**Factors affecting the adoption of innovation;**

Failed diffusion does not mean that the technology was adopted by no one. Rather, failed diffusion often refers to diffusion that does not reach or approach 100% adoption due to its own weaknesses, competition from other innovations, or simply a lack of awareness. From a social networks perspective, a failed diffusion might be widely adopted within certain clusters but fail to make an impact on more distantly related people. Networks that are over-connected might suffer from a rigidity that prevents the changes an innovation might bring, as well.[[43]](https://en.wikipedia.org/wiki/Diffusion_of_innovations#cite_note-43)[[44]](https://en.wikipedia.org/wiki/Diffusion_of_innovations#cite_note-44) Sometimes, some innovations also fail as a result of lack of local involvement and community participation.

For example, Rogers discussed a situation in Peru involving the implementation of boiling drinking water to improve health and wellness levels in the village of Los Molinas. The residents had no knowledge of the link between sanitation and illness. The campaign worked with the villagers to try to teach them to boil water, burn their garbage, install latrines and report cases of illness to local health agencies. In Los Molinas, a stigma was linked to boiled water as something that only the "unwell" consumed, and thus, the idea of healthy residents boiling water prior to consumption was frowned upon. The two-year educational campaign was considered to be largely unsuccessful. This failure exemplified the importance of the roles of the communication channels that are involved in such a campaign for social change. An examination of diffusion in [El Salvador](https://en.wikipedia.org/wiki/El_Salvador) determined that there can be more than one social network at play as innovations are communicated. One network carries information and the other carries influence. While people might hear of an innovation's uses, in Rogers' Los Molinas sanitation case, a network of influence and status prevented adoption.

**Heterophily and communication channels**

Lazarsfeld and Merton first called attention to the principles of [homophily](https://en.wikipedia.org/wiki/Homophily) and its opposite, [heterophily](https://en.wikipedia.org/wiki/Heterophily). Using their definition, Rogers defines homophily as "the degree to which pairs of individuals who interact are similar in certain attributes, such as beliefs, education, social status, and the like". When given the choice, individuals usually choose to interact with someone similar to themselves. Homophilous individuals engage in more effective communication because their similarities lead to greater knowledge gain as well as attitude or behavior change. As a result, homophilous people tend to promote diffusion among each other However, diffusion requires a certain degree of heterophily to introduce new ideas into a relationship; if two individuals are identical, no diffusion occurs because there is no new information to exchange. Therefore, an ideal situation would involve potential adopters who are homophilous in every way, except in knowledge of the innovation.

Promotion of healthy behavior provides an example of the balance required of homophily and heterophily. People tend to be close to others of similar health status. As a result, people with unhealthy behaviors like smoking and obesity are less likely to encounter information and behaviors that encourage good health. This presents a critical challenge for health communications, as ties between heterophilous people are relatively weaker, harder to create, and harder to maintain. Developing heterophilous ties to unhealthy communities can increase the effectiveness of the diffusion of good health behaviors. Once one previously homophilous tie adopts the behavior or innovation, the other members of that group are more likely to adopt it, too.]

**The role of social systems**

**Opinion leaders**

Not all individuals exert an equal amount of influence over others. In this sense [opinion leaders](https://en.wikipedia.org/wiki/Opinion_leadership) are influential in spreading either positive or negative information about an innovation. Rogers relies on the ideas of Katz & Lazarsfeld and the [two-step flow](https://en.wikipedia.org/wiki/Two-step_flow) theory in developing his ideas on the influence of opinion leaders

Opinion leaders have the most influence during the evaluation stage of the innovation-decision process and on late adopters. In addition opinion leaders typically have greater exposure to the mass media, more cosmopolitan, greater contact with change agents, more social experience and exposure, higher socioeconomic status, and are more innovative than others.

Research was done in the early 1950s at the University of Chicago attempting to assess the cost-effectiveness of broadcast advertising on the diffusion of new products and services. The findings were that opinion leadership tended to be organized into a hierarchy within a society, with each level in the hierarchy having most influence over other members in the same level, and on those in the next level below it. The lowest levels were generally larger in numbers and tended to coincide with various demographic attributes that might be targeted by mass advertising. However, it found that direct word of mouth and example were far more influential than broadcast messages, which were only effective if they reinforced the direct influences. This led to the conclusion that advertising was best targeted, if possible, on those next in line to adopt, and not on those not yet reached by the chain of influence.

Research on [actor-network theory (ANT)](https://en.wikipedia.org/wiki/Actor%E2%80%93network_theory) also identifies a significant overlap between the ANT concepts and the diffusion of innovation which examine the characteristics of innovation and its context among various interested parties within a social system to assemble a network or system which implements innovation.

Other research relating the concept to [public choice theory](https://en.wikipedia.org/wiki/Public_choice_theory) finds that the hierarchy of influence for innovations need not, and likely does not, coincide with hierarchies of official, political, or economic status. Elites are often not innovators, and innovations may have to be introduced by outsiders and propagated up a hierarchy to the top decision makers.

**Electronic communication social networks**

Prior to the introduction of the Internet, it was argued that social networks had a crucial role in the diffusion of innovation particularly [tacit knowledge](https://en.wikipedia.org/wiki/Tacit_knowledge) in the book *The IRG Solution – hierarchical incompetence and how to overcome it*. The book argued that the widespread adoption of computer networks of individuals would lead to much better diffusion of innovations, with greater understanding of their possible shortcomings and the identification of needed innovations that would not have otherwise occurred. The social model proposed by Ryan and Gross is expanded by Valente who uses social networks as a basis for adopter categorization instead of solely relying on the system-level analysis used by Ryan and Gross. Valente also looks at an individual's personal network, which is a different application than the organizational perspective espoused by many other scholars.

Recent research by Wear shows, that particularly in regional and rural areas, significantly more innovation takes place in communities which have stronger inter-personal networks.

**Organizations**

Innovations are often adopted by organizations through two types of innovation-decisions: collective innovation decisions and authority innovation decisions. The collective decision occurs when adoption is by consensus. The authority decision occurs by adoption among very few individuals with high positions of power within an organization. Unlike the optional innovation decision process, these decision processes only occur within an organization or hierarchical group. Within an organization certain individuals are termed "champions" who stand behind an innovation and break through opposition. The champion plays a very similar role as the champion used within the efficiency business model [Six Sigma](https://en.wikipedia.org/wiki/Six_Sigma). The process contains five stages that are slightly similar to the innovation-decision process that individuals undertake. These stages are: [agenda-setting](https://en.wikipedia.org/wiki/Agenda-setting), matching, redefining/restructuring, clarifying and routinizing.

**Extensions of the theory**

**Policy**

Diffusion of Innovations has been applied beyond its original domains. In the case of political science and administration, policy diffusion focuses on how institutional innovations are adopted by other institutions, at the local, state, or country level. An alternative term is 'policy transfer' where the focus is more on the agents of diffusion and the diffusion of policy knowledge, such as in the work of [Diane Stone](https://en.wikipedia.org/wiki/Diane_Stone). Specifically, policy transfer can be defined as "knowledge about how policies administrative arrangements, institutions, and ideas in one political setting (past or present) is used in the development of policies, administrative arrangements, institutions, and ideas in another political setting".

The first interests with regards to policy diffusion were focused in time variation or state lottery adoption, but more recently interest has shifted towards mechanisms (emulation, learning and coercion) or in channels of diffusion where researchers find that [regulatory agency](https://en.wikipedia.org/wiki/Regulatory_agency) creation is transmitted by country and sector channels. At the local level, examining popular city-level policies make it easy to find patterns in diffusion through measuring public awareness. At the international level, economic policies have been thought to transfer among countries according to local politicians' learning of successes and failures elsewhere and outside mandates made by global financial organizations. As a group of countries succeed with a set of policies, others follow, as exemplified by the deregulation and liberalization across the developing world after the successes of the [Asian Tigers](https://en.wikipedia.org/wiki/Four_Asian_Tigers). The reintroduction of regulations in the early 2000s also shows this learning process, which would fit under the stages of knowledge and decision, can be seen as lessons learned by following China's successful growth.

**Technology**

Peres, Muller and Mahajan suggested that diffusion is "the process of the market penetration of new products and services that is driven by social influences, which include all interdependencies among consumers that affect various market players with or without their explicit knowledge".

Eveland evaluated diffusion from a phenomenological view, stating, "Technology is information, and exists only to the degree that people can put it into practice and use it to achieve values".

Diffusion of existing technologies has been measured using "S curves". These technologies include radio, television, VCR, cable, flush toilet, clothes washer, refrigerator, home ownership, air conditioning, dishwasher, electrified households, telephone, cordless phone, cellular phone, per capita airline miles, personal computer and the Internet. These data can act as a predictor for future innovations.

Diffusion curves for [infrastructure](https://en.wikipedia.org/wiki/Infrastructure) reveal contrasts in the diffusion process of personal technologies versus infrastructure.

**Consequences of adoption**

Both positive and negative outcomes are possible when an individual or organization chooses to adopt a particular innovation. Rogers states that this area needs further research because of the biased positive attitude that is associated with innovation. Rogers lists three categories for consequences: desirable vs. undesirable, direct vs. indirect, and anticipated vs. unanticipated.

In contrast Wejnert details two categories: public vs. private and benefits vs. costs.

**Public versus private**

Public consequences comprise the impact of an innovation on those other than the actor, while private consequences refer to the impact on the actor. Public consequences usually involve collective actors, such as countries, states, organizations or social movements. The results are usually concerned with issues of societal well-being. Private consequences usually involve individuals or small collective entities, such as a community. The innovations are usually concerned with the improvement of quality of life or the reform of organizational or social structures.

**Benefits versus costs**

Benefits of an innovation obviously are the positive consequences, while the costs are the negative. Costs may be monetary or nonmonetary, direct or indirect. Direct costs are usually related to financial uncertainty and the economic state of the actor. Indirect costs are more difficult to identify. An example would be the need to buy a new kind of pesticide to use innovative seeds. Indirect costs may also be social, such as social conflict caused by innovation Marketers are particularly interested in the diffusion process as it determines the success or failure of a new product. It is quite important for a marketer to understand the diffusion process so as to ensure proper management of the spread of a new product or service.

**Intended versus Unintended**

The diffusion of innovations theory has been used to conduct research on the unintended consequences of new interventions in public health. In the book multiple examples of the unintended negative consequences of technological diffusion are given. The adoption of automatic tomato pickers developed by Midwest agricultural colleges led to the adoption of harder tomatoes (disliked by consumers) and the loss of thousands of jobs leading to the collapse of thousands of small farmers. In another example, the adoption of snowmobiles in Saami reindeer herding culture is found to lead to the collapse of their society with widespread alcoholism and unemployment for the herders, ill-health for the reindeer (such as stress ulcers, miscarriages) and a huge increase in inequality.

**Mathematical treatment**

Main article: [Logistic function](https://en.wikipedia.org/wiki/Logistic_function)

The diffusion of an innovation typically follows an S shaped curve which often resembles a [logistic function](https://en.wikipedia.org/wiki/Logistic_function). [Mathematical programming](https://en.wikipedia.org/wiki/Mathematical_programming) models such as the [S-D model](https://en.wikipedia.org/wiki/S-d_model) apply the diffusion of innovations theory to real data problems. In addition to that, [agent-based models](https://en.wikipedia.org/wiki/Agent-based_models) follow a more intuitive process by designing individual-level rules to model diffusion of ideas and innovations.

**Complex systems models**

[Complex network](https://en.wikipedia.org/wiki/Complex_network) models can also be used to investigate the spread of innovations among individuals connected to each other by a network of peer-to-peer influences, such as in a physical community or neighborhood.

Such models represent a system of individuals as *nodes* in a network (or [graph](https://en.wikipedia.org/wiki/Graph_(discrete_mathematics))). The interactions that link these individuals are represented by the edges of the network and can be based on the probability or strength of social connections. In the dynamics of such models, each node is assigned a current state, indicating whether or not the individual has adopted the innovation, and model equations describe the evolution of these states over time.

In threshold models, the uptake of technologies is determined by the balance of two factors: the (perceived) usefulness (sometimes called utility) of the innovation to the individual as well as barriers to adoption, such as cost. The multiple parameters that influence decisions to adopt, both individual and socially motivated, can be represented by such models as a series of nodes and connections that represent real relationships. Borrowing from social network analysis, each node is an innovator, an adopter, or a potential adopter. Potential adopters have a threshold, which is a fraction of his neighbors who adopt the innovation that must be reached before he will adopt. Over time, each potential adopter views his neighbors and decides whether he should adopt based on the technologies they are using. When the effect of each individual node is analyzed along with its influence over the entire network, the expected level of adoption was seen to depend on the number of initial adopters and the network's structure and properties. Two factors emerge as important to successful spread of the innovation: the number of connections of nodes with their neighbors and the presence of a high degree of common connections in the network (quantified by the [clustering coefficient](https://en.wikipedia.org/wiki/Clustering_coefficient)). These models are particularly good at showing the impact of opinion leaders relative to others. [Computer models](https://en.wikipedia.org/wiki/Computer_models) are often used to investigate this balance between the social aspects of diffusion and perceived intrinsic benefit to the individuals.

**Criticism**

Because there are more than four thousand articles across many disciplines published on Diffusion of Innovations, with a vast majority written after Rogers created a systematic theory, there have been few widely adopted changes to the theory. Although each study applies the theory in slightly different ways, this lack of cohesion has left the theory stagnant and difficult to apply with consistency to new problems.

Diffusion is difficult to quantify because humans and human networks are complex. It is extremely difficult, if not impossible, to measure what exactly causes adoption of an innovation.This is important, particularly in healthcare. Those encouraging adoption of health behaviors or new medical technologies need to be aware of the many forces acting on an individual and his or her decision to adopt a new behavior or technology. Diffusion theories can never account for all variables, and therefore might miss critical predictors of adoption.This variety of variables has also led to inconsistent results in research, reducing heuristic value.

Rogers placed the contributions and criticisms of diffusion research into four categories: pro-innovation bias, individual-blame bias, recall problem, and issues of equality. The pro-innovation bias, in particular, implies that all innovation is positive and that all innovations should be adopted.Cultural traditions and beliefs can be consumed by another culture's through diffusion, which can impose significant costs on a group of people. The one-way information flow, from sender to receiver, is another weakness of this theory. The message sender has a goal to persuade the receiver, and there is little to no reverse flow. The person implementing the change controls the direction and outcome of the campaign. In some cases, this is the best approach, but other cases require a more participatory approach. In complex environments where the adopter is receiving information from many sources and is returning feedback to the sender, a one-way model is insufficient and multiple communication flows need to be examined.