System Dynamics
A Tool for Investigating Church and Religious Growth

John Hayward
Division of Mathematics & Statistics
University of South Wales, UK

Church Growth Modelling
Aims of Talk

- System dynamics methodology
  - Tool modelling church growth, religious change

- Explain SD with a simple model of church growth

- Applications
  - Denominational level
  - Congregational level – pastor’s views
  - Potential sociological research
What is System Dynamics?

- **Industrial Dynamics 1950s-60s**
  - Originator JW Forrester MIT

- **Applied Business and Social Modelling**
  - Supply chains, business cycles
  - World model

- **Key Features**
  - Model Structure
  - Causal connections between variables
  - Hypothesis -> Structure -> Behaviour
  - Feedback
<table>
<thead>
<tr>
<th>Church</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No of People</td>
</tr>
</tbody>
</table>

Unless something changes
What is there today
Will be there tomorrow
Stock

Unless something changes
What is there today
Will be there tomorrow

50 today – 50 tomorrow
Flow

Causal Material Link

Hypothesis:
10 new people come to church each year

Adds to stock “per year”
Flow

Hypothesis -> Structure -> Behaviour

Hypothesis:
10 new people come
to church each year

Structure:
Constant recruitment

Behaviour:
Straight line growth
Hypothesis:
Fixed fraction of people leave each year

Connector
More in church more leave

Causal Information Link

Flow out
Converter

Parameter
Determined outside system

Hypothesis:
Fixed fraction of people leave each year
Balancing Feedback Loop

Hypothesis -> Structure -> Behaviour

Hypothesis:
Fixed fraction of people leave each year

Structure:
balancing loop $B1$

Behaviour:
slowing growth
Balancing Feedback Loop

Hypothesis -> Structure -> Behaviour

Hypothesis:
Fixed fraction of people leave each year

Conclusion:
For continual church growth recruitment must increase with size
Reinforcing Feedback Loop

Hypothesis:
Each Person in church recruits
Infinite Demand
Reinforcing Feedback Loop

Hypothesis -> Structure -> Behaviour

Hypothesis:
Each Person in church recruits
Infinite Demand

Structure:
reinforcing loop R1

Behaviour:
increasing growth
Extend Model Boundaries

Where do church leavers go?

- New stock
- Structure same
- Behaviour same
Where do new recruits come from?

Hypothesis:
Fixed demand

New stock

Structure changed – limited recruitment base
Behaviour changed
Social Diffusion

How does church interact with those outside?

Hypothesis:
Fixed demand
homogeneous mix

New balancing loop
Reduce recruitment
**Social Diffusion**

Hypothesis:
- Fixed demand
- Homogeneous mix

Parameter

Assume all population is open to joining church
Dominant Feedback Loops

Hypothesis:
Fixed demand
Homogeneous mix

Structure:
$R_1$, $B_1$, $B_2$

Behaviour:
Growth limited
Disaggregate

Who in church recruits?

Hypothesis: Not all church members recruit
**Hypothesis:**
Enthusiasts recruit sub group of church
Hypothesis:
Enthusiasts cease potential to recruit when established
Limited Enthusiasm Model

Hypothesis:
Limited enthusiasm

Structure:
$R_1, B_1, B_2, B_3$

Behaviour:
growth lower over quicker
• Growth through *enthusiasts*
• Some converts non-recruiting
• *Left Church* eventually recycled to Outside Church
• Births and Deaths – all categories
# Thresholds

- Potential enthusiasts to reproduce
- Extinction threshold
- Revival-growth threshold

<table>
<thead>
<tr>
<th>Denomination</th>
<th>Condition</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UK</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentecostal</td>
<td>Revival Growth</td>
<td></td>
</tr>
<tr>
<td>Charismatic/New paradigm</td>
<td>Survival</td>
<td>Was revival growth - slowed</td>
</tr>
<tr>
<td>Baptist</td>
<td>Survival</td>
<td>Fairly Flat</td>
</tr>
<tr>
<td>Anglican</td>
<td>Survival</td>
<td>Significant decline to come</td>
</tr>
<tr>
<td>Catholic</td>
<td>Extinction</td>
<td></td>
</tr>
<tr>
<td>Methodist</td>
<td>Extinction</td>
<td></td>
</tr>
<tr>
<td><strong>USA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentecostal</td>
<td>Revival Growth</td>
<td></td>
</tr>
<tr>
<td>Southern Baptist</td>
<td>Survival</td>
<td>Decline does not fit model</td>
</tr>
<tr>
<td>Episcopal</td>
<td>Extinction</td>
<td></td>
</tr>
</tbody>
</table>
Church of England 2001-2011

- Most fits above extinction (optimistic)
- Some below (pessimistic)
- Change of curvature
Church of England 2001-2011

Optimistic fit - enthusiasts start to reproduce again
Southern Baptist Convention

- Does not fit after 2006
  - Decline too rapid – why?
  - Extra loop/force

- Too fast for aging
- Fall in birth rate
  - Not worked through
  - In simulation
- Leaving/Switching
- Enthusiasts less effective
  - Internal confidence
  - External legitimacy
Discipleship Model

- Pastors Understand Discipleship
- All churches had discipleship programs
- 5 Categories
- Estimate Stocks, Flows
**Challenge Perceptions**

- **Stock Estimates** – optimistic
- **Flow Estimates** – pessimistic
- **Transfer in of mature missing**
How can sociological theory be added to SD model?

Secularisation
Dynamics Outside Church

- Recycle
- Overshoot
- Re-growth possible
Sociological Theory

Open can become closed
- Effect of secularisation
- Constant hostility rate
Religiosity a variable
- Increase as church increases
- Decrease as closed unbelievers increases
Religiosity makes
• Enthusiasts more effective
• Church more attractive
• Open stay open

Reversed
• 4 new feedback loops
• All R
Sociological Theory

Extract the New Feedback Loops

Competing Forces
- $R2, R3$ religiosity
- $R4, R5$ secularity

Reinforcing Loops
- Unstable
- Can change very fast

$R2$, $R3$, $R4$, $R5$
Effect of Secularisation on Unbelievers

1-4 increasing effect
- Stability possible
- Too much and church pushed to extinction
Conclusion

- Congregational Dynamics
  - Understandable church to pastors
  - Evaluate policies
  - Challenge perceptions
- Theories of Growth
  - Develop principles
  - Tested against data
- Potential for Sociological Theory
- SD Software
  - SD Courses
  - SD Society

John Hayward

University of South Wales, UK
Church Growth Modelling