In insisting on English as the working language of the institute, Suh was keen to make KAIST more attractive to international students. That switch to English has not been plain sailing, however, with some Korean students finding it hard to follow lectures, although Jeong says that the current president Sung-Mo Kang is "more reasonable" on the English-only rule.

Suh, who was born in Korea, was a controversial figure. Having spent the bulk of his career in the US education system, he was keen to make KAIST more competitive by making it harder for researchers to get a permanent academic post. Researchers in Korea typically get tenure without too much trouble after a set period in the job provided that they have published a certain number of papers and taught assigned classes, but Suh wanted to tighten up the system. He changed the rules so that researchers have to apply for tenure within eight years and are judged on factors such as their publication record, teaching ability, service to the community, as well as recommendations from referees. What is more, individual researchers have only one chance to apply and if promotion is denied, they have to leave KAIST within a year.

"It's a tough system," admits Jeong, "but on the other hand, junior faculty members have good students, lots of facilities and a relatively small teaching load. Yes, it was quite an abrupt change when the new rules came in and there was some confusion at the start, but I think that we've now made things clearer." In a sense, the changes at KAIST are a microcosm of what is happening in Korea as a whole – abrupt and perhaps rather uncomfortable in the short term, but essential if the country is to achieve its full potential.

● Read more about Korea in the *Physics World* Special Report at http://ow.ly/q1m8G

In search of a Korean Nobel laureate

With research becoming an increasingly international endeavour, Korea is actually helped by the fact that many of the country's senior scientists spent periods abroad early in their careers and so already have good international ties. Many of these scientists did PhDs or postdocs overseas in the 1980s and 1990s, taking advantage of opportunities at labs in the US and Europe. Fortunately, the brain drain has not become permanent and many of these scientists have since come back home, while retaining connections with their peers abroad.

"Physics has a bright future in Korea," says Cheol Eui Lee, a nanophysicist at Korea University in Seoul who is also president of the Korean Physical Society (KPS). "But establishing strong international networks between Korean scientists and foreign researchers is vital for us. We are still some way behind leading countries such as the US or the UK, but I think we will be much more competitive in 10–20 years' time."

Lee feels one immediate issue for the Korean physics community is the quality of science education in schools. Physics is not compulsory for students and only the top 5% or so of pupils end up taking the subject to an advanced level at age 16–17. "We are concerned about this situation but the KPS is trying hard to make things better," he says. One initiative the KPS has begun to get students more interested in the subject is called "Physics in the Hand" – a competition for pupils to give presentations on the physics of how a mobile or smartphone works. The KPS has received a government grant to support the initiative.

But what would really boost the Korean physics community would be if more of its members got worldwide recognition, for example through winning a Nobel prize. No Korean physicist has ever received such an award, although there is a feeling that the country's scientists have come close to a Nobel in areas such as graphene or work linked to the Standard Model of particle physics. "A Korean Nobel laureate in physics," says Lee, "would certainly make a difference for our subject."

Publishing

Paper 'fitness' predicts future citation rate

The number of citations received by a journal paper over its lifetime can be predicted using a simple model that uses data from the first five years of publication. That's the claim by researchers from Northeastern University in Boston, US, who say their model can be applied across all disciplines, including physics. They add that it will help identify high-impact work early on, with particular benefits for junior researchers who are trying to gain academic standing (*Science* 342 127).

Developed by a team led by physicist Albert-László Barabási, the new model was used to see if a paper's initial citation patterns could forecast its long-term impact, regardless of the scientific discipline, content or journal of publication.

The model, which can also be adapted to analyse groups of papers from a given journal, institute or researcher, uses three empirical parameters derived from the first few years of a paper's history. The first, "immediacy", measures how quickly a paper reaches its citation peak, while the second, "longevity", quantifies how citations drop away with time.

Impact factors
By using citation data from a paper's first five years, researchers have created a model to predict its future impact.

iStockphoto/Galina Ermolaeva

The third parameter – "fitness" – relates to the size of the citation peak following a paper's publication. The fitness parameter describes the paper's inherent ability to attract citations over other competing papers, reflecting its novelty and importance as perceived by the research community. The researchers discovered that this parameter alone predicts the total number of citations a paper will ever receive. "If we can estimate this single parameter – and we can – then we can assign to each paper their ultimate impact," says Barabási.

The researchers applied their model to a database of 4492 papers that were published in the *Physical Review* group of journals in the 1960s. They used the first five years of their citation histories to derive the three model parameters and predict the subsequent citation behaviour over the next 25 years. Good agreement was found between the predicted and observed citations: 93.5% fell within the predicted range that incorporated uncertainties in the model parameters.

The main limitation of the model is that it requires several years of citation data to predict long term impact with reasonable accuracy. "For most papers, three years is sufficient," says Barabási. "However, for about 20%, four to five years are useful, and for an even smaller percentage, even longer [is needed]." The model does not, however, predict rare, additional citation peaks that can occur long after publication with major breakthroughs in a field.

James Evans, a sociologist specializing in science and technology at the University of Chicago says the study is a "high water mark in modelling citation dynamics". However, he cautions against using fitness as a surrogate for paper quality and urges care in the model's application given that its predictions of citations measure only one aspect of research impact.

Jude Dineley