淺談當批判系統思考遇見社會科學時

羅世輝[1]　劉成達[2]

摘要

Forrester 首創社會系統的結構理論奠基當今的系統動態學已 60 餘年，但在跨領域與其他社會科學的應用溝通仍充滿挑戰與隔閡。本文提出批判系統思考可支持系統動態學/系統思考的科學哲學基礎，批判系統思考哲學是系統動態學/系統思考之研究、及實務的隱藏前提假設，其理論焦點兼具結構理論或形式理論、及內容理論或實質理論，其解釋形式是結構解釋、機制解釋，理論範圍可含實證的一般化至典範。

關鍵詞：批判系統思考、系統理論、動態複雜回饋、社會科學典範、辯證整合

[1] 大葉大學企業管理學系副教授(**shlo@mail.dyu.edu.tw**)

[2] 大業大學管理學院博士班研究生(donaldliu1000901@gmail.com，通訊作者)

1. 前言

系統理論(general system theory/general systems theory)自 von Bertalanffy (1950a, 1950b)創建以來已發展近 70 年，其核心概念是互依的(interconnected/interrelated)元素間具互動(interaction)、回饋(feedback)影響本質(Richardson, 1991)，其內涵包含系統科學(systems science)、系統科技(systems technology)、系統哲學(systems philosophy)(von Bertalanffy, 1972)，從初期的具體性系統(real/concrete system)到抽象性系統(abstracted system)、概念性系統(conceptual system)(Miller, 1965a, 1971)，從早期的自然科學到現今的社會科學，尺度從微小的生物系統到巨大的社會系統(Miller, 1965b, 1972)，系統理論已經超越學科成為跨領域的共同基礎(Forrester, 1964)，也成為一新的科學研究取向(approach)(Hempel, 1951)甚至典範(paradigm)(Kast & Rosenzweig, 1972)，但系統理論仍在持續不間斷演化。Forrester (1961, 1968a)更首創系統動態的結構理論(theory of structure)，為大尺度的社會系統(social system)管理注入過去欠缺「動態」(dynamic)的時間視角(temporal lens)(Ancona et al., 2001)，強調「改變」(change)(Langley et al., 2013)、「解決問題」(problem-solving)的思維(Forrester, 1958)，從此奠基後來的系統動態學(system dynamics)/系統思考(systems thinking)的結構哲學，也推升系統理論在社會科學應用的新紀元(Ackoff, 1973, 1974)。但儘管如此，當今的系統動態學/系統思考仍需對其科學哲學做更廣泛、更深入的探究(Forrester, 1980; Ulrich, 1988)，特別是在當系統理論遇見社會科學時，仍存在眾多挑戰，阻絕系統動態學與其他社會科學的對話(Repenning, 2003)。

系統紀元(systems age)已經來臨，系統是整合的新思維(Ackoff, 1973, 1974)，本研究選取批判取向的批判系統思考(critical systems thinking)為代表，是因為它已發展、又整合多數的系統觀哲學(Jackson, 1994; Jackson, 2009; Jackson, 2010)，並可以增加與社會科學的對話(Midgley et al., 1992; Ulrich, 2003)，但究竟批判系統思考是甚麼?自 Flood (1990)提出已歷經近三十年，雖未有明確定義，但 Jackson (1991)指出批判系統思考植基於三項承諾：警覺(awareness)、互補(complementarism)、解放(emancipation)，批判系統思考更一直是當今系統動態學/系統思考的重要基礎，也已內化成本領域研究的基本素養前提，只是本領域社羣尚不足夠大以推廣至本領域以外的其它社羣，故本研究參考社會科學研究方法(Neuman, 2011)、社會科學及社會的本質(Burrell & Morgan, 1979; Lane, 1999; Lane, 2001a)(圖 1、2)、及藉文獻討論，目的是藉批判系統思考淺談系統動態學/系統思考在社會科學的適當定位、深化其他社會科學社羣對系統觀本質的認識、及強化跨領域的知識對話豐富性。

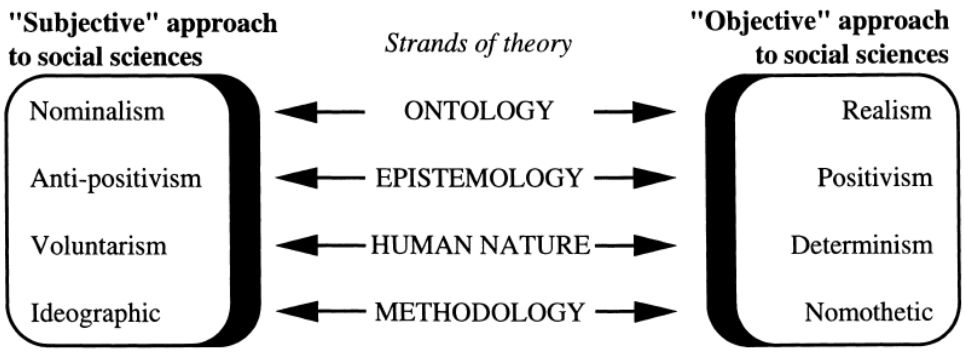

圖 1：社會科學本質的前提假設(來源：Burrell & Morgan, 1979；Lane, 1999)

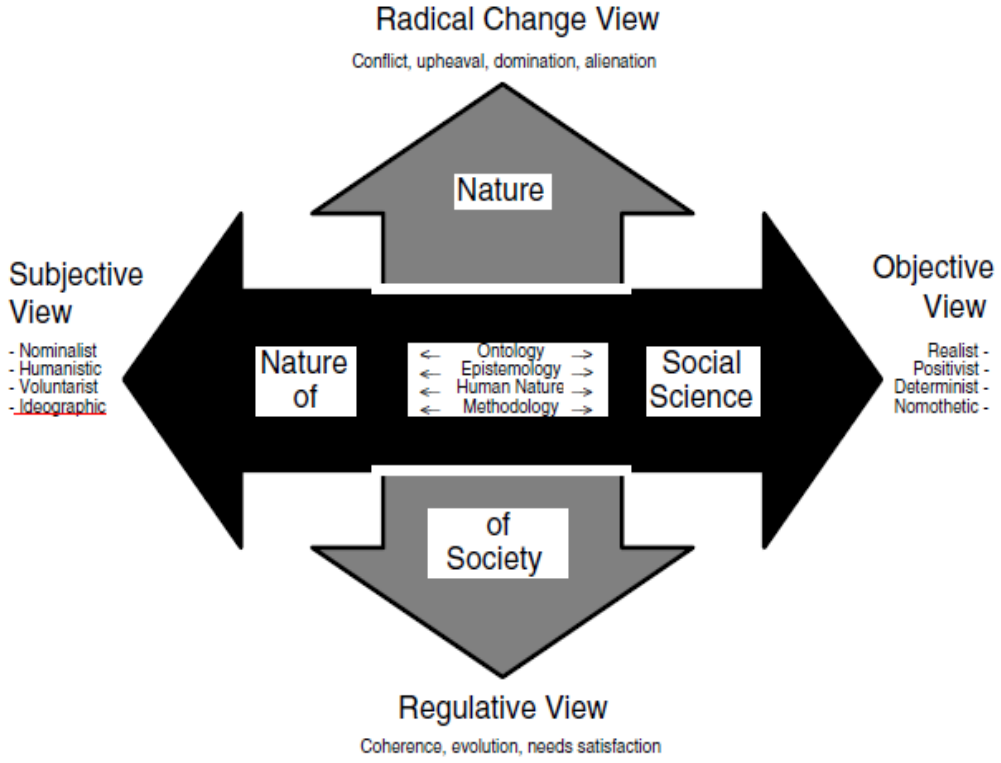

圖 2：社會科學暨社會本質的前提假設(來源：Burrell & Morgan, 1979；Lane, 2001)

2. 批判系統思考與 PSS、ISS、CSS

Lane (1999)、Midgley et al. (1992)指出系統動態學自在社會科學實踐以來，已發展、演化出多元風貌，尤其對系統理論在科學哲學本質有更深入的辯論，依據待解決的問題情境(problem contexts)(mechanical/systemic)(簡單系統/複雜系統)、及系統內行動者決策目標(goal/purpose/function))(unitary/pluralist)(單一/多元)而有不同的

分類與重點(Jackson, 1988, 1990; Jackson & Keys, 1984)，形成不同的分枝，因而歸屬在不同的社會科學典範(Burrell & Morgan, 1979; Checkland, 1981; Jackson & Carter, 1993; Lane, 1994; Lane, 2001a; Oliga, 1988)，如圖 3。

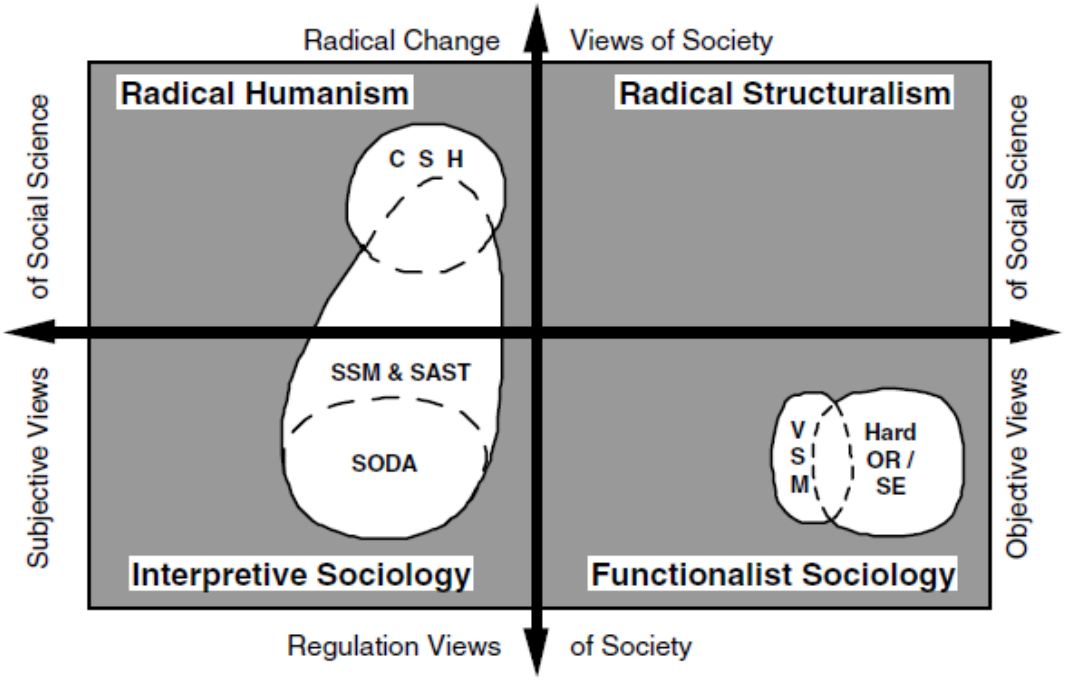

圖 3：四個社會科學典範、系統及作業研究取向(來源：Burrell & Morgan, 1979；Checkland, 1981；Lane, 1994；Lane, 2001) (CSH：critical systems heuristics。SSM：soft systems methodology)

起源於自然科學應用的系統思維，早期待解決問題屬*機械一單一*，偏重以有效率、最佳化的方法達到已知結果，如作業研究、系統工程、控制工程。當導入至生物、社會科學的應用場域後，各元素在時間、空間彼此緊密互依本質下形成複雜(complex)系統，例如同一變數在時間軸上，前一時間間隔資料會直接影響後一時間間隔資料，具遞迴關係(recurrence relation)，即行為與結果關係持續重複發生；在空間軸上，個人、組織、社會亦因互依(interdependence)本質形成回饋環路(Weick, 1979)，致問題屬性屬*系統一單一*，即系統是複雜但卻仍具一致的目標，此便成為當今系統理論的重要前提。系統動態觀提出以不斷增強環路(reinforcing loop，簡稱正環)、反覆調節環路(balancing loop，簡稱負環)、時間滯延(time delay)三者互動而成系統動態理論(Coyle, 1977; Senge, 1990)，Sterman (1985)指出系統動態模型即是理論(Schwaninger & Grösser, 2008)，亦是可檢驗的動態假設(dynamic hypothesis)，動態假設解釋隨時間改變的系統行為樣貌(pattern)，以數學、解析、及「實驗」控制的模擬，獲得正確邏輯及吻合客觀事實，並可檢驗其動態假設的效度(堅實性測試、敏感度測試)。動態行為樣貌可能是發散(成長或衰退)、收斂(漸增或漸減至一目標)、滯延、振盪、S 曲線、或其他互動組合(Coyle, 1977)，樣貌是環路間的互動過程呈現，環路間互動強度並非固定，即環路間不同變數對某共同變數

的影響權重也非固定(Richmond, 1993)，可能隨時間而改變、或出現主導環路轉移(shift of dominant loop)。客觀變化事實著重在隨時間推移所呈現可觀察現象的樣貌，此與實證社會科學(positivist social science, PSS)哲學強調可觀察、可量測的客觀事實、提出可經檢驗為偽(falsifiable)的假設相同(Schwaninger & Grösser, 2008)，PSS觀點採理性(rational)、經驗(empirical)，以解析及控制下的變數，量性驗證其普遍的因果定律。PSS 強調決定主義(determinism)，此也與系統理論的系統結構影響其行為趨勢觀點相同。

隨著跨學科的知識創造過程，將尺度稍小、問題較易顯露、且更想要「改變」的「組織」(organizations) (Ackoff, 1971)亦視為一互依系統，其具雙向互動的回饋本質，故系統理論多與組織管理實務聯結。當面對組織複雜現象、管理決策議題，尤其在納入人(human agency)的主觀自由意志(free will)、詮釋、意圖、行動後，逐漸地增加決策者/行動者(actor)的觀點，藉描繪其心智思維、決策規則、行動、後果、及修正後的互動，使互動機制(mechanism)逐漸顯露、浮現(emerge)，並反覆步驟以正確勾勒問題、及解釋問題形成的原因，以因果回饋圖(casual loop diagram, CLD)表示及溝通，因此形成軟性系統方法論(soft systems methodology, SSM) (Zexian & Xuhui, 2010)，也成為系統方法的典範轉移(King, 1994)。SSM 的典範屬詮釋社會科學 (interpretive social science, ISS)，其認為可觀察、可量測的表象未必全然是事實真相，強調在自然場域環境中，以同理心理解(verstehen)行動者的主觀內心思維及其與環境互動的意義，透過反覆地比較相異、歸類相似(或切題)成另一較高層次概念，並尋找此概念的性質，反應在可操作的連續變化的面向上，並選擇適切的相關概念，將互動過程及結果建構成事件的條件、演變的脈絡，使真相浮現以詮釋人的行動意義(Creswell, 2013; Neuman, 2011)，此方法亦與行動者/問題間互動的系統觀點相當類似。

隨著管理實務政策槓桿解的需求提高，系統理論不僅需描繪問題形成的主、客觀因果互動外，更需在組織系統內找到解決問題，在恰當的時間、空間互動上創造有用的高槓桿解(Meadows, 2008)，例如增加(或減少)資訊系統內的回饋環路，故須能結合質性探索、量性模擬的方法(Wolstenholme, 1982; Wolstenholme & Coyle, 1983)，而在建模過程的各步驟間來回反覆修正(Coyle, 1983a; Lane & Oliva, 1998; Sterman, 2000; Wolstenholme, 1999)，以期研究結果符合研究目的，並藉模擬的「實驗」(Harrison et al., 2007)描繪管理決策規則(decision rules)(Sterman, 1987)、及建立理論(Bradshaw et al., 1983; Davis et al., 2007)，此時的質性探索轉成以存量(stock/level)、流量(flow/rate)為基礎的因果回饋圖，以利後續量性模擬、及政策、情境敏感度分析，此有效解決複雜、甚至紊亂(messes)(Ackoff, 1994)的管理實務問題，將主、客觀的觀點互補整合(Lane & Oliva, 1998)，以批判實在論(critical realism)(Mingers, 2000; Mingers, 2006b; Tsang & Kwan, 1999)打破認識論(epistemology)的限制，將複雜、無法分割且互依的表象、實際、真實等三層領域(empirical、actual、real domains)(Bhaskar, 2008)，整合成一凝聚體(aggregate) (Jackson, 2000; Lichtenstein, 2000; Mele et al., 2010; Morin, 1992; Rahn, 1985)，讓現象背後隱藏的深層結構得以浮現(Bunge, 1997, 2001; Jackson, 1985; Mingers, 2004b; Mingers, 2015)，並去除本體論(ontology)客觀、主觀的矛盾，利用群體建模(group

model building)(Andersen et al., 1997)調和不同層級多利益關係人間的不一致，成為批判系統思考的核心(Jackson, 2001)。批判的辯證(dialectic)過程是啟發式(heuristics)的互動學習，強調捨棄聚焦差異處，取而代之是運用智慧將二看似相反卻能歸結相似共同處，將二看似相反卻可歸結相似處成互補的一體(組)、或融合二元論(dissolving dualism)(Lane, 1999; Smith, 2006)、溶解(dissolution)以重新創造(Ackoff, 1981, 1994)設計成高槓桿的新環路(Meadows, 2008)、或組成另一相關、連續變化的分佈頻譜(spectrum)(Sushil, 1994, 1997; Troncale, 1988)、或相似的類比(analogy)、隱喻(metaphor)、同構(isomorphism)(Ackoff & Vergara, 1981; Lane, 1998; Lane & Smart, 1996; von Bertalanffy, 1950a)。

換言之，納入多個利益關係人、或不同層級的人，取適當系統邊界，在隱形邊界的開放系統內，尋找時間(相對足夠長)、空間(相對足夠緊密)的可能互動關聯性，因為系統具階層性(hierarchy)，系統由整體(wholes)構成，而每一個整體也是系統，系統是一無斷變化的連續體，無絕對的內、外(Meadows, 2008; Senge, 1990)，故可歸結相似、共同交集處成一新回饋環路概念體、或新共識(或一致目標)，而非區隔成相異、互斥無關的二者，著眼內部跨層級空間組成之新概念體、及時間推移過程形成不同環路互動的結構，正、負環路間的不同主導性轉移形成多種共通性結構(generic structures)(Paich, 1985)，而在此共通性結構關係下，除有相同趨勢樣態外，系統的主導結構可進一步充分解釋系統行為，亦即在相同結構及方程式下，即使在不同初始條件、甚至從不同路徑影響，均會發生主導環路轉移，而接續的主導環路均能促使系統到達最終相同後果(equifinality)(von Bertalanffy, 1950a, 1950b)或目標，換言之，系統具以內部不同方法終均可得到相同結果的結構特質，結構的同構特質更可推廣至跨領域系統間共同相似性成系統同構(systems isomorphy)(Jackson, 1993; Lane, 1998; Lane & Smart, 1996; Troncale, 1988; Vancouver, 1996)。

批判系統思考挖掘現象背後隱藏的主觀心智模式(mental model)、及客觀結構的互動機制，此與 Giddens (1979)討論社會系統提出結構化理論(theory of structuration) 非常類似(Lane, 2001b)，認為結構、能動二元性(duality of structure & agency)共同相互形塑影響。Bunge (1979, 2000, 2001)更進一步指出社會的系統論(systemism)(Pickel, 2007)是兼顧整體的結構外，亦同時考慮其內部個別要素彼此互依的雙向關係，Bunge (1997)稱之為系統觀的取向(systemic approach)。批判社會科學 (critical social science, CSS)哲學與批判理論(critical theory)類似，同意部分 ISS 對 PSS 的批評，並加入了新的觀點，但也不同意部分 ISS 觀點(Neuman, 2011)，既不排斥表象，也不否定底層結構(underlying structure)，二者是互為表裏、相互支持，亦即真相是由好幾層鑲嵌(embedded)、堆疊建構而成，真相來自不停地正(thesis)、反(anti-thesis)、合(synthesis)的辨證及整合過程。CSS 之本體論是採實在論學派(realist)、定名論學派(nominalist)二者間之連續體的某個位置，不執著於對立的某一方，而是融合二者成一連續變化體。Jackson (1985)強調社會系統理論需以批判取向進行，因為批判社會科學強調警覺、辯證、解放、互補，在既有中提倡不同的介入干預以獲得改變(Neuman, 2011)，此與批判系統思考哲學本質是相同的(Jackson, 1993; Jackson, 2010)。

儘管典範不可共量性問題仍在爭辯中，但各典範間也未必完全互斥(Scherer, 1998; Willmott, 1993a, 1993b)，事實上系統思維亦仍在學習、及與人類社會共同演化(coevolution)中(Ing, 2013; Ing & Wilby, 2013; Pickel, 2007)，甚至系統典範可能仍在變革過渡中(Sterman, 1985; Sushil, 1997)，但演變至今以批判系統思考(critical systems thinking)(Flood, 1990; Jackson, 1991; Jackson, 1994, 2001)最具互補整合性，尤其能跨接社會系統的組織理論、管理實務間的對話(Jackson, 1985; Kast & Rosenzweig, 1972; Mingers, 2003; Smith, 2006)、適切提供特定情境的權變角度(Kast & Rosenzweig, 1972)。其科學哲學具批判實在論本質及整合思維(Dobson, 2001; Lane, 1994; Mingers, 2000, 2004b; Mingers et al., 2013)，部份接受主觀觀點，卻也反對其中部分觀點，同理在客觀觀點上亦然。其亦與批判社會科學共享相同基礎(Mingers, 1992; Mingers, 2004c; Mingers, 2014, 2015; Neuman, 2011)─兼具不同、多元互補、整合的新研究取徑(multimethodology)(Bahm, 1981; Bunge, 1979; Gregory, 1996; Jackson, 2010; Mingers & Brocklesby, 1997; Schwaninger, 2006; Ulrich, 2012)，批判取向(critical approach)(Mingers, 2000, 2006a; Tsang & Kwan, 1999)的系統觀點是察覺各不同本體論、認識論、方法論(methodology)的限制、及互補性(Jackson, 1991; Jackson, 2001; Lane, 1994; Mingers, 2015; Oliga, 1988; Zexian & Xuhui, 2010)，重新反思各隱藏假設前提 (assumptions)(Dent & Umpleby, 1998)，以適切的觀點距離(distance of perspective)(Richardson, 1991)或系統視角(system lens)(Meadows, 2008)，既不太近關心單一個體，但也不忽略系統內個人感知、驅動壓力，原看似矛盾、或對立的二端，但換個觀點距離反思辯證，又浮現另一更大的連續因果鏈，綜合個體、整體(Bunge, 1979, 2000)、溶合二元 (dissolving dualism)(主/客觀、鉅/微觀、意志/決定、理論/實務)(Lane, 1999; Smith, 2006)、兼顧見樹又見林(Richmond, 1994; Senge, 1990; Sherwood, 2002)、無段地放大或縮小，對表象、實際、真實等三層鑲崁領域中複雜、不可分割且互依的事件、行動、過程、或概念，反覆找尋整體結構與個人行動間的動態潛在互依關聯、真實驅動壓力、自主組織(self-organization)(Meadows, 2008)、及可能的整合理論及回饋環路(Jackson & Keys, 1984; Lane, 2001b)、或自我生成的系統(Bunge, 1979, 2000, 2001; Mingers, 2004a)，亦即讓現象背後隱藏的深層主導機制/結構得以顯露浮現，形成多環路鑲崁的有意義空間聚合體、或凝聚成自主動態(dynamic coherence of a holon)(Lane & Oliva, 1998)的長、短期連續時間整體。

儘管系統取向(systems approach)對欲解決的問題(簡單機械或複雜系統)、系統目標(單一或多元)等均有不同觀點，對系統理論在社會科學理論的應用演化亦有不同分枝，但對於朝批判取向的辯證整合、互補觀點的發展方向卻是相同的(Dobson, 2001; Flood, 1990; Jackson, 1985; Mingers, 2015; Mingers et al., 2013; Tsang & Kwan, 1999)。儘管系統哲學仍有不同的分類(Bahm, 1981)，而且系統理論仍持續與其他取向整合、演化中，但無論產出是質性的因果回饋圖、或量性的模擬，其差異僅是不同研究階段有不同的研究成果、或是符合不同的研究目的而已，模型則永遠可以再修訂改正，但對社會科學社羣而言，都應該將系統觀點定位在 CSS(Jackson, 2001)，而非僅以 PSS、或 ISS 的單一研究取向觀點來提出質疑。換言之，現今的系統動態學/系統思考的系統理論具判系統思考的科學哲學本質基礎，批判系統思考的思維不排斥任何類型的科學思維，只要合理、適當，並符合其目的即可，幾乎可與其他

主要科學研究取向結合。故本研究提出：以批判系統思考的科學哲學基礎，可支持當今主流的系統動態學/系統思考的本體論、認識論、及方法論，批判系統思考哲學是系統動態學/系統思考之研究、及實務的諸多隱藏前提假設(assumptions)。

3. 批判系統思考的理論與形式理論、實質理論

批判系統思考產生的系統理論應用在社會科學時，究竟其理論焦點是實質、或形式?其解釋形式是因果、詮釋、或結構解釋?其理論範圍是實證的一般化、中層理論、或是典範呢(Neuman, 2011)?

Forrester (1968a); (Forrester, 1968b) 的系統動態結構理論含四個理論層次，其認為系統屬內生觀點(endogenous point of view)(Richardson, 2011)，任何跨越系統邊界的原因，本質上非產生系統行為的根本原因，而是出自被界定的系統之內部互動機制引起，認為「系統是原因的思考」(system-as-cause thinking)(Richmond, 1994)，亦即從盒子內部機制思考(Gerring, 2007)其原因，此為最高層級理論(grand theory)(Größler et al., 2008; Lane, 2001a)。而此機制來自回饋環路、及回饋環路間的結構，對有興趣的變數呈現出隨時間變化的曲線，即由環路間的互動結構產生系統行為曲線樣貌，此為第二層級理論。每一回饋環路必定含存量、及流量等二類變數(Coyle, 1977)，存量定義在任何時間下系統的累積狀態，是藉由流量的積分以產生結果，故通常選取可觀察、有意義、上期資料可累積影響至下期資料等為存量變數，回饋環路內的存、流量變數呈現系統隨時間推移的行為基礎，此為第三層級理論，例如：若系統的流量存在存量與常數相乘的遞迴關係之最簡形式時，則存量變數可呈現等比的時間序列行為。與存量相關的敘述僅含流量的次結構(即存量僅唯一受流量影響)，而與流量相關的敘述則可含系統運作的決策、政策、規則等干預行動的次結構，包含系統欲達到(或改變)的目標、觀察的現況狀態、認知的現況狀態、與目標差距、欲改變的調整行動、及改變的速率(rate of change)、行動的節奏等，此為第四層級理論。Lane (2001a)補充說明，存量變數與回饋環路關係型態，皆未侷限在某特定具體變數上，故可一般化於其它具此類屬思維(generic thinking)(Richmond, 1993)的變數上，而數個環路的組合建構亦可再進一步類推成共通性結構，而歸納推論成相似的系統隱喻(systems metaphor)，若能輔以跨領域的實證資料，系統結構間的相似性甚至可形成結構同構定律(isomorphic law)(Hempel, 1951; von Bertalanffy, 1950a)理論。Lane (2001a)亦進一步認為針對特定個案問題，若模型能獲實證資料支持，藉電腦模擬、演繹的推論模型，能提供符合其情境、過程的實質模型理論，以具體特定變數行為樣貌解釋社會現象，則更屬實質理論，故批判系統思考的系統理論兼具結構理論(structure or formal theory)、及內容理論(content or substantive theory)二層次，理論範圍可含實證的一般化至典範(圖 4)(Größler et al., 2008)。

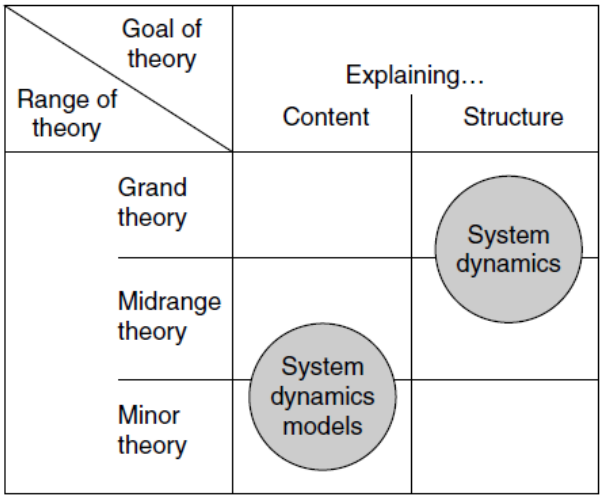

圖4：系統動態學/系統動態模型的理論焦點、範圍(來源：Größler, Thun & Milling, 2008)

系統觀的存量變數是最重要的變數類型，故須優先在社會現象中具體的被觀察到其隨時間變化的樣貌，一般而言存量變數具有多項本質：可累積、緩衝、記憶、慣性、延遲等屬性。因回饋環路必定含存量變數，故對存量變數而言，回饋環路提供遞迴關係來源，在任何存在相對足夠長的時間致產生回饋效果，使得存量變數與時間推移具密切相關，在下一期時間間隔累加前，其儲存、或記憶截至目前的最新資料，亦即在任何時間均有現況值，為一隨時間變化的連續變數，存量變數具動態、自主組織(如：增加、減少、或適應)等特質，尤其強調連續變化的曲線趨勢、或樣態。而流量變數則是唯一可改變存量變數的變數類型，流量相當於改變的政策、決策規則等行動，為單位時間的改變幅度，隱含干預政策行動的強度、改變的節奏，其影響結果則是行動後果、政策效果，相當於存量。因系統內時間、空間是取相對足夠長、緊密(tightly coupled)(Sterman, 2001)以產生回饋，故其環路中的因果鏈結關係並不僅侷限在鄰近周圍處，也不排斥、甚至擴大至時間滯延後的影響，致使其行動後果是逐漸產生(Senge, 1990)。

誠如前述批判系統思考是兼具實證學派、及詮釋學派的批判學派觀點，其辯證過程整合系統理論的演化、及知識的再創造，使不可或缺的每部份相互互補共同成為一整體，而非僅是可有可無的補充(supplementary)。複雜社會現象下各層級、領域之不同概念間，本就存在互動回饋(Richardson, 1991)本質，而此相互回饋關聯即可整合成一環路關係，成另一更寬廣、包容的新概念，故原因與後果並非線性的二事件，而可能是循環互補、是同一整體內的其中部分(Senge, 1990)。正如系統亦是不可切割的整體一般，故當今的系統理論超越狹窄、個別對立的理論、觀點(Burrell & Morgan, 1979; Mulej, 2007; Pickel, 2007, 2011)時，其已發展成兼具、包容結構/形式理論(structure or formal theory)、及內容/實質理論(content or substantive theory)二層次。辯證過程捨棄鎖定差異處，取而代之是運用創造力將二看似相反卻能歸結相似共同處，成互補的一更廣概念體(Jackson, 1993)、或整合成動態、連續

變化的一整體(Sushil, 1994, 1997; Troncale, 1988)、或歸結成相似的類比、隱喻，此結構融合、簡化的系統類比、隱喻、或同構，是社會科學理論中不可或缺的另一「概念」(concepts)，也提供另一更簡潔的理論普遍化的途徑，更可整合自然科學與社會科學間的思維差異(von Bertalanffy, 1950a)。

依據 Forrester (1961, 1971)系統動力學存量、流量、輔助變數間之關係，包含物質實體流、資訊流、行動的選擇或後果反應、結果滯延、方程式、及函數等，其關係應較嚴謹的因果事件更為廣義。但儘管如此，環路中的因果鏈結(causal link or causal influence)仍需合理化，Coyle (1977)曾提出六種基本因果鏈結合理化(justification of influence diagram links)檢驗方法：物質守恆、直接觀察、政策明訂、已接受的理論、假設、前提、或信念、統計證據等。因此在資訊回饋環路思維下的因果鏈結可以是對系統質性產生的描述，也可以是影響關係，故亦有學者將 causal loop diagram 擴大稱為 influence diagram(Coyle, 1983b; Wolstenholme, 1982; Wolstenholme & Coyle, 1983)。系統理論提出的結構理論(structural theory)(Größler et al., 2008)、結構解釋(structural explanation)(Neuman, 2011; Senge, 1990)，並非因果解釋，事件表象的因果律未必全然是事實真相(reality)，卻可能來自隱藏底層的結構、機制(Bhaskar, 2008; Mingers & Standing, 2017; Tsang & Kwan, 1999)，當表象可觀察的事件消失時，卻可能是底層機制正、反互動抵銷的結果，尤其在連結個人意圖、決定行動、及個人等自然因果以外之「半自然」(quasi-natural)的組織科學，複雜系統可容納異質因果互動、轉換(McKelvey, 1997)。故系統觀的因果鏈結包含充分必要條件下的因果解釋、及行動意義的詮釋解釋(Lane, 2000, 2001a)，其認為因果鏈結中的前置原因是產生結果變數改變的壓力源，故其因果鏈結並非皆屬充分必要條件、與環境無關，而是在環境中(environment-full)(Dent & Umpleby, 1998)、與環境互動，必要但非充分條件的生產者-產物(producer-product)關係(Ackoff, 1973, 1974, 1979; Churchman & Ackoff, 1950; Gharajedaghi & Ackoff, 1984)，其因果鏈結包含自由意志選擇、決策選擇(Casadesus-Masanell & Ricart, 2011)、及「行動基礎」(activity basis)的「產生」(produce)等具體可操作化思維(operational thinking)(Richmond, 1993)，亦即將概念、思維拆解成可模擬(程式化)的操作程序，以物質、及資訊等特質的鏈結步驟表達，流量通常可直接或間接藉由存量的狀態、及其他輔助變數共同合成下「產生」(generic flow templates)(Richmond, 2003)，以數學方程式、或函數表示變數間可能的正向、或負向影響，其時間、空間的因果鏈結關係並非全然鄰近，而是包含物質製造及運送、及資訊蒐集及處理等滯延效果，此因果鏈形成的回饋環路才是分析單位(units of analysis)(Coyle, 1977; Richardson, 1991)。以此時、空聚合的潛藏環路結構、互動機制作為理論視角，故系統動態觀點的理論是結構理論，此模型更能提供結構解釋(Größler, 2008; Größler et al., 2008; Schwaninger & Grösser, 2008)、機制解釋(mechanismic explanation)(Bunge, 1997, 2004; Pickel, 2001; Sadovnikov, 2004)。

此外，儘管非系統動力學領域學者，對社會系統內回饋環結構理解可能不同，但歷史社會學學者 Sewell (1992)曾指出結構是社會互動過程的源頭，結構也是持續演化的結果，認為結構可比喻由資源(resources)等組合而成，資源兼具使能(empower)、限制(constrain)社會行動。社會學學者 Giddens (1979) 進一步深化論述，

結構含規則與資源(rules and resources)，行動者可跨越時空，藉規則與資源，進行與結構的互動，即可主動地產生、及再造(reproduce)另一結構(Lane, 2001b)。規則提供不變原則，資源提供起始動量，經傳遞、轉換以循環不斷，結構可使能(enable)、或限制人的行動，但卻非完全決定，人亦可在某些範圍內有選擇意志，在不變結構互動中進行其變化，人的行動被動地受結構限制或使能，但也同時在主動之互動過程再創造結構(Giddens, 1984)。二領域仍有共通之處，系統中的通則架構形塑系統外顯的基本樣貌(或曲線趨勢圖)，個別事件則是基本樣貌下的其中一種變化(單一曲線)表現(Johannessen, 1997)。此二學者之結構觀點可能可對系統思考的正環、負環提供一些補充性解釋，並對兼具鉅觀/微觀的整體結構與個人行動的雙重性，在方法論上提供一些不同領域學者間的連結。

本研究提出：批判系統思考的理論焦點兼具結構理論(或形式理論)、及內容理論(或實質理論)二層次，解釋形式屬結構解釋、或機制解釋，其理論範圍可含實證的一般化至典範。

4. 結論

社會系統的複雜本質已超越人類現有的知識、思維、模式，其動態的本質亦顛覆人類看問題的既有方式，儘管系統動態學/系統思考在社會系統的應用、演化已歷經 60 年，但對於其在社會科學典範的定位，仍受到很多批評與討論，隨著解放、改變等覺醒運動受到重視，社會科學自身也發展出有別於 PSS、ISS 取向的第三類途徑 CSS，前二者的互斥、單一思維並不能完整科學的研究，而 CSS 辯證融合、互補、改變的本質、特性，恰恰與系統哲學不謀而合，因為系統思維自身也歷經不同硬性、軟性方法論的演化，而不同系統思維間也已融合成批判系統思考(Floyd, 2008)。系統思維開啟系統紀元(Ackoff, 1973)、及科學革命(Ackoff, 1974; Sterman, 1985)，解放時空相近的因果關係、單向線性靜態關係、單一事件表象、及單一方法論，包容時間滯延、動態變化及時空回饋環路，對於人與問題互動的動態複雜現象，批判系統思考支持各方法論間的互補(Jackson, 1993; Jackson, 1994)，挖掘隱藏的深層機制，融合表象、實際、真實三層領域互動，兼納行動者的意義詮釋，使潛藏互補、不可或缺的整體真相浮現，開創新洞察，強化系統動態學/系統思考在社會科學的科學合理性、適切性。

批判系統思考不排斥相異的觀點，反而以系統視角、將觀察尺度縮、放，以容納及並存多元理論，尋找可能存在的相似共通性，形成新的環路、機制或結構，尤其在尋找高槓桿解時，更能包容質性、量性、實驗模擬等研究方法同時存在，得到啟發與創造改變，因為系統是整體的合成，每個整體亦是一次系統，系統是一無段變化的連續體，無絕對邊界區隔空間內外、及分隔時間先後，系統的邊界裁定僅取決於研究問題的目的，時間、空間是取相對足夠致足以產生回饋，而浮現的回饋機制結構可成為普遍化的理論，也可具體解釋某一特定現象的動態樣貌，系統的隱喻更可以跨越較狹窄的理論層級，找到相似交集處，支持各層級理論間的互補(Jackson, 1993)，成為呈現事實真相的新典範(Sterman, 1985)。對於亟欲解決動態複

雜系統的組織問題，批判系統思考提出整合主觀、客觀，去除單一偏執，融合個人意圖與自然因果的共同演化(McKelvey, 1997)，同時批判系統思考也回應 Daft & Lewin (1990); Daft & Lewin (1993)新組織研究對常態科學的解放呼籲，過度偏執於一方，不利於新知識的連結與創造，更有害於理論與實務的融合，故當系統動態學/系統思考遇上社會科學時，批判系統思考應可有效成為與其他社會科學對話的橋樑，並可做為克服系統理論與實務落差的思維工具(Jackson, 2010; Smith, 2006)，進而成為整合自然科學與社會科學間的系統取向(von Bertalanffy, 1950a)之科學哲學基礎。

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