By Bruce L. Tow and David A. Gilliam

Synthesis: An Interdisciplinary Discipline

As the professional world becomes more and more specialized, it's time for today's — and tomorrow's — leaders to embrace a multidisciplinary approach to problem solving.

We are either the beneficiaries or the victims (depending on your point of view) of a data explosion. The amount of recorded data is growing at a staggering rate, and the knowledge required to process that data is becoming more complex.

As a result, individuals and groups have become increasingly specialized in various fields. Recently, the term "subspecialist" has become part of our language. For example, the physicist specialty has almost entirely split into subspecialties such as "astrophysicist" and "plasma physicist," whose practitioners typically make little or no attempt to keep up with advances in the other subspecialties.

This trend toward greater degrees of specialization has been a natural, necessary, and generally healthy reaction to the world's growing complexity. After all, any individual or group has only a limited amount of intellectual capacity — and time — to apply to a task.

Though it solves some problems,

specialization unfortunately also has major drawbacks. For example:

• Specialization has not been a planned or coordinated process, and as a result, there are significant knowledge gaps between specialties. As subspecialization proceeds, the number of gaps grows at a rapid and increasing rate because you have now to deal with the gaps between subspecialties. Consider the significant amount of knowledge available to a chemistry student, and then consider the slightly more limited world of biochemistry and the even-more-limited amount of knowledge in the realm of space biochemistry.

• Specialists create unique vocabularies to allow them to communicate more effectively among themselves, but this trend further restricts their ability to communicate with others outside their specialty.

More and more problems require specialists from multiple fields to tackle them. However, it is increasingly difficult to achieve effective communication between specialists. Whenever resolution of a particular problem requires coordination between differing specialists or lies in a gap between two or more specialties, a serious challenge is posed: The individuals involved are effective only as specialists; they require a narrow focus and a specialized language to perform their jobs effectively.

The ideal solution to this problem would take advantage of the strengths inherent in specialization while finessing the pitfalls. Ideally, when faced with a multidisciplinary problem, there would be someone who could:

• Identify which combination of specialties is likely to solve the problem and organize a team.

• Motivate the individuals to work as a group toward a solution to the problem.

• Achieve effective communication (directly and indirectly) between specialists.

If enough people try this approach, and train others to do so, it will become a recognized discipline: *Synthesis.*

A Theoretical Basis for Synthesis

In the 1970s, SRI International (then called Stanford Research) asked some of its brightest researchers to explore a question vital to their success as a think tank and provider of innovative solutions: Why did some of their multidisciplinary projects succeed while others failed? This was a key question because, up until then, nobody at SRI could find a pattern. After careful study, researchers led by Joseph McPherson (who started SRI's Innovation Management Program) came up with a theory, which SRI subsequently put into successful practice: They identified a type of individual whom they called a Bridge. The Bridge (as it happened, quite accidentally) combined the focused knowledge of a specialist with an intense, innate curiosity about the other disciplines in any multidisciplinary project in which that person was involved.

Typically, a Bridge was a specialist assigned to a given multidisciplinary project, who at some point—without project-management knowledge or approval—would ask both basic and project-focused questions of project members in other specialties. In many cases, Bridges were a source of annoyance and distraction both to their management and their other-specialty peers. The SRI researchers discovered a powerful and unexpected correlation between the project's success and the presence of a Bridge.

The researchers conjectured that the Bridge was, in effect, cross-fertilizing or "coupling" the various disciplines involved in the project, usually without the Bridge, the project management, or the other specialists involved realizing that anything unusual was going on. Interestingly, the researchers also found that the majority of project breakthroughs were coming not from the Bridge, as one might expect, but rather from those team members being "annoyed"! As a result, SRI began to keep an eye out for and nurture Bridges for their multidisciplinary projects.

What was going on in the mind of the Bridge? Why was this person, otherwise a respected and valued specialist in his or her field, so driven as to defy management pressure—*Why aren't you getting your own work done?*—and peer disapproval—*Why does this person keep asking me stupid questions? He's no [name your own specialty]!*

Our theory is that people get different levels of reward from different types of learning. Most people, we believe, get the biggest brain-reward from learning something that increases their mastery of, or deepens their understanding of, a specific specialty area (we call these people Type M for "mastery"). However, a small subset of people get a much bigger brain-reward from learning something completely new (we call these people Type N for "new"). As to the proportion of people who are Type M versus N, it's difficult to measure, but perhaps as many as 95% are Type M.

Of formal disciplines, probably the closest match to Synthesis is found in systems engineering. (Note that we're not referring to the *systems engineering* that is a synonym for computer software development, but to the much rarer type that's responsible for bridging the gap between specific specialties, such as development and marketing.) Bell Labs uses this respected and extremely practical job classification. Systems engineers are expected to bridge Bell Labs's large development and marketing gap to make both sides successful. We know of one person whom Bell Labs hired after earning a PhD in chemical engineering because of the person's "generalist" dissertation, which married chemical engineering, economics, and artificial intelligence to find profitable chemical-reaction byproducts. By the same token, that same person got relatively

Key Definitions

Bridge	A Bridge is a person who, while primarily employed as a specialist, formally or informally does Synthesis whenever possible when engaged in a multidisciplinary endeavor.
Coupling	Coupling is the act of combining information from different-discipline sources.
Gatekeeper	A gatekeeper is a person who (formally or informally) acts as an information conduit for others, helping them get quick and effective access to both technical and organizational information in order to resolve problems effectively.
Synthesis	Synthesis is the act of solving problems by gathering and combining information from diverse sources.
Synthesist	A Synthesist is a person who has made a profession out of the art and science of combining or spanning multiple conventional disciplines or specialties.
Type M	A Type M person is one who gets a significantly greater brain reward from increasing mastery by adding to his or her existing knowledge versus learning about something in a different discipline.
Type N	A Type N person is one who gets a significantly greater brain reward from learning something new versus adding to existing knowledge in a discipline.

little interest from chemical companies because of the same dissertation (i.e., they wanted a Type M).

Interestingly, nearly all systems engineers of this type are either talented newcomers (who almost always have advanced degrees in other fields) or close-to-retirement senior technical staff with a lifetime of practical experience and customer knowledge.

Synthesis Today

Because the development of specialties and subspecialties came about spontaneously in response to early perceptions of what was needed, we have an enormous number of multidisciplinary gaps containing real problems that require—but cannot receive—proper attention. Why don't these problems get enough attention? Some possible reasons are:

- They're very hard to identify. Because they fall into the cracks between existing specialties, few people are even looking for them.
- Neither layman's language nor existing specialized languages (or jargon) can properly describe these problems or their solutions.
- There are few incentives for a specialist to wander outside the boundaries of his or her field and strong negative incentives against such wandering. Thus, specialists are motivated to state that they're not the "right person" to deal with the problem or carry that "wrong person" feeling into a project even if they are assigned to it.
- It's almost impossible to estimate ahead of time the financial return on this type of investment.

When such problems are addressed, it's often done almost accidentally rather than as a deliberate decision to exploit an opportunity. Someone will be "fooling around" (with or without the permission of his or her supervisor), trip over what looks like an opportunity and develop it far enough that it looks attractive even to conservative management, and then almost retroactively get the go-ahead to pursue it to its completion.

Some companies, such as 3M, encourage creativity and technical innovation vis-à-vis so-called "bootlegging policies." 3M's bootlegging policy is known as the "15 percent" rule. It encourages employees to spend up to 15% of their time on pet projects that fall outside the limitations of their specialized responsibilities. Art Fry famously developed Post-It Notes, one of 3M's most successful products, as a result of this policy.

The Future of Synthesis

One could easily foresee the subspecialization trend leading to hyperspecialization. It's not beyond credibility to envision a surgeon who repairs only knees injured as a result of playing football. However, in every subspecialized field, there are always those who refuse to follow their peers into picking a subspecialty and instead try to keep up with and communicate between their specialty's subgroups. The more specialization that exists, the greater the need will be for Bridges.

Occasionally, completely new specialties evolve that borrow from many other specialties, as is the case with urban planning, for instance (requiring as much knowledge of geography and architecture as social psychology and politics). The evolution from an accidental art to a recognized science typically takes decades as the new discipline "pays its dues" in our business and educational systems. Multidisciplinary specialties like urban planning serve a real need. However, the amount of time it takes for a new field to be identified and to work its way through governmental, business, and educational infrastructures is far too slow.

In the short-term future (the next 10 years), most Synthesis will be conducted informally by Bridges working to improve communication between disciplines and thereby achieve multidisciplinary breakthroughs. A very small number of enlightened enterprises will deliberately employ Bridges. In addition, Synthesists and Bridges will begin to locate one another and create special-interest groups to pursue and extend Synthesis. Also, a small number of Synthesists will attempt to make a full-time living as consultants, focusing on solving complex, real-world problems for their clients. Some will collectively begin to gather a set of tools and techniques for solving multidisciplinary problems. And some Synthesists will

Synthesis in the Professional World

Signs of Synthesis already exist in many professions, including:

• **Systems engineers.** These are people who try to make complex human "systems" work properly. They are often called upon to bridge the gaps between certain specialties (for example, between development and marketing). Sometimes these individuals are called architects or program directors or, more simply, system thinker or problem solver.

• **Industrial engineers.** This specialty formed when manufacturers, faced with an enormously complex system of people and machines and the need to build something that works and sells, identified a need for a position that would focus on making everything run smoothly no matter what.

• **Operations researchers.** Since World War II, a few military and intelligence organizations—and an even smaller number of private enterprises—have hired operations researchers to use mathematical modeling, probability calculations, and other statistical techniques to analyze and synthesize optimal processes for complex operations, such as factory-floor or transportation-network optimization.

• **Bridges and Gatekeepers.** A small number of organizations regularly coordinate multidisciplinary R&D with "Bridges" and "Gatekeepers." For example, Georgia-Pacific recently posted a job opening for an Operations Maintenance Gatekeeper. Its job requirements included a mix of technical, business, and social skills, and "the ability to communicate at all levels of the organization."

• **Synthesists.** Although not referred to as such just yet, a very small number of individuals are utilized explicitly for their synthesizing skills. Most have evolved during their careers from Specialists to Bridges to full-time facilitators for multidisciplinary endeavors. Most are near retirement age. (See Figure 1.)

• **Emergency managers.** If a multidisciplinary problem is pressing enough, ordinary rules can and often are suspended, and someone is chosen to work between specialties. An interesting example of this was when President Carter needed a chairperson for the investigation of the Three Mile Island nuclear accident. He chose John Kemeny, a brilliant mathematician and teacher who was at that time president of Dartmouth College. Although Kemeny knew little about nuclear power when he was hired, his ability to extend his knowledge quickly and coordinate a diverse team of investigators allowed him to conduct a full, fair, and impartial investigation in a very short time.

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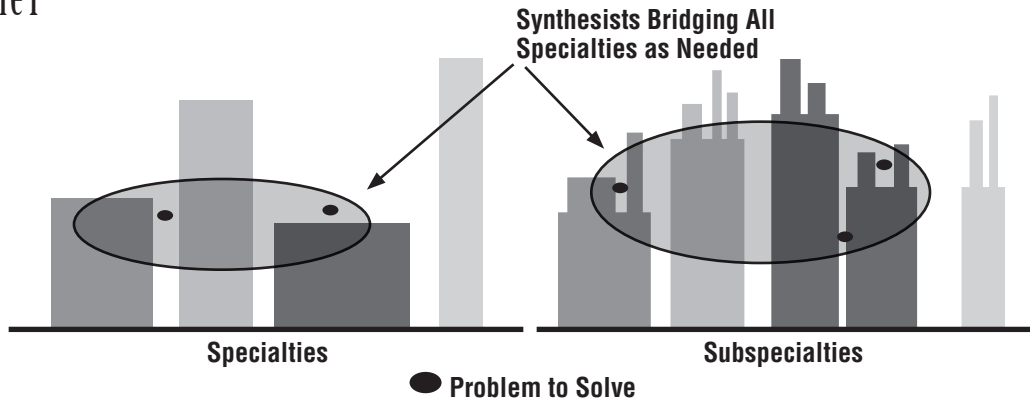
Figure 1



publish papers or make formal presentations on problems tackled or solvable with Synthesis.

In the medium-term future (10 to 15 years), the use of Bridges will be far more widespread and recognized, and a few enlightened organizations will employ Synthesists on a regular basis. The terms "Bridge" and "Synthesis" will become known throughout the multidisciplinary community.

In this time frame, the Synthesis special-interest group will become a formal institute whose purpose is promoting the use of and recognition of Synthesis and related activities. Publications on Synthesis will regularly appear in generalist scientific journals, and at least one published book on Synthesis will be in general circulation. Major universities will begin to allow classes to be taught (probably at the graduate level as interdisciplinary courses) on Synthesis and its techniques and philosophies. Some colleges will grant a few degrees in Synthesis as a nonstandard major.

In the long-term future (15 to 25 years), Synthesis will become a generally recognized discipline. Most large organizations will hire Synthesists or Bridges as employees or consultants to resolve complex issues. The terms "Synthesis" and "Bridge" will appear in modern dictionaries and encyclopedias in their new context.

During this period, the Synthesis Institute will provide a member certification process for Synthesists (Student, Member, Associate, Fellow, etc.) and offer educational and research grants to deserving students and researchers. There will be a formal test to identify Type N versus Type M people. Liberal arts colleges will require or encourage undergraduates to take at least one class in Synthesis. Major colleges and universities will have tenured positions and regularly grant doctorates in Synthesis. And Synthesists will formally organize and lead efforts to resolve longstanding and extraordinarily complex problems such as world poverty.

Becoming a Synthesist

Formal education for a Synthesist is likely to vary widely. Most Synthesists are likely to pursue a liberal arts undergraduate education (perhaps with a focus on communication or human psychology), finding therein ample opportunities to satisfy their wide span of curiosity. While some will eventually receive a graduate degree in Synthesis, the majority likely will either enter the workplace immediately after college or formally pursue a graduate degree in a traditional field while utilizing their spare time or spare course credits looking at other fields outside of their major.

For most people, the training to become a Synthesist will primarily happen on the job, because the majority of skills required are people skills rather than data skills. People pursuing a graduate degree in Synthesis are likely to be the exceptions rather than the rule.

A typical professional Synthesist will follow one of three paths:

- **Formal**. Graduate degree (master's or PhD) in Synthesis from an accredited college or university, followed by hiring by a large organization as a Synthesist or researcher.
- **Bridge-then-Synthesist**. Liberal arts undergraduate degree (usually with a traditional, non-Synthesis graduate degree) followed by work as a Bridge, followed (years later) by recognition as a Synthesist.
- **Historical**. Any educational background (including no college) followed by many years of work as a specialist, more and more use as an informal Bridge, and eventual recognition as a formal Bridge, followed (possibly at or near retirement age) by recognition as a Synthesist.

Educators can help support the growth of Synthesis as a discipline by discussing it with students and encouraging multidisciplinary courses in which students get to exercise Synthesis. They could also encourage students with an interest in and aptitude for Synthesis to better understand their potential opportunities in tomorrow's world, which could include a career in Synthesis.

Businesspeople should be alert to opportunities to use Synthesis to achieve a competitive edge in the marketplace. Staff members who show possible aptitude in Synthesis should be identified.

If you recognize yourself as a Type N person (a lover of new ideas), identify tasks in your organization that are multidisciplinary as well as difficult to resolve, and volunteer to work on those tasks; network with like-minded individuals; and help develop the field of Synthesis.

In any case, you can expect the world to shift, making it easier both for natural Synthesists to gain recognition as such and for enterprises to exploit those people's natural skills, aptitudes, and attitudes. ❑

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