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have just discussed and serves to illustrate these elements.Hybrid corn became one of the most important new agricultural technologies after it was released to Iowa farmers in 1928. The new seed ushered in the agricultural innovations in the 1930s through the 1950s that led to an agricultural revolution in farm productivity. Hybrid seed was developed by agricultural scientists at Iowa State University and other state land-grant universities. The diffusion of hybrid seed was heavily promoted by the Iowa Agricultural Extension Service and by salesman from seed corn companies. Hybrid corn yielded an increased harvest of about 20 percent per acre over the open-pollinated varieties that it replaced. It was also more drought-resistant and better suited to harvesting with mechanical corn pickers. The seed lost its hybrid vigor after the first generation, so farmers had to purchase hybrid seed each year. Previously, farmers had saved their own seed, selected from their best-looking corn plants. The adoption of hybrid corn meant that an Iowa farmer had to make important changes in his corn-growing behavior. Hybrid seed corn ushered in a new era of farmers' dependence on agribusiness companies that sold chemical fertilizers, pesticides, and other farm inputs.When Professor Bryce Ryan, fresh from his Ph.D. studies in sociology at Harvard University, arrived at Iowa State University in 1939, he chose hybrid corn as the innovation of study in his investigation of social factors in economic decisions. This interest drew him to study how Iowa farmers' social relationships with their neighbors influenced them to adopt hybrid corn. Ryan had read anthropological work on diffusion while he was at Harvard, so he cast his Iowa study of hybrid corn in a diffusion framework. But unlike the qualitative methods used in anthropological studies of diffusion, the Iowa investigation mainly utilized qualitative data from survey interviews with Iowa farmers about their adoption of hybrid corn seed.In the summer of 1941, Neal C. Gross, a new graduate student in rural sociology, was hired as a research assistant on the hybrid corn diffusion project. Ryan and Gross selected two small Iowa communities located some fifty miles west of Ames and conducted personal interviews with all of the farmers living in these two systems. Using a structured questionnaire, Neal Gross, who did most of the data gathering, interviewed each respondent as to when the farmer decided to adopt hybrid corn (the year of adoption was to become the main dependent variable in the data analysis), the communication channels used at each stage in the innovation-decision process, and how much of the farmer's corn acreage was planted in hybrid (rather than open-pollinated seed) each year. In addition to these recall data about the innovation, the two rural sociologists also asked each respondent about his formal education, age, farm size, income, frequency of travel to Des Moines and other cities, readership of farm magazines, and other variables that were later correlated with innovativeness (measured as the year in which each farmer decided to adopt hybrid corn).Neal Gross was from an urban background in Milwaukee, Wisconsin, and initially felt somewhat uncomfortable interviewing Iowa farmers. Someone in Ames told Gross that farm people got up very early in the morning, so on his first day of data gathering, he arrived at a respondent's home at 6:00 a.m., while it was still half dark. By the end of this first day, Gross had interviewed twenty-one people, and he averaged an incredible fourteen interviews per day for the entire study! Today, a survey interviewer who averages four interviews per day is considered hardworking. During one personal interview, an Iowa farmer, perhaps shyly leading him on, asked Gross for advice about controlling horse nettles. Gross had never heard of horse nettles. He told the farmer that he should call a veterinarian to look at his sick horse (horse nettles are actually a kind of noxious weed).Neal Gross personally interviewed 345 farmers in the two Iowa communities, but twelve farmers operating less than twenty acres were discarded from the data analysis, as were 74 respondents who had started farming after hybrid corn began to diffuse. Thus, the data analysis was based on 259 respondents.When all of the data were gathered, Ryan and Gross coded the farmers' interview responses into numbers. The diffusion researchers analyzed the data by hand tabulation and with a desk calculator (computers were not available for data analysis until some years later). Within a year, Gross (1942) completed his master's thesis on diffusion of hybrid corn, and shortly thereafter Ryan and Gross (1943) published their research findings in the journal Rural Sociology (this article is the most widely cited publication from the study, although there are several others). This paper became the founding document for the research specialty of the diffusion of innovations. Several previous studies had been completed on the diffusion of agricultural innovations, but they did not lead to a research tradition because they did not create a research paradigm for the diffusion of innovations (Valente and Rogers, 1995). The Ryan and Gross (1943) study established the customary research methodology to be used by most diffusion investigators: retrospective survey interviews in which adopters of an innovation are asked when they adopted, where or from whom they obtained information about the innovation, and the consequences of adoption. Ryan and Gross (1943) popularized the term "diffusion" (which had previously been used by anthropologists), although they did not use the concept of "innovation." That term would come from later scholars.All but 2 of the 259 farmers had adopted hybrid corn in the thirteen years between 1928 and 1941. When plotted cumulatively on a year-by-year basis, the adoption rate formed an S-shaped curve over time. After the first five years, by 1933, only 10 percent of the Iowa farmers had adopted. Then the adoption curve "took off," shooting up to 40 percent adoption in the next three years (by 1936). Then the rate of adoption leveled off as fewer and fewer farmers remained to adopt the new idea. The overall shape of the rate of adoption looked like an "S."Farmers were assigned to adopter categories on the basis of when they adopted the new seed (Gross, 1942). Compared to later adopters, the innovators had larger-sized farms, higher incomes, and more years of formal education. The innovators were also more cosmopolitan, as measured by their number of trips to Des Moines, Iowa's largest city, located about seventy-five miles from the two study communities.Although hybrid corn was an innovation with a high degree of relative advantage over the open-pollinated seed that it replaced, the typical farmer moved slowly from awareness-knowledge of the innovation to adoption. The innovation-decision period from first knowledge to the adoption decision averaged about nine years for all respondents, an indication that the innovation-decision process involved considerable deliberation, even in the case of an innovation with spectacular results. The average respondent took three or four years after planting his first hybrid seed, usually on a small trial plot of about one acre, before deciding to plant 100 percent of his corn acreage in hybrid varieties. Communication channels played different roles at various stages in the innovation-decision process. The typical farmer first heard of hybrid seed from a salesman, but neighbors were the most frequently cited channel leading to persuasion. This salesman were more important channels for earlier adopters, and neighbors were more important for later adopters. The Ryan and Gross (1943) findings suggested the important role of interpersonal networks in the diffusion process in a system. The farmer-to-farmer exchanges of their personal experiences with hybrid seed were at the heart of diffusion. When enough such positive experiences were accumulated by the innovators, and especially by early adopters, and exchanged with other farmers in the community, the rate of adoption took off. This threshold for hybrid corn occurred in 1935. After that point, it would have been impossible to halt its further diffusion. The farm community as a social system, including the networks linking the individual farmers within it, was a crucial element in the diffusion process. In order to understand the role of diffusion networks and opinion leadership, Ryan and Gross (1943) should have asked sociometric questions of their respondents, such as "From which other farmers did you obtain information about hybrid corn?" The sample design, which consisted of a complete enumeration in two communities, would have made the use of such communication network questions appropriate. But "information was simply collected from all community members as if they were unrelated respondents in a random sample" (Katz et al., 1953).Even without sociometric data about diffusion networks, Ryan and Gross (1943) sensed that hybrid corn had spread in the two Iowa communities as a kind of social snowball: "There is no doubt but that the behavior of one individual in an interacting population affects the behavior of his fellows. Thus, the demonstrated success of hybrid seed on a few farms offers new stimulus to the remaining ones." The two rural sociologists intuitively sensed what later diffusion scholars were to gather more detailed evidence to prove: that the heart of the diffusion process consists of interpersonal network exchanges and social modeling by those individuals who have already adopted an innovation to those individuals who are influenced to follow their lead. Diffusion is fundamentally a social process.Study of the invisible college of rural sociologists investigating diffusion as of the mid-1960s identified the researchers who first utilized a new concept and/or methodological tool in studying diffusion (Crane, 1972). Ryan and Gross launched fifteen of the eighteen most widely used intellectual innovations in the rural sociology diffusion research tradition. So Bryce Ryan and Neal Gross played key roles in forming the classical diffusion paradigm. The hybrid corn study has left an indelible stamp on the history of all diffusion research.SummaryDiffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. Diffusion is a special type of communication concerned with the spread of messages that are perceived as new ideas. Communication is a process in which participants create and share information with one another in order to reach a mutual understanding. Diffusion has a special character because of the newness of the idea in the message content. Thus some degree of uncertainty and perceived risk is involved in the diffusion process. An individual can reduce this degree of uncertainty by obtaining information. Information is a difference in matter-energy that affects uncertainty in a situation where a choice exists among a set of alternatives.The main elements in the diffusion of new ideas are: (1) an innovation (2) that is communicated through certain channels (3) over time (4) among the members of a social system. 1. InnovationAn innovation is an idea, practice, or object perceived as new by an individual or other unit of adoption. Most of the new ideas discussed in this book are technological innovations. A technology is a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome. Most technologies have two components: (1) hardware, consisting of the tool that embodies the technology as a material or physical object, and (2) software, consisting of the knowledge base for the tool. The characteristics of an innovation, as perceived by the members of a social system, determine its rate of adoption. Five attributes of innovations are: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability.Re-invention is the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. 2. Communication ChannelsA communication channel is the means by which messages get from one individual to another. Mass media channels are more effective in creating knowledge of innovations, whereas interpersonal channels are more effective in forming and changing attitudes toward a new idea, and thus in influencing the decision to adopt or reject a new idea. Most individuals evaluate an innovation not on the basis of scientific research by experts but through the subjective evaluations of near peers who have adopted the innovation. These near peers thus serve as role models, whose innovation behavior tends to be imitated by others in their system.A distinctive aspect of diffusion is that at least some degree of heterophily is usually present in communication about innovations. Heterophily is the degree to which two or more individuals who interact are different in certain attributes, such as beliefs, education, social status, and the like. The opposite of heterophily is homophily, the degree to which two or more individuals who interact are similar in certain attributes. Most human communication takes place between individuals who are homophilous, a situation that leads to more effective communication. Therefore, the heterophily that is often present in the diffusion of innovations leads to special problems in achieving effective communication. 3. Time Time is involved in diffusion in (1) the innovation-diffusion process, (2) innovativeness, and (3) an innovation's rate of adoption. The innovation-decision process is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. We conceptualize five steps in this process: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. An individual seeks information at various stages in the innovation-decision process in order to decrease uncertainty about an innovation's expected consequences. The decision stage leads (1) to adoption, a decision to make full use of an innovation as the best course of action available, or (2) to rejection, a decision not to adopt an innovation.Innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system. We specify five adopter categories, classifications of the members of a social system on the basis of their innovativeness: (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards. The rate of adoption is the relative speed with which an innovation is adopted by members of a social system.4. Social SystemA social system is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. A system has structure, defined as the patterned arrangements of the units in a system, which gives stability and regularity to individual behavior in a system. The social and communication structure of a system facilitates or impedes the diffusion of innovations in the system. One aspect of social structure is norms, the established behavior patterns for the members of a social system. Opinion leadership is the degree to which an individual is able to influence informally other individuals' attitudes or overt behavior in a desired way with relative frequency. A change agent is an individual who attempts to influence clients' innovation-decisions in a direction that is deemed desirable by a change agent. An aide is a less than fully professional change agent who intensively contacts clients to influence their innovation-decisions. We distinguish among three main types of innovation-decisions: (1) optional innovation-decisions, choices to adopt or reject an innovation that are made by an individual independent of the decisions of other members of the system, (2) collective innovation-decisions, choices to adopt or reject an innovation that are made by consensus among the members of a system, and (3) authority innovation-decisions, choices to adopt or reject an innovation that are made by relatively few individuals in a system who possess power, status, or technical expertise. A fourth category consists of a sequential combination of two or more of these three types of innovation-decisions: Contingent innovation-decisions are choices to adopt or reject that are made only after a prior innovation-decision.A final way in which a social system influences diffusion concerns consequences, the changes that occur to an individual or a social system as a result of the adoption or rejection of an innovation.Copyright © 1995, 2003 by Everett M. Rogers

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