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ATIS: Theorems from Initial Axiom Set

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ATIS Report

The SimEd Basic Logic as Founded on the Logic of Axiomatic Theory of Intentional Systems:

ATIS Theorems Derived from Initial Axiom Set

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Presented in this report are the theorems that have been derived from the *Initial Axiom Set* of the *ATIS* **Education Theory**. Further, it will be seen that the collection of metadata that is directly transmitted to an *ATIS*-analysis technology will maintain privacy and answer the questions concerning such use of metadata. See note below.

While Report #5 presents numerous theorems, this report will present only those theorems that are derived from the *Initial Axiom Set*. The *Initial Axiom Set* will be presented first, followed by the theorems.

While many of the theorems presented herein are founded on various logical operations from the *Predicate Calculus*, some will also be presented that rely on a substantive evaluation of the theory and are a result of various *Theory-Construction Schemas*. Theorems derived in this manner are not simply the result of a mechanical application of logical relations, but require the creative input of the researcher.

While the initial theorems derived by means of the *Theory-Construction Schemas* will rely on the *Initial Axiom Set*, the same technique can be used with respect to a specific empirical system.

That is, upon analyzing a specific empirical system, various observed relations could be used instead of the axioms for the required predicates in the *Theory-Construction Schemas*. The validity of these theorems will be dependent on the creativity and logical expertise of the researcher. Although, it is believed that *Data Mining Technologies* may be able to provide, possibly automatically, relations that can be arbitrarily entered in the schemas to generate theorems. In addition, data obtained from a specific system either directly or by means of an *APT Analysis* may also provide the predicates required to generate theorems by means of *SimEd*.

Metadata Acquisition that Maintains Privacy: One important point needs to be made concerning the automatic inclusion of metadata that results in system relations generated from *Data Mining Technologies*. Although blanket accumulation of metadata may be illegal, or even unconstitutional, if such metadata could be included in an *ATIS*-analysis, it would maintain private secrecy concerns and yet alert NSA and other officials to identifiable individuals who require greater surveillance, or even an immediate alert to a potential terrorist attack. Ignoring this capability of an *ATIS*-analysis may actually jeopardize the security and safety of the United States. By directing metadata directly into an *ATIS*-analysis no individual will see the data unless a specific individual threat is recognized and identified by that analysis.

A-GSBT *Initial Axiom Set*

A.10. $I\mathcal{P}^{\downarrow} \sqsupset F\mathcal{P}^{\downarrow}$

A.15. $O\mathcal{P}^{\uparrow} \sqsupset F\mathcal{P}^{\uparrow}$

A.28. ${}_{\mathbb{S}}\mathcal{T}^{\uparrow} \sqsupset {}_{A}\mathbb{S}^{\uparrow}$

A.33. $T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow} \sqsupset f_{T}^{\uparrow}$

A.35. $I\mathcal{P}^{c} \wedge F\mathcal{P}^{c} \sqsupset O\mathcal{P}^{c}$

A.90. $T\mathcal{P}^{\uparrow} \sqsupset {}_{C}\mathcal{C}^{\downarrow}$

A.91. $f_{I}^{\downarrow} \sqsupset {}_{U}\mathcal{C}^{\downarrow}$

A.93. $f_{I}^{\downarrow} \sqsupset \mathcal{X}^{-\uparrow}$

A.100. ${}_{CC}\mathcal{C}^{\uparrow} \sqsupset f_{I}^{\uparrow}$

A.102. ${}_{I}\mathcal{C}^{\uparrow} \sqsupset f_{I}^{\uparrow}$

A.105. ${}_{C}\mathcal{C}^{\uparrow} \sqsupset T\mathcal{P}^{\downarrow}$

A.106. ${}_{CC}\mathcal{C}^{\uparrow} \vee {}_{S}\mathcal{C}^{\uparrow} \sqsupset T\mathcal{P}^{\uparrow}$

A.107. ${}_{CC}\mathcal{C}^{\uparrow} \vee {}_{S}\mathcal{C}^{\uparrow} \sqsupset I\mathcal{P}^{\uparrow}$

A.144. ${}_{\mathbb{S}}\mathcal{T}^{\downarrow} \sqsupset \mathcal{I}^{\uparrow}$

A.151. $\mathcal{I}^{\uparrow} \sqsupset F\mathcal{P}^{\downarrow} \wedge f_{O}^{\downarrow}$

A.194. $\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset T\mathcal{P}^{\uparrow}$

A.195. $\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset f_{I}^{\downarrow}$

ATIS Theorems Obtained Directly from the SIGGS Hypotheses (Axioms)

The following theorems were presented in Report #3-1, as they were obtained directly from the SIGGS Hypotheses. They are presented here in order to bring all current theorems together into one report.

T.12. $I_{\mathcal{P}}^{\uparrow} \sqsupset {}_{\mathbb{S}}\mathscr{F}^{\downarrow}$

System input increases, implies system filtration decreases.

T.13. $I_{\mathcal{P}}^{\downarrow} \sqsupset {}_{\mathbb{S}}\mathscr{F}^{\uparrow}$

System input decreases, implies system filtration increases.

T.21. $f_{T}^{\uparrow} \sqsupset C^{\uparrow}$

System feedthrough increases, implies system compatibility increases.

T.29. ${}_{O}\mathbb{S}^{\uparrow} \sqsupset {}_{EF}\mathcal{S}^{\downarrow}$

System openness increases, implies state efficiency decreases.

T.53. ${}_{CC}\mathscr{C}^{\uparrow} \sqsupset {}_{F}\mathscr{C}^{\uparrow}$

System complete connectivity increases, implies system flexibility increases.

T.54. ${}_{S}\mathscr{C}^{\downarrow} \sqsupset \mathcal{W}^{\uparrow}$

System strongness decreases, implies system wholeness increases.

T.55. ${}_{S}\mathscr{C}^{\uparrow} \sqsupset {}_{HO}\mathscr{C}^{\downarrow}$

System strongness increases, implies system hierarchical orderness decreases.

T.56. ${}_{S}\mathscr{C}^{\uparrow} \sqsupset {}_{F}\mathscr{C}^{\uparrow}$

System strongness increases, implies system flexibility increases.

T.57. ${}_{U}\mathscr{C} \supset {}_{HO}\mathscr{C}$

System unilateralness, implies system hierarchical orderness.

T.179. $\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset {}_{V}\mathscr{C}^{\uparrow}$

System size increases and system complexity growth is constant, implies system vulnerability increases.

T.180. $\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset {}_{F}\mathscr{C}^{\downarrow}$

System size increases and system complexity growth is constant, implies system flexibility decreases.

T.181. $\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset {}_{C}\mathcal{C}^{\downarrow}$

System size increases and system complexity growth is constant, implies centrality decreases.

T.182. $\mathcal{Z}_{c} \wedge \mathcal{X}^{-\uparrow} \sqsupset {}_{D}\mathcal{C}^{\uparrow}$

System size is constant and system complexity degeneration is increasing, implies system disconnectivity increases.

T.183. $\mathcal{Z}^{\downarrow} \wedge \mathcal{X}^{-\uparrow} \sqsupset {}_{D}\mathcal{C}^{\downarrow}$

System size decreases and system complexity degeneration increases, implies system disconnectivity decreases.

ATIS Theorems Obtained Directly from the SIGGS Hypotheses (Axioms) as a Result of Logical Schemas

The following theorems have been derived from the *Initial Axiom Set* with applications of various logical schemas. Some were initially presented in Report #5, but the following theorems also include the proof of the theorems. The logical schema and the axioms from which they were derived identify the theorems. The first number of the identification is the logical schema, and the next number or numbers identify the axioms.

T.0.106-90. $\vdash {}_{CC}\mathcal{C}^{\uparrow} \vee {}_{S}\mathcal{C}^{\uparrow} \sqsupset {}_{C}\mathcal{C}^{\downarrow}$

If system complete connectivity increases or strongness increases, then centrality decreases.

Proof:

1.	${}_{CC}\mathcal{C}^{\uparrow} \vee {}_{S}\mathcal{C}^{\uparrow} \sqsupset \mathrm{T}\mathcal{P}^{\uparrow}$	Axiom 106
2.	$\mathrm{T}\mathcal{P}^{\uparrow} \sqsupset {}_{C}\mathcal{C}^{\downarrow}$	Axiom 90
3.	${}_{CC}\mathcal{C}^{\uparrow} \vee {}_{S}\mathcal{C}^{\uparrow} \sqsupset {}_{C}\mathcal{C}^{\downarrow}$	Transitivity, 1,2
4.	$\therefore \vdash {}_{CC}\mathcal{C}^{\uparrow} \vee {}_{S}\mathcal{C}^{\uparrow} \sqsupset {}_{C}\mathcal{C}^{\downarrow}$	Q.E.D.

T.0.194-90. $\vdash \mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset {}_{C}\mathcal{O}^{\downarrow}$

If system size increases and complexity growth is constant, then centrality decreases.

Proof:

1.	$\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset T\mathcal{P}^{\uparrow}$	Axiom 194
2.	$T\mathcal{P}^{\uparrow} \sqsupset {}_{C}\mathcal{O}^{\downarrow}$	Axiom 90
3.	$\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset {}_{C}\mathcal{O}^{\downarrow}$	Transitivity, 1,2
4.	$\therefore \vdash \mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset {}_{C}\mathcal{O}^{\downarrow}$	Q.E.D.

T.0.195-91. $\vdash \mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset {}_{U}\mathcal{O}^{\downarrow}$

If system size increases and complexity growth is constant, then unilateralness decreases.

Proof:

1.	$\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset f_{I}^{\downarrow}$	Axiom 195
2.	$f_{I}^{\downarrow} \sqsupset {}_{U}\mathcal{O}^{\downarrow}$	Axiom 91
3.	$\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset {}_{U}\mathcal{O}^{\downarrow}$	Transitivity, 1,2
4.	$\therefore \vdash \mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset {}_{U}\mathcal{O}^{\downarrow}$	Q.E.D.

T.0.195-93. $\vdash \mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset \mathcal{X}^{-\uparrow}$

If system size increases and system complexity growth is constant, then complexity degeneration increases.

Proof:

1.	$\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset f_{I}^{\downarrow}$	Axiom 195
2.	$f_{I}^{\downarrow} \sqsupset \mathcal{X}^{-\uparrow}$	Axiom 93
3.	$\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset \mathcal{X}^{-\uparrow}$	Transitivity, 1,2
4.	$\therefore \vdash \mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset \mathcal{X}^{-\uparrow}$	Q.E.D.

T.1.96-97. $\vdash [\mathbf{T}_{\mathcal{P}}^{\approx \min} \wedge \mathbf{F}_{\mathcal{P}}^{\uparrow}] \vee [f_{I}^{\uparrow} \wedge e^{\approx \min}] \sqsupset {}_{D}\mathscr{C}^{\uparrow}$

If system toput is close to minimum and fromput increases, or system feedin increases and compatibility is close to minimum, then system disconnectivity increases. [NOTE: This theorem is not derived from the Initial Axiom Set.]

Proof:

1. $\mathrm{T}_{\mathcal{P}}^{\approx \min} \wedge \mathrm{F}_{\mathcal{P}}^{\uparrow} \sqsupset {}_{D}\mathscr{C}^{\uparrow}$ Axiom 96
2. $f_{I}^{\uparrow} \wedge e^{\approx \min} \sqsupset {}_{D}\mathscr{C}^{\uparrow}$ Axiom 97
3. $[\mathbf{T}_{\mathcal{P}}^{\approx \min} \wedge \mathbf{F}_{\mathcal{P}}^{\uparrow}] \vee [f_{I}^{\uparrow} \wedge e^{\approx \min}] \sqsupset {}_{D}\mathscr{C}^{\uparrow}$ Logical Schema 1
4. $\therefore \vdash [\mathbf{T}_{\mathcal{P}}^{\approx \min} \wedge \mathbf{F}_{\mathcal{P}}^{\uparrow}] \vee [f_{I}^{\uparrow} \wedge e^{\approx \min}] \sqsupset {}_{D}\mathscr{C}^{\uparrow}$ Q.E.D.

T.1.100-102. $\vdash {}_{CC}\mathscr{C}^{\uparrow} \vee {}_{I}\mathscr{C}^{\uparrow} \sqsupset f_{I}^{\uparrow}$

If system complete connectivity increases or system interdependence increases, then system feedin increases.

Proof:

1. ${}_{CC}\mathscr{C}^{\uparrow} \sqsupset f_{I}^{\uparrow}$ Axiom 100
2. ${}_{I}\mathscr{C}^{\uparrow} \sqsupset f_{I}^{\uparrow}$ Axiom 102
3. ${}_{CC}\mathscr{C}^{\uparrow} \vee {}_{I}\mathscr{C}^{\uparrow} \sqsupset f_{I}^{\uparrow}$ Logical Schema 1
4. $\therefore \vdash {}_{CC}\mathscr{C}^{\uparrow} \vee {}_{I}\mathscr{C}^{\uparrow} \sqsupset f_{I}^{\uparrow}$ Q.E.D.

T.1.106-194. $\vdash [{}_{CC}\mathscr{C}^{\uparrow} \vee {}_{S}\mathscr{C}^{\uparrow}] \vee [\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c}] \sqsupset \mathbf{T}_{\mathcal{P}}^{\uparrow}$

If system complete connectivity increases or strongness increases, or system size increases and complexity growth is constant, then system toput increases.

Proof:

1. ${}_{CC}\mathscr{C}^{\uparrow} \vee {}_{S}\mathscr{C}^{\uparrow} \sqsupset \mathrm{T}_{\mathcal{P}}^{\uparrow}$ Axiom 106
2. $\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset \mathrm{T}_{\mathcal{P}}^{\uparrow}$ Axiom 194
3. $[{}_{CC}\mathscr{C}^{\uparrow} \vee {}_{S}\mathscr{C}^{\uparrow}] \vee [\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c}] \sqsupset \mathbf{T}_{\mathcal{P}}^{\uparrow}$ Logical Schema 1
4. $\therefore \vdash [{}_{CC}\mathscr{C}^{\uparrow} \vee {}_{S}\mathscr{C}^{\uparrow}] \vee [\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c}] \sqsupset \mathbf{T}_{\mathcal{P}}^{\uparrow}$ Q.E.D.

T.6.91. **If $\vdash f_{\mathrm{I}}^{\downarrow} \sqsupset {}_{\mathrm{U}}\mathscr{O}^{\downarrow}$, then $f_{\mathrm{I}}^{\downarrow} \vdash {}_{\mathrm{U}}\mathscr{O}^{\downarrow}$**

If "system feedin decreases, then system unilateralness decreases" is a theorem; then system feedin decreasing yields system unilateralness decreasing.

Proof:

1. $f_{\mathrm{I}}^{\downarrow} \sqsupset {}_{\mathrm{U}}\mathscr{O}^{\downarrow}$ — Axiom 91
2. **If $\vdash f_{\mathrm{I}}^{\downarrow} \sqsupset {}_{\mathrm{U}}\mathscr{O}^{\downarrow}$, then $f_{\mathrm{I}}^{\downarrow} \vdash {}_{\mathrm{U}}\mathscr{O}^{\downarrow}$** — Logical Schema 6
3. $\therefore$ **If $\vdash f_{\mathrm{I}}^{\downarrow} \sqsupset {}_{\mathrm{U}}\mathscr{O}^{\downarrow}$, then $f_{\mathrm{I}}^{\downarrow} \vdash {}_{\mathrm{U}}\mathscr{O}^{\downarrow}$** — Q.E.D.

ATIS System-Construction Logical Schemas

Theory-Construction Logical Schemas provide the means to obtain system-specific theorems; that is, system-specific predictions of system behavior. Theorems derived in this manner are the result of the creative input of the researcher.

The theorems provided for *Logical Schema 3* will rely on the *Initial Axiom Set* to provide the system extensions by which the theorems are derived. However, it is believed that *Data Mining Technologies* may be able to provide, possibly automatically, relations that can be arbitrarily entered in the schemas to generate theorems. In addition, as stated in the introduction to this report, data obtained from a specific system either directly or by means of an *APT Analysis* may also provide the predicates required to generate theorems by means of *SimEd*.

In addition to demonstrating the use of *Theory-Construction Logical Schemas*, the following example will also address questions relating to the temporal factors involved in *ATIS* systems analysis.

Theorem 3.33.90 is given and proved on the following page. The axiom and logical schema required for this theorem are given below.

Theory Construction from A.33. $\mathrm{T}_{\mathcal{P}}{}^{\uparrow} \wedge \mathrm{F}_{\mathcal{P}}{}^{\uparrow} \sqsupset \oint_{\mathrm{T}}{}^{\uparrow}$

System input decreases, implies system fromput decreases.

Founded on *Logical Schema 3:* $\mathrm{P} \supset \mathrm{R} \vdash \mathrm{P} \supset (\mathrm{Q} \supset \mathrm{R})$

Since A.33 requires the temporal implication, the logical schema must be rewritten to conform to this requirement, hence, the following schema will be used:

Logical Schema 3T: $\mathrm{P} \sqsupset \mathrm{R} \vdash \mathrm{P} \sqsupset (\mathrm{Q} \sqsupset \mathrm{R})$

T.3.33-90. $T\mathcal{P}^{\uparrow}, (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}) \supset \oint_T^{\uparrow} \vdash (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}) \supset ({}_C\mathcal{C}^{\downarrow} \supset \oint_T^{\uparrow})$

Assume that system toput increases, and toput increases and fromput increases, implies feedthrough increases; yields system toput increases and fromput increases, implies centralization decreases implies feedthrough increases.

Proof:

1.	$T\mathcal{P}^{\uparrow}$	Assumption
2.	$T\mathcal{P}^{\uparrow} \supset {}_C\mathcal{C}^{\downarrow}$	Axiom 90
3.	${}_C\mathcal{C}^{\downarrow}$	Modus Ponens, 1,2
4.	$T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow} \supset \oint_T^{\uparrow}$	Axiom 33
5.	$\vdash (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}) \supset (Q \supset \oint_T^{\uparrow})$	Logical Schema 3T, 4
6.	Let $Q \equiv {}_C\mathcal{C}^{\downarrow}$	From 3
7.	$\vdash (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}) \supset ({}_C\mathcal{C}^{\downarrow} \supset \oint_T^{\uparrow})$	Substitution, 5,6
8.	$T\mathcal{P}^{\uparrow}, (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}) \supset \oint_T^{\uparrow} \vdash (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}) \supset ({}_C\mathcal{C}^{\downarrow} \supset \oint_T^{\uparrow})$	From 1,4,7
9.	$\therefore\ T\mathcal{P}^{\uparrow}, (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}) \supset \oint_T^{\uparrow} \vdash (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}) \supset ({}_C\mathcal{C}^{\downarrow} \supset \oint_T^{\uparrow})$	Q.E.D.

To help visualize the results of this theorem, it can be rewritten as follows using the Deduction Theorem:

T.3.33-90. $T\mathcal{P}^{\uparrow}, (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}) \supset \oint_T^{\uparrow},\ (T\mathcal{P}^{\uparrow} \wedge F\mathcal{P}^{\uparrow}), {}_C\mathcal{C}^{\downarrow} \vdash \oint_T^{\uparrow}$

What this theorem says is that if toput and fromput increase, then centralization will decrease, and with the decrease of centralization, feedthrough will increase. While this may now be more intuitive, it is clear that this system relation would have been difficult to determine without having the formal tools now available. That is, this theorem has assisted in finding a non-obvious result.

Logical Schema 3 Theorems

The following theorems are derived from *Logical Schema 3T*.

Logical Schema 3T: $P \sqsupset R \vdash P \sqsupset (Q \sqsupset R)$

T.3.106-T53. ${}_{CC}\mathcal{Q}^{\uparrow}, {}_{CC}\mathcal{Q}^{\uparrow} \vee {}_{S}\mathcal{Q}^{\uparrow} \sqsupset T\mathcal{P}^{\uparrow} \vdash {}_{CC}\mathcal{Q}^{\uparrow} \vee {}_{S}\mathcal{Q}^{\uparrow} \sqsupset ({}_{F}\mathcal{Q}^{\uparrow} \sqsupset T\mathcal{P}^{\uparrow})$

Assume complete connectivity increases, and complete connectivity increases or strongness increases, implies toput increases; yields complete connectivity increases or strongness increases, implies, flexibility increases implies toput increases.

T.3.107-T56. ${}_{S}\mathcal{Q}^{\uparrow}, {}_{CC}\mathcal{Q}^{\uparrow} \vee {}_{S}\mathcal{Q}^{\uparrow} \sqsupset I\mathcal{P}^{\uparrow} \vdash {}_{CC}\mathcal{Q}^{\uparrow} \vee {}_{S}\mathcal{Q}^{\uparrow} \sqsupset ({}_{F}\mathcal{Q}^{\uparrow} \sqsupset I\mathcal{P}^{\uparrow})$

Assume strongness increases, and complete connectivity increases or strongness increases, implies input increases; yields complete connectivity increases or strongness increases, implies, flexibility increases implies input increases.

T.3.194-T179. $\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset T\mathcal{P}^{\uparrow} \vdash \mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset ({}_{V}\mathcal{Q}^{\uparrow} \sqsupset T\mathcal{P}^{\uparrow})$

Assume size increases and complexity growth is constant, implies toput increases; yields size increases and complexity growth is constant, implies, vulnerableness increases implies toput increases.

T.3.194-T180. $\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset T\mathcal{P}^{\uparrow} \vdash \mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset ({}_{F}\mathcal{Q}^{\downarrow} \sqsupset T\mathcal{P}^{\uparrow})$

Assume size increases and complexity growth is constant, implies toput increases; yields size increases and complexity growth is constant, implies, flexibility increases implies toput increases.

T.3.194-T181. $\mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset T\mathcal{P}^{\uparrow} \vdash \mathcal{Z}^{\uparrow} \wedge \mathcal{X}^{+}{}_{c} \sqsupset ({}_{C}\mathcal{Q}^{\downarrow} \sqsupset T\mathcal{P}^{\uparrow})$

Assume size increases and complexity growth is constant, implies toput increases; yields size increases and complexity growth is constant, implies, centralization decreases implies toput increases.

Axiomatic Temporal Implication Logic

Temporal Implication Logic has been developed to address the logic with respect to empirical systems that have a time set and, therefore, a sequence of events. The types of relations that are of concern in this logic are those where one event precedes another in time, and the first is considered to imply, or "cause", the other. For example, the situation where feedin precedes feedout and there is a relation between the two that we wish to represent by an implication would fall within this classification.

Using conventional logic, paradoxes will arise whereby equivalences will result in the conclusion implying the premise, an empirical impossibility since the conclusion is subsequent in time to the premise. *Temporal Implication Logic* is designed to constructively handle temporal parameters of implication.

To distinguish *Temporal Implication* from the implication of the *Sentential* and *Predicate Calculi*, a distinctive symbol will be used. Whereas 'implication' for the logic used in this research is designated by '$\supset$', *Temporal Implication*, TI, will be designated by '$\sqsupset$'.

The problem with TI is that equivalences are not valid when either predicate of the TI is negated. All other logical operations and equivalences hold. The following *Axiomatic Temporal Implication Logic* provides the logic required to formally prove theorems in an empirical theory where temporal implications occur.

For this logic, the operation for negation is not allowed, while most other operations can be defined in terms of '$\sqsupset$' and '$\wedge$', which are the two basic undefined operations. In addition to negation, the exclusive "or" also cannot be defined.

For the following axioms, F, P, Q, and R are statements, and x is a variable (i.e., a bound occurrence of x).

TI-A.1. $P \sqsupset PP$

TI-A.2. $PQ \sqsupset P$

TI-A.3. $(P \sqsupset R) \sqsupset (P \sqsupset (Q \sqsupset R))$

TI-A.4. $\forall x(P \sqsupset Q) \sqsupset (\forall xP \sqsupset \forall xQ)$

TI-A.5. $P \sqsupset \forall xP$, if there are no free occurrences of x in P; i.e., no unknowns.

TI-A.6. $\forall xF(x,y) \sqsupset F(y,y)$

The distinction between this axiom set and that of the standard logic is that the following axiom has been removed:

$$(P \sqsupset Q) \sqsupset (\sim(QR) \sqsupset \sim(RP))$$

In place of the above axiom, the following has been used:

TI-A.3. $(P \sqsupset R) \sqsupset (P \sqsupset (Q \sqsupset R))$

This replacement effectively precludes $\sim Q \sqsupset \sim P$ as a logical equivalence of $P \sqsupset Q$. It also precludes numerous other equivalences in which negation of statements occur.

Following are the definitions of '$\vee$' and '$\equiv$'. The exclusive "or," '$\underline{\vee}$', cannot be defined within this logic.

$P \vee Q =_{df} (P \sqsupset Q) \sqsupset Q$

$P \equiv Q =_{df} (P \sqsupset Q) \wedge (Q \sqsupset P)$

This logic is designed specifically to address the problems relating to temporal implications as distinct from the standard logic that does not address this issue.

In practice, when analyzing a specific system, both the TI Logic and Standard Logic will be utilized. For any time-dependent implication, the TI Logic will be used. For all other considerations, the Standard Logic will be used.