of a particular system transition, the transition flows begin to change by growing to a peak level without seeing any physical changes on the stocks. This may be related to the pre-development phase of the transition. When the flows reach a certain maximum point, they will trigger a physical change on the stocks. The flows will maintain this approximately constant transition activity level for a period of time, while the stocks continue to grow to a certain maximum level during this period. This may be related to the take-off and acceleration phases of the transition. At the point where stocks have reached their approximate maximum point, the flows responsible for the transition will begin to reduce to another state of dynamic equilibrium, while the stocks have reached their full growth potential and remain stable.

4. Management of Transition

The previous sections dealt with transition theories, which help to explain how transitions come about. However, assuming that key stakeholders understand these theories, how do they make transition happen? [16] state that the aim of transition management (TM) is to manage transitions for sustainability. However, transitions cannot be managed in the normal sense, but their direction and speed can be influenced directly and indirectly using three types of steering and coordination mechanisms; plans, markets, and institutions [17, 18]. Transition management is therefore a new direction-finding concept that uses certain broad heuristics that rely on variation and selection processes [19, 20].

4.1. Transition Management Elements

This section explores the various elements needed for the management of transitions. The transition instruments are the TM elements used as tools to drive system transitions to an end-state. They can be derived from the myriad of the TM elements. Similarly, transition design (TD) variables are transition instruments that are used as methods for invoking transitions. They can be derived from transition instruments. Thus, TM instruments come from TM elements, and in turn, TD variables come from transition instruments. Determining whether or not transition instruments are variables, is not a direct and easy process [21].

4.2. Transition Management Cycle

The TM cycle attempts to capture and translate abstract doctrines of TM governance into an applied management framework that is suitably flexible, while encompassing almost all complexity in transitions [22]. The idea is to organise and structure the complex and seemingly dispersed activities that involve many stakeholders and associated with many uncertainties [23, 24]. It is an iterative and cyclical process in which the transition visions, goals, agendas and objectives are all subject to adjustment in the course of the TM process due to learning processes [23, 25]. Four main activities are involved in the TM cycle as shown in Figure 4 below.

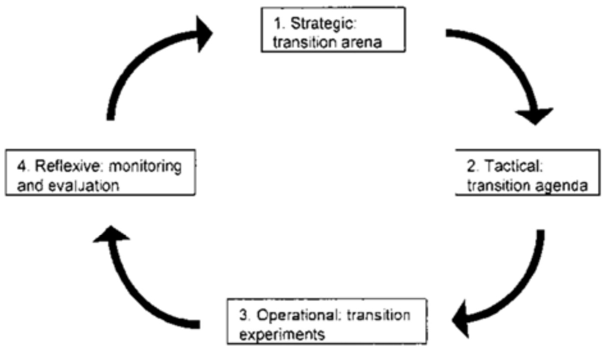

Figure 4. *Transition management cycle [22].*

The time period for a cycle depends on the practical context of operation but according to documented experience so far, one cycle takes about 2-5 years [17]. The four activity levels of the TM cycle are explained below: (1) Strategic level: transition arena and vision development; (2) Tactical level: developing the transition agenda; (3) Operational level: starting and executing transition experiments; and (4) Reflexive level: monitoring and evaluation of the transition process, transition management, transition agenda and transition experiments.

4.3. System Transition Design Route

Socio-technical systems contain many interdependent components such as technological elements, network of actors, and the rules that influence actor behaviour [26]. The active actors in the systems have objectives and the various means for realizing these objectives [16]. The fact that socio-technical systems (STS) are evolutionary, the associated technologies may have limited capabilities, because their designs may not meet present needs such as sustainability [16, 27]). This limitation will have consequences on the process of policy design leading to changes in technical components of an STS through changes in actor behaviour; i.e. rules [28]. The policy attempts to influence the behaviour of actors controlling the system in the desired direction, leading to a change in technical components, and, hence, improving the system performance [29]. However, many external influences are associated with the design and implementation of policies, changes in actor behaviour and the technical components [28]. Figure 5 shows the steps or route involved in system transition design (STD).

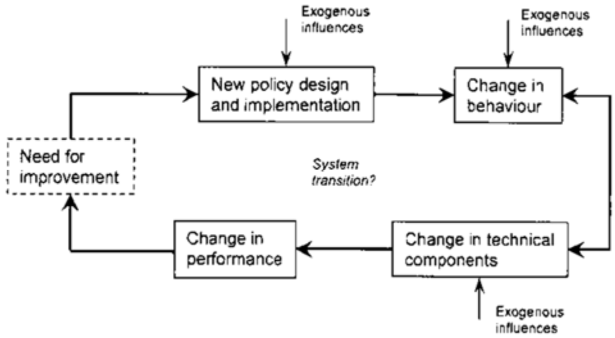

Figure 5. *Transition design route/sequence [16, 28].*

Since system transition involves changes in both technical and social sub-systems, the policy designed for structural change only becomes effective when it succeeds in changing behaviour and transforming technology while fulfilling the requirements associated with the pathways of the transition [28]. Therefore, a system transition is necessary for a structural change in STS.

4.4. System Transition Design Process

A transition assemblage consists of design variables such as experiments and policies, which can be varied during the design of transition in search of the possible combination that best fulfils the transition goals. Because there are a number of different variables to choose from, hence, they are referred to as design alternatives [21]. To design system transitions, the designer has to observe the system process from an imaginary independent high-level position that is freely detached from the direct influence of the system [28]. Therefore, the design process of a complex system may be seen as a next level design; i.e. meta-design or the design of a design process. A meta-design is one that combines the design of technical and social systems [30]. Transition design comprises designing the best combination of transition variables (transition assemblage) that fulfil the goals of a transition [21].

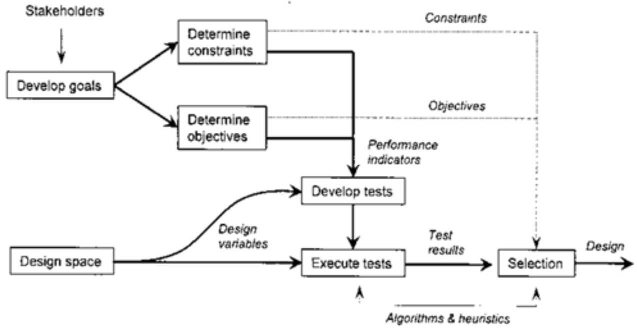

Figure 6. *A conceptual model of a system transition design [31].*

As shown in Figure 6, the meta-design uses a conceptual model of a stepwise design process. The basic steps are highlighted below [4, 16, 21, 31]: (1) The development of goals, objectives and constraints; (2) Specification of the design space and variables; (3) The development and execution of tests; and (4) Selection of a design alternative.

Table 1. *A summary of transition literature [4, 7, 13, 16, 22, 28, 31].*

	MLP levels	**Micro (niche)**	**Meso (regime)**	**Macro (Landscape)**	**Global**
Transition analysis	*Transition pathway*	Transformation (Landscape/ regime)	Reconfiguration (Landscape/ regime/ niche)	Substitution (Landscape/ regime/ niche)	De-alignment/ re-alignment (Landscape/ regime/ niche)
	MPP phases	Predevelopment (Dynamic equilibrium)	Take-off (Change starts)	Acceleration/ breakthrough (Fast change)	Stabilisation (Change settles)
	Stocks-flows	Flows	Flows/stocks	Flows/stocks	Flows/stocks
Regime	*Regime dimension/ stabilizing mechanism*	Actors/vested interest	Rules/institution/ rules & institutions	Material & technology/ sunk investment	
Transition management	*TM cycle activity levels*	Strategic	Tactical	Operational	Reflexive
	System transition design route	Policy change	Behaviour change	Technology change	Performance change
	System transition design process	Stakeholders	Transition elements	Test	Selection & design

5. Literature on System Transition

Ideas around the analysis and management of transitions have been presented in the previous sections. In the following sub-sections, the component similarity of the various concepts within transition analysis and management is explored to relate the various ideas to each other. Table 1 provides a summary of transition literature.

5.1. Links in the Literature on System Transition

The previous sections dealt with the concepts of understanding transitions (transition analysis), commanding transitions (transition management), and the transition content consisting of the items being designed (regime elements) and those used for the design (design tools). This section assesses the key literature developed in system transitions to capture the order in which these seemingly discrete concepts and developments operate.

The three pillars of transition literature, namely, transition analysis, transition management and transition content, have an order of communication both within themselves (with internal entities) and outside with other groups. The three transition content groups (system elements, TM elements, and performance indicators) interact during transition. To support the understanding of the meaning of the system elements and their dynamics, the theory of transition analysis which is formed by the transition content, serves to structure the content into a formal order. In order to drive transitions, the design/management which is also formed by the transition content serves to operationalise transitions in a formal order of changing activities in a stepwise manner (Figure 7).

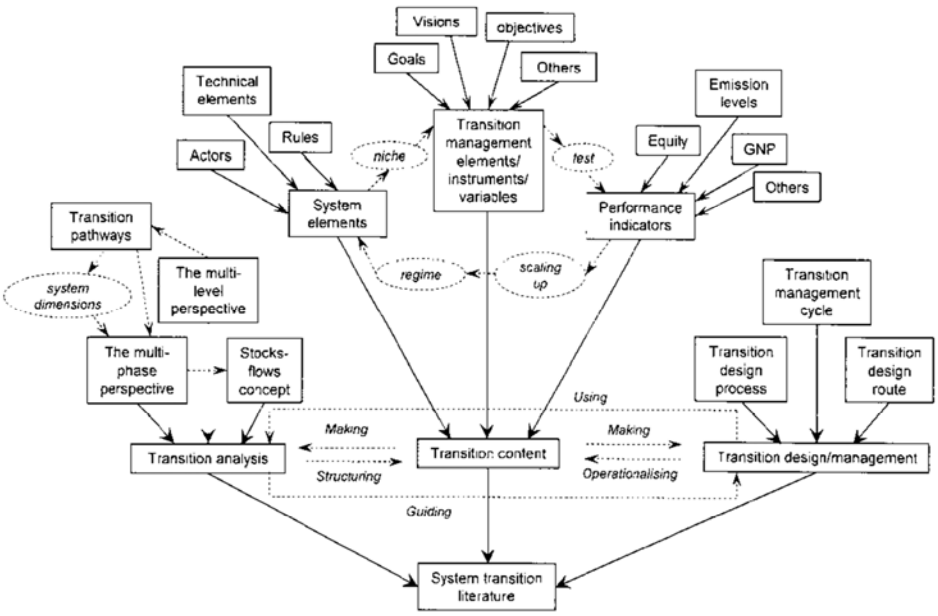

Figure 7. *An interactive web of system transition literature.*

5.2. Content of System Transition

The analysis and design of transition function through a process using basic items contained within the system. The transition content encompasses all the items involved in the process of system transition. Three groups of transition items, namely, system elements, transition management elements (instruments/variable), and performance indicators (PIs), can be identified in the process of system transitions. These items may also be conceptualised in two ways; the soft and the hard items. The soft items refer to the elements required for the process of system transition, while the hard items relate to the physical infrastructure being managed. Both hard and soft items can be found at any level on the MLP framework.

The soft items in the TM elements are those required as tools to bring about the changes required during transitions while the hard items are the technical components that form potential substitutes to regime technology. Performance indicators are soft items that help to show whether or not a transition is successful. The TD variables, which are part of the TM elements, form the various alternatives that undergo tests during transition experiments. When the PIs show that a transition experiment is successful for a particular alternative by fulfilling the transition goals, it is scaled-up into the regime to substitute the existing system elements accordingly. Subsequent re-structuring of system elements will give rise to a new regime with better performance in terms of the corresponding transition goals. These items are necessary ingredients of any transition. The formal approach in putting these items into order for bringing about transitions is referred to as transition management or design as shown in Figure 7 above.

5.3. Pattern of Transition Analysis

As discussed in section 3, existing concepts for the analysis of transition are the multi-level perspective (MLP), multi-phase perspective (MPP), transition pathways, and stocks-flows. The interaction among dynamics at multiple levels on the MLP framework gives rise to the transition pathways, each of which follow a definite pattern of the four phases of the MPP corresponding to the stocks-flows developments [13, 16]. The MPP consists of three system dimensions; the transition speed, time period, and size of change [4].

5.4. Pattern of Transition Management

The strategy of 'making transitions happen' is also built on different concepts for the management of transitions (section 4). These are the TM cycle, transition design (TD) route and TD process. However, the ideas are analogous and their contents and procedural stages can communicate well with one other at each step. With reference to the TM cycle, the strategic level (transition arena) consists of the TM actor selection and vision development processes. In the TD process, this stage of transition arena corresponds with that of the stakeholders. On the TD route, the stage of transition arena or stakeholders has been skipped, as it starts with the stage of the design of new policy and its implementation. It should be noted that it is the actors in the strategic level or stakeholder stage in the TM cycle or TD process that design the policies in the TD route. At the tactical level (transition agenda) of the TM cycle, the formulation of transition strategies and pathways to the developed visions correspond with the TD process stage for developing design variables (such as strategies for experiments and policies) for the transition. This is the novel policy design part of the 'new policy design and implementation' (NPDI) stage of the TD route.

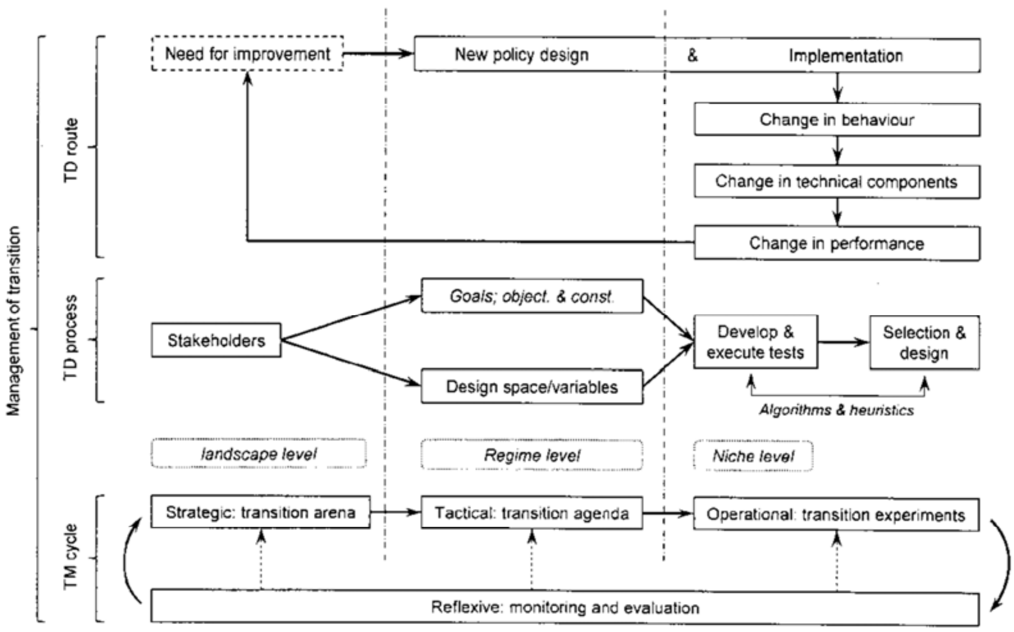

Figure 8. *A superimposed framework of system transition design and management [16, 22, 31-32].*

The operational stage of the TM cycle involves carrying out transition experiments at the niche level to test for the feasibility of experiments in contributing to the transition goals, which, if successful, may be scaled-up into the regime. This means that the operational stage covers both the activities of experimentation (at the niche level) and scaling-up (into the regime level), and, hence, deals with both the niche and regime levels. The experimentation aspect of the operational stage corresponds with the 'development and execution of tests' stage, whereas the scaling up aspect corresponds with the 'selection and design' stage of the TD process. Similarly in the TD route, the implementation of designed policies, which change behaviour, technical components and performance, could exist at any of the niche (during variable experimentation and testing) or regime level (when a variable is scaled-up and used for design).

Generally, the strategic, tactical and operational levels of the TM cycle correspond with the landscape, regime and niche levels of the MLP framework [23]. The closure of the TD route model with the 'need for improvement' is analogous to the 'monitoring and evaluation' stage of the TM cycle, whereas the 'algorisms and heuristics' stage of the TD process represent only a fraction of them, all of which are used for checking the possibility of reviews and modifications to the transition process (Figure 8). From the design of new policy to its implementation process lies the development of design space and variables for the transition agenda, and also goals, objectives, constraints and performance indicators. However, it should be noted that not all activities in other models lying within 'new policy design and implementation' belong to it, but it only includes the policy aspect of the design space and variables part.

6. A Simplified Transition Framework

To design the all-inclusive model of system transition, there is the need to compose relevant concepts by relating or condensing them into a smaller representative model to reduce their complexity and simplify their conceptions.

6.1. Articulating the Theory of Transition

The concepts of transition analysis can be related to the MLP as the reference model. With reference to the regime shift region on the meso-level of the MLP, the pre-development phase of dynamic equilibrium could be found within the range of the existing regime polygon where physical changes are yet to start. The beginning of physical change is marked by the end of the continuous arrows projecting from the first regime. The first part of the destabilisation region towards the new regime marks the beginning of transition changes, and, hence, the take-off phase of the MPP. The acceleration phase comprises the greatest proportion of the destabilisation period until a point where regime stability can be noted. The range of the stability period represents the stabilisation phase.

In the stocks and flows concept of system transitions, the stocks accumulate gradually over long time periods, while the flows change sharply over short periods of time [4]. This shows that the concept involves a forward time factor, and, hence, may be related to the MPP on the MLP. As shown in Figure 8, the transition flows (actor activity in transition) begin to change gradually with the beginning of the pre-development phase and continue to grow until they reach a certain level of accumulation, sufficient to kick-start a change on stocks level (physical changes). At the take-off phase (and also the acceleration phase), the changes in flows will continue at somewhat constant level, while stocks will continue to grow throughout the take-off and acceleration phases due to the momentum created by the flows. The stocks reach their maximum level towards the end of the acceleration phase, and at the beginning of the stabilisation phase, where the change in flows begins to drop. At this point, the stocks will maintain a somewhat constant level throughout the stabilisation phase until the end of the transition (into a new regime), while changes in the transition flows will continuously and gradually diminish (approaching zero) at the end of the transition.

6.2. Articulating the Content and Process of Transition

As discussed in section 5.2, the transition design and management process can be condensed to any one of the models shown in figure 7. The 'transition design (TD) route', which is the most simplified and explicit form of the process notion, with each step thereof covering important activities involved in the process, is valid at any level on the MLP. The elements in the system can be related to the three regime dimensions of the actor network, rules and institutions, and technical components, which carry the three respective regime stabilizing mechanisms of vested interest and organisational capital, rules and institutions, and sunk investments and technical complementarities responsible for regime inertia [32-34]. Regime inertia imply that transition of an existing regime entails unlocking or destabilizing the regime. This process can be explicitly structured and accommodated by features of the MLP framework.

6.3. Integrating the Content and Process of Transition on the MLP

During a transitioning process, activities in the 'new policy design and implementation' (NPDI) step are concerned with setting new rules for the system, thereby attempting to unlock and change the landscape. However, this policy is only one of the many rules in the rules and institutions (R/I) regime dimension, but being a formal rule enforced by the government in a top-down manner, it has the potential to prompt a change the other two rule types; the normative and cognitive rules. This causes a 'change in actor behaviour' (CAB) in the next step of the transition process, responsible for partly or fully 'unlocking' the vested interest and social network (VI/SN) aspect of the stabilizing mechanisms. At this point, regime actors begin to shift focus towards system improvement for adopting competence enhancing add-ons, or system innovation for undertaking experimentations in niches to create a portfolio of related technologies as potential substitutes to existing technical components. Where a technology is successful in contributing to the transition goals, it is scaled-up into the regime to form part or whole of the existing technologies, depending on the transition pathway involved. Therefore, activities in the 'change in technical components' (CTC) step are responsible for unlocking the sunk investment and technical complementarity (SITC) mechanism, and introducing new technical components with different performance; i.e. 'change in performance' (CP). This is the stage where physical structural change begins to take shape and becomes noticeable (Figure 9).

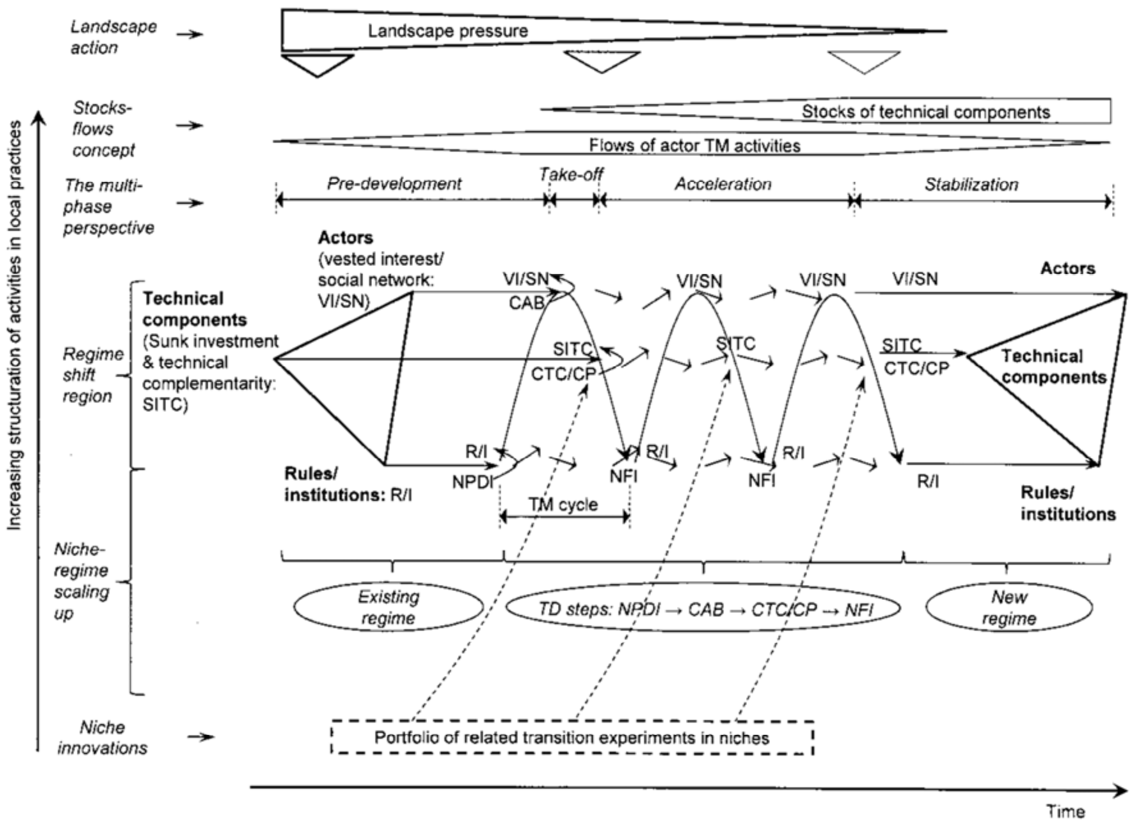

Figure 9. An all-inclusive transition framework of system transition [4, 13, 16, 22].

Here, a complete TM cycle based on the representation has been executed and performance checks are done by observing the TM activities, structural changes and new performance caused by the policy to see if additional cycles are required. This is the 'monitoring and evaluation' stage of the TM cycle or the need for improvement (NFI) step of the TD route. Where necessary, the process cycle is repeated with probably adjusted or modified transition variables. To put the TD steps (i.e. NPDI-CAB-CTC/CP-NFI) into action means to design and manage the transition, and, therefore, a cycle of the TD route is equivalent to a TM cycle. These cycles are iterative where each next cycle carries adjusted forms of TM elements of the previous. The successive TM cycles in the transition direction assume that solutions are continuously proffered to existing regime problems, and the success is indicated by the diminishing intensity of the landscape pressure. However, it should be noted that for a specific case, where the initial transition variables being adequate and successful in driving a transition to an end-state (although unlikely), there might be no need for the NFI stage, and it may be said that activities in the first TM cycle are sufficient for the transition purpose.

7. Conclusions and Recommendations

The existing body of literature on transition theory is complex, fragmented and frequently 'dry', and therefore difficult to understand, particularly for beginners in the field of transition. This paper reviewed existing theories and created a new comprehensive framework of transition literature that is not a substitute to existing models but acts as a facilitator for readers who are new to the subject by making the theory more easily traceable. Moreover, this paper is the first to review and critically assess the key aspects of the theory of socio-technical transition, as well as organise their elements and demonstrate their complementary roles. The body of transition literature is built on two basic pillars; namely, the theory of transition (transition analysis) aimed at understanding transition dynamics, and the practice of transition (transition design/management) that drives transition, both of which function by processing basic underlying items of transition content. Both transition pillars use simplified approaches in form of conceptual models and frameworks, which are either inter-linked, relating well to each other on a flow chart, or analogous (represented by a single model or framework).

Considerable effort has been demonstrated to undertake a strategic articulation of key concepts in the transition literature to design an all-inclusive framework to promote an effective understanding of transition dynamics. Accordingly, the approach divided the literature into three aspects; the analysis, management, and content of transition. The transition analysis aspect deals with all conceptualisation of transition, enabling the acquisition of a mental picture of system transitions dynamics. The management aspect puts together all formalised activities aiming to bring about transitions. Finally, the transition content identifies and groups all the items (both soft and hard), which exist within the context of system transition. The proposed MLP framework of system transition forms the reference model of the transition framework. All concepts, contents and processes fit well into the MLP framework. The MPP of transition phases has been precisely located on the meso-level of the MLP along the range of the polygonal regime shift cylinder. The stocks-flows concept of transition relates well to the transition phases in terms of progress direction and change points. Thus, the concepts of the MPP and stocks-flows have been simultaneously identified on the regime shift region. Regime contents and the transitioning process narrowed into three dimensions (technical components, actors, and rules) and the transition design route (NPDI-CAB-CTC/CP-NFI) fit well into the regime level of the MLP. Similarly, contents and process at the niche and landscape levels fit well into their respective context.

The transition framework is based on transition literature and makes it easier to conceive and trace the dynamics and the inevitable complexity associated with system transition in a tree fashion. An ambiguity may seem to exist when considering overlaps between system levels with no clear distinction borders. However, this has been clarified by corresponding labels, which provide appropriate demarcations of level activities. Nevertheless, further detailed work on individual concepts particularly applied to ‘real world’ examples of relevance to practitioners should follow. The authors also recommend that the functionality of the framework should be enhanced by suggesting better matching locations of concepts.

Acknowledgements

This research was supported by the University of Maiduguri, Nigeria. We thank our colleagues who provided insight and expertise that greatly assisted the in conduct of the research. We thank the Dean Faculty of Engineering, and the H. O. D. Civil Engineering Department, for their assistance and comments that greatly improved the quality of the manuscript.

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