

# Science, Technology and Innovation (STI) Policy Instruments: Guidelines for Effective Implementation



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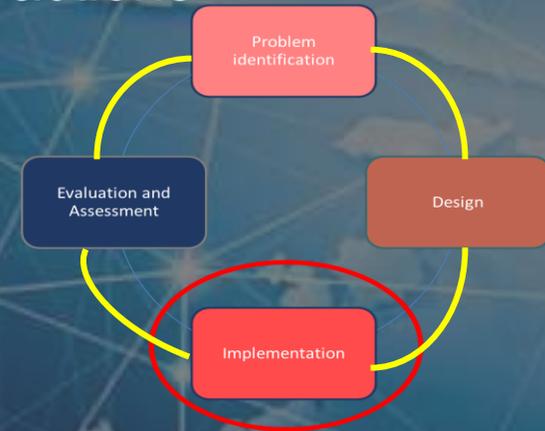
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# What is STI policy instrument implementation?

- ❑ Implementation is the stage of STI policy cycle where policy instruments are executed or operationalized into actions



- ❑ Characteristics of the Implementation Stage
  - Proof of concept and learning phase
  - Social and Political process
  - Managerial focus
  - Involves Communication and Convincing
  - Change process
- ❑ Implementation needs a significant different skill set to be successful than other stages of the policy process

# WHAT DOES THE LITERATURE TELL US?

- ❑ Command and control orientation
  - ✓ Top-down
  - ✓ Bottom-up
  - ✓ Hybrid
- ❑ Rational choice views
  - ✓ Game theory
  - ✓ Agency approaches
- ❑ Contingency Approach
- ❑ Organizational, Bureaucratic and Managerial Perspectives

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## Graph-Based Concept Learning

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### Abstract

We introduce the graph-based relational concept learner SubdueCL. We start with a brief description of other graph-based learning systems: the Galois lattice, Conceptual Graphs, and the Subdue system. We then present our new system SubdueCL and finally we show some preliminary results of a comparison of SubdueCL with the two Inductive Logic Programming (ILP) systems Foil and Progol.

### Introduction

We describe our current research on graph-based concept learning based in the SubdueCL system. Graph-based systems have the potential to be competitive in the learning task, because they provide a powerful and flexible representation that can be used for relational domains. The main competitors of graph-based systems are logic based systems, especially Inductive Logic Programming (ILP) systems, which have dominated the area of relational concept learning. We are comparing our graph-based approach with the ILP systems Foil and Progol. On the theoretical side, we have studied other graph-based systems, and we are applying the related theory to our system. For example, we are working in a PAC learning analysis of the SubdueCL system in order to show that it is possible to learn using graph-based systems with a polynomial number of training examples.

The paper is organized as follows. The related work section briefly describes the graph-based systems that we have studied: Conceptual Graphs, the Galois lattice and the Subdue system. The SubdueCL section describes our graph-based concept learning system. The empirical results section presents some preliminary results from a comparison of SubdueCL with the two ILP systems Foil and Progol. The last section presents our conclusions and future work.

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### Related Work

In this section we briefly describe the role of ILP systems as concept learners and then we present some work related to graph-based concept learners.

#### ILP Systems

One approach to relational concept learning systems is Inductive Logic Programming (ILP), which represents data using First Order Predicate Calculus (FOPC) in the form of Prolog logic programs. ILP systems have been successful in structural domains: Progol in the Chemical Carcinogenicity domain (Srinivasan, King, Muggleton et al. 1997) and FOIL (Cameron and Quinlan 1994) for learning patterns in Hypertext domains (Slattery & Craven 1998). The system presented in this paper uses graphs as its data representation, which are flexible and descriptive. Graphs can also describe FOPC using Conceptual Graphs as introduced by John Sowa (Sowa 1992).

#### Conceptual Graphs

Conceptual Graphs (CGs) are a logic-based knowledge representation derived from Semantic Networks and Peirce Existential Graphs (Sowa 1992). Figure 1 shows an example of a Conceptual Graph expressing "A cat is on a mat". Square vertices represent relations. Edges are used to link concepts with relations.

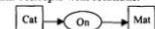


Figure 1: A Conceptual Graph's Example

CGs are being used in different areas of Artificial Intelligence like natural language processing, information retrieval and expert systems. Conceptual Graphs provide a powerful and rich knowledge representation that has been used for concept learning as presented in (Jappy and Nock 1998). Their work describes a PAC Learning (Valiant 1985) analysis using Conceptual Graphs to show its effectiveness for Learning. With this model, the authors were able to

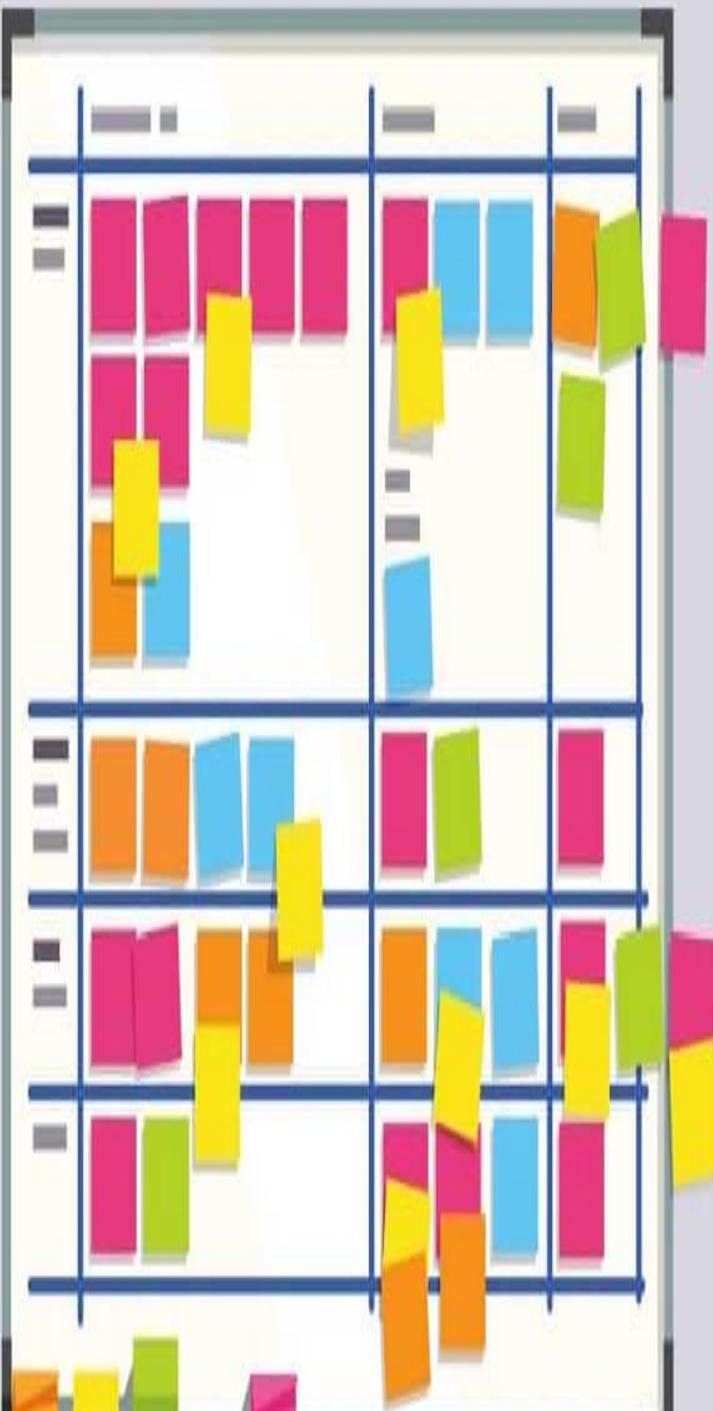


# THE PRACTICE OF IMPLEMENTATION



# PLANNING

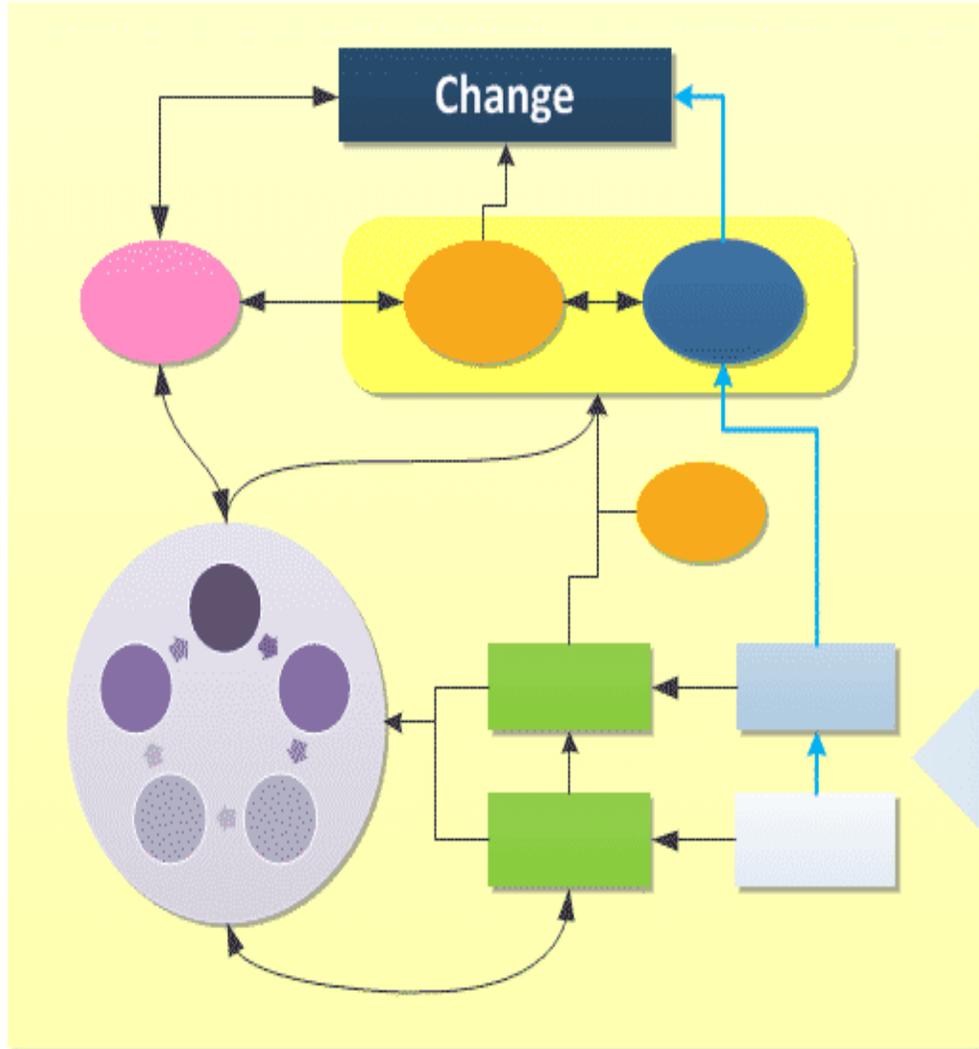
- Stages: exploring and preparing, planning and resourcing, operationalization, full implementation
- Tools:
  - ✓ Logical Frameworks, Theories of change
  - ✓ STI Roadmap: describe long, middle and short term and operational actions that are necessary to implement the policy
  - ✓ Calendars: setting steps, time allocates to each step and deadlines
- Roles and responsibilities: clearly identify tasks and duties and answerabilities at all levels
- Resources: human and financial
- Targets: measurable and realistic STI performance indicators (input, output, impact)
- Costing: content and process
- Press and social media: actions to obtain public support





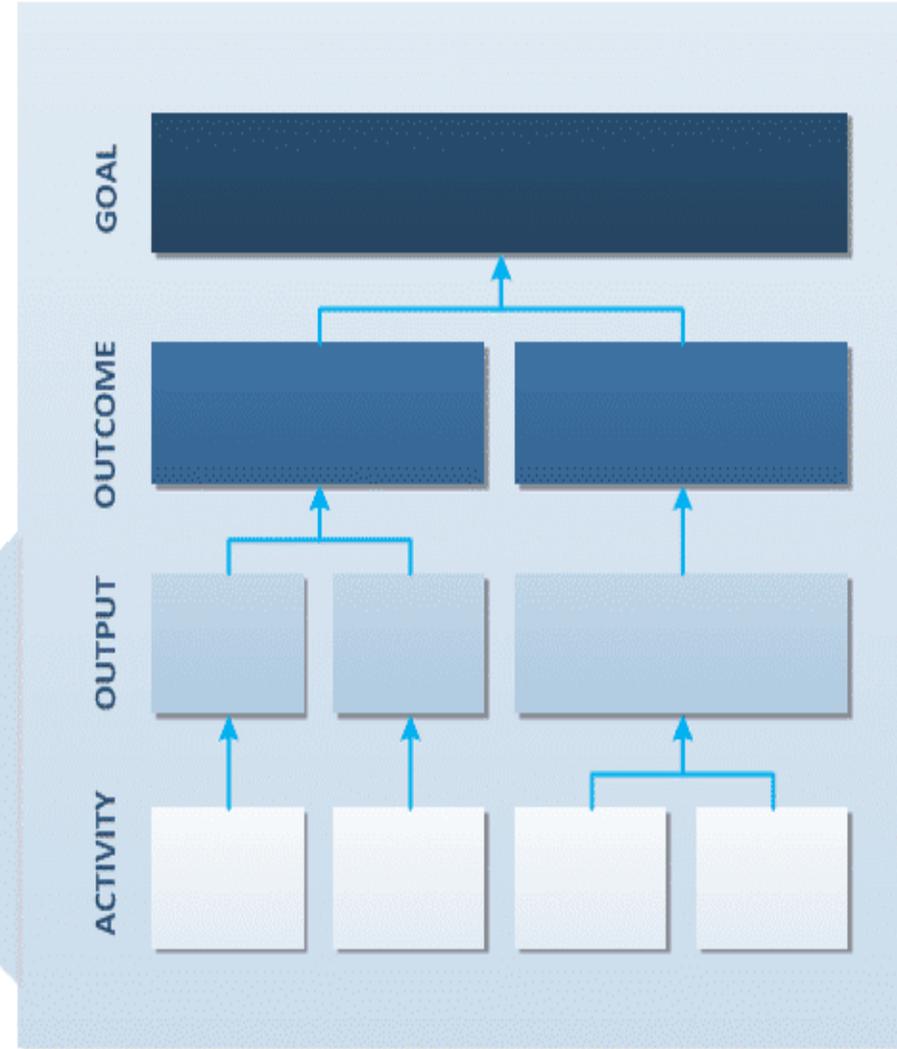
# Theory of Change

Shows the big picture with all possible pathways – messy and complex

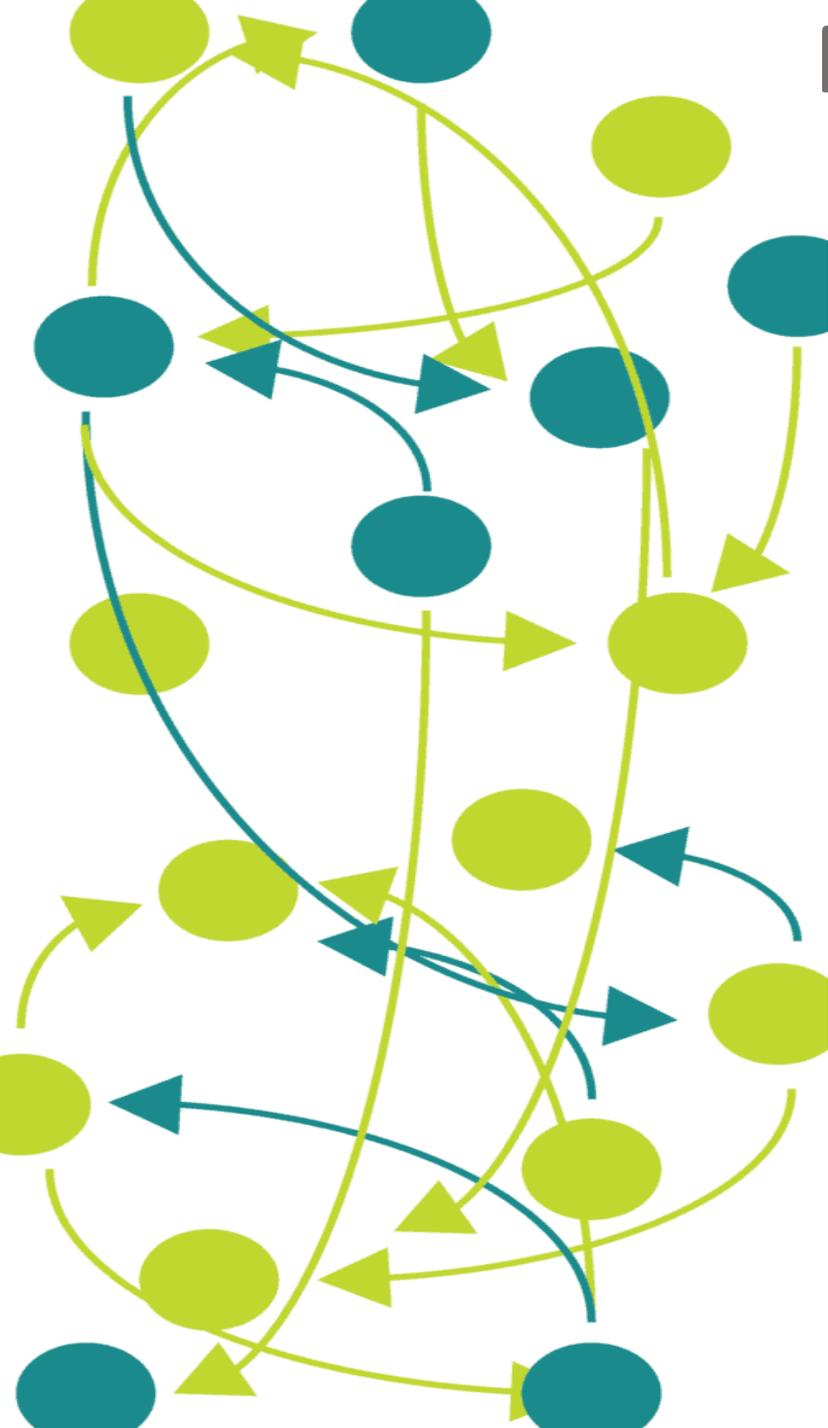


# Logical Framework

Shows just the pathway that your program deals with – neat and tidy



# MULTI-LEVEL, MULTI-ACTOR AND MULTI-FIELD APPROACH



- ❑ Assess the current economic, social and political environment and how to adapt to implement effectively
- ❑ Identify
  - ✓ the main inputs (laws, regulations) and outputs (behavioural outcomes) needed to succeed
  - ✓ the key STI actors required to implement the policies (granular perspective)
  - ✓ the social, economic and political (SEP) relations between key STI actors and with other actors
  - ✓ the SEP effects and repercussions of the implementation process
- ❑ Examine and assess the systemic interactions of the above and their impact on successful implementation

# THE POLITICS OF IMPLEMENTATION

- ❑ A highly political process, involving not only government and stakeholders, but also non-stakeholders
- ❑ Approaching politicians
  - ✓ Make a solid and convincing case of the benefits of STI policy instruments for society
  - ✓ Identify and work with like-minded politicians
  - ✓ Identify the short-term benefits and quick gains that specific policy instruments can achieve (what is in for me?)
  - ✓ Test the waters of possible political responses through successful small initiatives or pilot projects
- ❑ Identify potential political allies and supporters beyond the STI community
- ❑ Co-opt allies and supporters into your camp as early as possible during the implementation and build networks, coalitions and political lobbies with them
- ❑ Neutralise possible opposition to implementation actions early on through inviting them to participate in projects and negotiations or by weakening opponents in their own fields
- ❑ Seek substantive support from communities of practice and population at large

# LEADERSHIP AND COMMITMENT

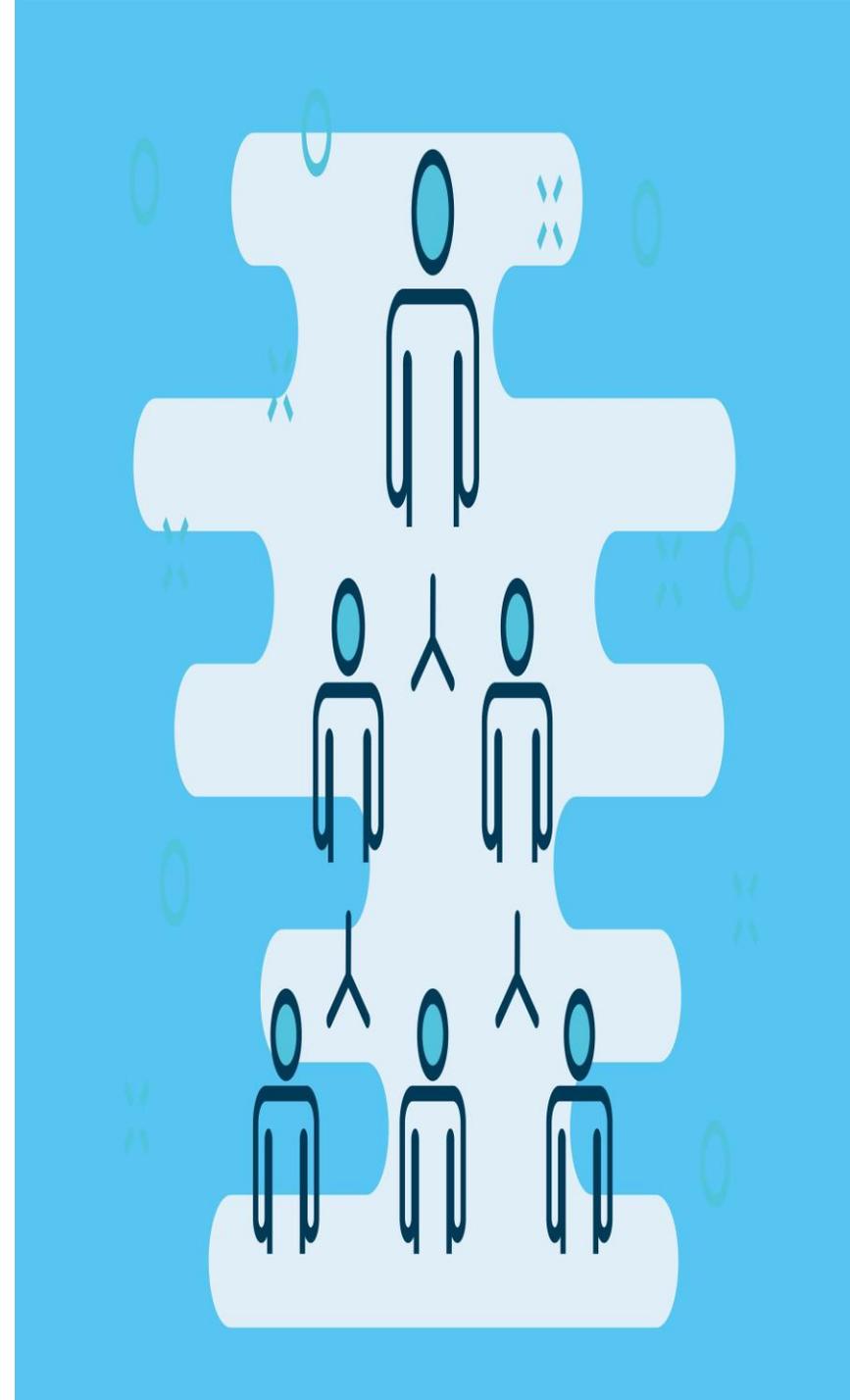


- Ensure STI is top Presidential or parliamentary priority
- Make sure it is also top Ministerial priority
- Secure private and public sector champions
- Draw on STI bureaucracy: influence and advocacy
- Work on generating leadership and commitment
- Build on committed personnel
- Have a 'lead ministry' that guides the process



# GOVERNANCE

- ❑ Introduce an overall representative STI multi-stakeholder consulting/decision making instance
- ❑ Establish:
  - A body with the overall responsibility for implementation within the 'lead ministry' (directorates, departments, agencies)
  - The subordinate duties, structures and joint tasks that fit the purposes of organizations
  - Intra and interorganizational teams
  - Clear accountabilities
- ❑ Transparency:
  - Full information on the reasoning underlying the policies, processes and actors involved
  - Clear and accessible processes and related rules



# COORDINATION



- ❑ Achieving successful STI policy implementation often depends significantly on non-STI actors or actions
- ❑ Create
  - Multi-stakeholder implementation committees, working groups and teams
  - Selection mechanisms that ensure relevant organizations are involved
  - Rotating managerial responsibilities
  - Focal points across implementation agents
- ❑ Follow-up on the tasks and ensure they are delivered as expected and in time



# TRADITIONAL AND SOCIAL MEDIA AND INTERNET



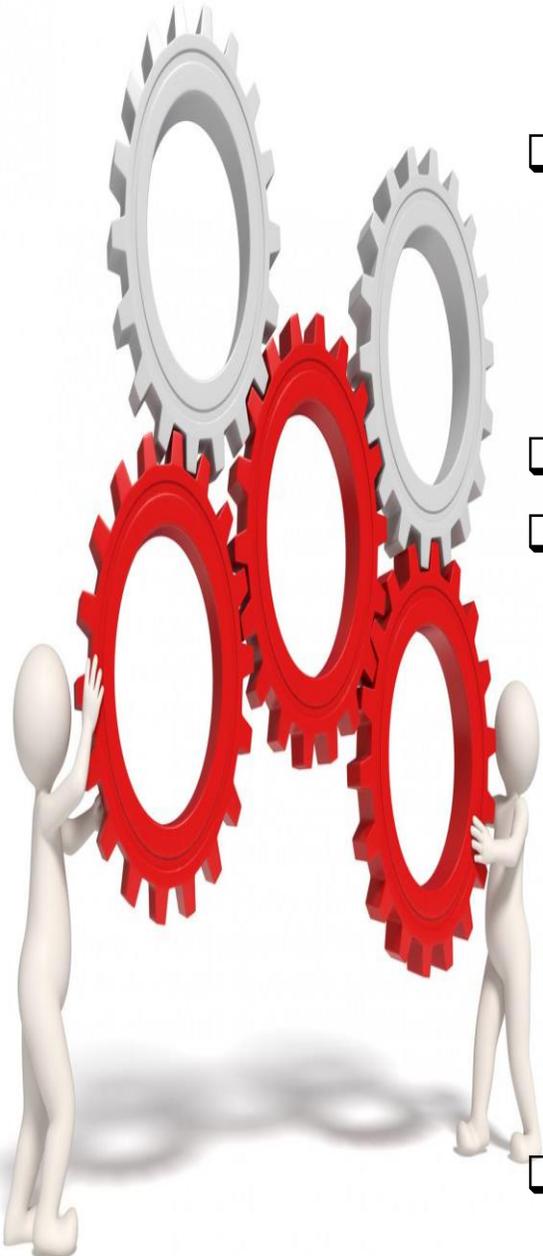
- ❑ Media and social media can be an important ally for implementing STI policies
- ❑ Identify media outlets that are used by the STI communities to disseminate information
- ❑ Introduce a media campaign aimed at:
  - Presenting the rationale and expected benefits of the policies
  - Inform the public and put STI at the center of the policy debate
  - Encourage debate
  - Advocate for the policies and enlist support
- ❑ Use internet platforms, facebook, tweeter, webpages and e-facilities to facilitate the involvement of stakeholders
- ❑ Ensure that information provided is easy to understand, useful and comprehensive so that users can have an adequate understanding of the issues at stake
- ❑ Develop media campaigns to sensitize national population on STI issues, especially youth
- ❑ Make extensive use of government media to sensitize population





# MANAGERIAL CAPABILITIES

- ❑ Implementation involves
  - ✓ allocation of resources across competing demands
  - ✓ it is unpredictable and uncertain
  - ✓ the resistance of some stakeholders and other sectors of the population
  - ✓ entails practical difficulties and the disruption of existing arrangements
- ❑ Entrust STI managers with driving the implementation stage of the policy process
- ❑ Introduce the required managerial capabilities:
  - Technical expertise: content and process
  - Holistic thinking
  - Creativity
  - Problem solving
  - Social networks
  - Communicating
  - Influencing and convincing
  - Trustworthy and respect
  - Risk-taking
  - Exploration and experimentation
- ❑ Make use of adequate implementation vehicles: executive orders, administrative mechanisms, rules and regulations





# RESOURCES

- ❑ Ensure the necessary level of financial resources
  - Content: R&D grants, subsidies, tax incentives, funding programs, capacity building, services
  - Process: consultants, studies, interviews, travel, meetings, software, communications, press, social media
  - Financing scenarios, cost of doing nothing
- ❑ Obtain the right mix of STI human resources
  - Managers
  - Experts
  - Support staff
  - Communications professionals
- ❑ Attain the required knowledge
  - Diaspora/retirees
  - International Experts
  - Consultancy companies/international organizations





# LEARNING AND FEEDBACK LOOPS

- ❑ STI policy Implementation is far from being an exact science and successful implementation involves learning by doing and learning from the experiences and mistakes done
- ❑ Learning by doing:
  - Consider the contextual conditions and how they affect implementation
  - Continuously adjust plans to reflect contextual conditions
  - Test alternative approaches to implementation as problems emerge
  - Reflect on the regular challenges that emerge during implementation
  - Regularly collect process data, systematize and analyze it (evidence-based)
  - Constantly monitor progress
- ❑ Learning from experience:
  - Codify implementation process
  - Analyze and explain what went right and wrong and how can it be improved
  - Draw on experiences elsewhere
  - Perform full post-implementation process evaluations
- ❑ Improve processes based on the knowledge generated during learning



## FINAL REMARKS



- ❑ Policy instruments implementation challenges lie more in the social, political and managerial processes involved than in the technicalities of the instruments
- ❑ The ‘implementation mix’ applicable to each country or context depends on the institutional development in that specific context, although implementation challenges occur at all levels of institutional development
- ❑ The ‘implementation mix’ applicable to each country or context also depends on the nature of instrument in hand. For intricate instruments and with significant impact, more elaborate processes tend to be required. Conversely, for instruments that are less sophisticated and of less impact, a simpler approach can be taken.
- ❑ The complexities involved to achieve effective implementation are such that ‘cutting corners’ or reducing the length of time processes demand for political expediency will only derail implementation and result in failure. Implementation processes need the time that they need.



*Many Thanks*

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