

Pruned into Immortality

The Intellectual Genealogy of the Actor Model

Intellectual Genealogies Project

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Seed paper: Carl Hewitt, Peter Bishop, Richard Steiger. “A Universal Modular ACTOR Formalism for Artificial Intelligence.” *IJCAI-73*, Stanford, August 1973, pp. 235–245 — with Hewitt’s 1977 *Artificial Intelligence* article and Agha’s 1986 book as seed cluster.

An intellectual genealogy follows ideas through history, not just papers through a citation network.

Abstract. In August 1973, the International Joint Conference on Artificial Intelligence, meeting at Stanford, heard a paper by Carl Hewitt, Peter Bishop and Richard Steiger with a proposal of unusual scope: a single kind of object — the actor, invoked only by sending it messages — could unify all of computing. The paper was an artificial-intelligence manifesto, and concurrency was one advertised benefit among a dozen. Fifty-three years later “actor” is a keyword in a mass-market programming language, and the citation record shows a shape no other seed in this series has: two humps, with the strongest decade arriving five decades after publication — 1,436 citing works in 2010–19, against 58 in the whole of the 1970s. This report reconstructs how that happened. The short version is that the model lasted by being pruned. Its sequential half was absorbed into the lambda calculus by Scheme within two years, on the Scheme authors’ own account. Its AI half ended with the PLANNER project. Its concurrency half was standardized in 1986 by a student’s book, which then replaced the founding papers as the reference of record. Industry adopted the name and dropped the bibliography: attribution now flows through Wikipedia, an encyclopedia that banned the model’s creator from editing it. And Erlang, the most successful “actor language” of all, is documented not to descend from the model at all.

1 The Original Intervention

There is a sentence in the proceedings of the 1973 International Joint Conference on Artificial Intelligence that assigns an accountant to every piece of running software: “Every actor has a banker which monitors the use of space and time.” To modern eyes that reads like satire; in 1973 it was a primitive. The paper, by Carl Hewitt, Peter Bishop and Richard Steiger (Hewitt et al. 1973), is remembered today as the origin of the actor model of concurrency. Read on its own terms, it is something else: a victory announcement from the PLANNER project. “In the course of this work we have succeeded in unifying the formalism around one fundamental concept: the ACTOR.” And the unification is total: “Data structures, functions, semaphores, monitors, ports, descriptions, Quillian nets, logical formulae, numbers, identifiers, demons, processes, contexts, and data bases can all be shown to be special cases of actors”. One kind of thing, answering only to messages, and everything else a special case of it.

The advertised benefits give the measure of the ambition. The paper’s own list runs from the foundations of semantics through knowledge-based programming, education (a “cooperating society” of Papert’s “little men”), privacy and protection, synchronization, resource allocation, and hardware architecture. Concurrency appears as one strand among these

— the strand the future would pull on. The paper bans goto, interrupt and semaphore. It sketches an actor machine in which the basic unit of execution is a message send, observes that “Current developments in hardware technology are making it economically attractive to run many physical processors in parallel”, and gives the resulting style a name that deserved to catch on: “swarm of bees” programming. It also states a principle: “Control flow and data flow are inseparable.”

The 1973 actor is a heavier creature than the one in today’s textbooks. Besides the banker, every actor has a scheduler; monitors; a binding procedure; and an intention: “The intention is the CONTRACT that the actor has with the outside world.” Around it sits the apparatus of the AI program: worlds and extension worlds, world-directed invocation (the authors call it “wishful thinking”), the logical connectives themselves defined as actors, and a language, PLANNER-73, soon renamed PLASMA.

The ancestors are named in the paper itself, with a candor its descendants would not reciprocate. The acknowledgements say the work “explores the consequences of generalizing the message mechanism of SMALL TALK and SIMULA-67; the port mechanism of Krutar, Balzer, and Mitchell; and the previous CALL statement of PLANNER-71 to a universal communications mechanism”, and they credit “Alan Kay whose FLEX and SMALL TALK machines have influenced our work”. Two personal contacts recorded there matter for what follows: “Robin’s puzzlement over the meaning of ‘equality’ for processes led to our definition of behavior”, and C. A. R. Hoare appears as “independently investigating ‘monitors’”. Hewitt’s own late retrospective (Hewitt 2010) gives the same account of the sources: Lisp, Simula 67, Smalltalk-72, “as well as ideas for Petri Nets, capability systems”. Readers of Report No. 2 will recognize the return address. By its authors’ own record, the actor model is downstream of the Simula lineage, by way of Kay’s Smalltalk-72.

Just as telling is what the paper does not contain. There is no formal semantics; that took Greif’s thesis in 1975 (Greif and Hewitt 1975), Baker and Hewitt’s “laws” in 1977 (Baker and Hewitt 1977), Clinger’s denotational account in 1981 (Clinger 1981), and Agha’s formulation of 1985/86 (Agha 1986). There is no vocabulary of mail addresses or behavior replacement. There is no treatment of partial failure, and no delivery guarantee. Keep those last two absences in mind; Sections 4 and 5 return to both. The paper proposed a theory of everything. The field would keep one chapter, and not the one the authors led with.

2 The First Descendants

Some accounting before the descendants. The corpus for this genealogy merges the citing works of three texts: the 1973 paper; Hewitt’s 1977 article

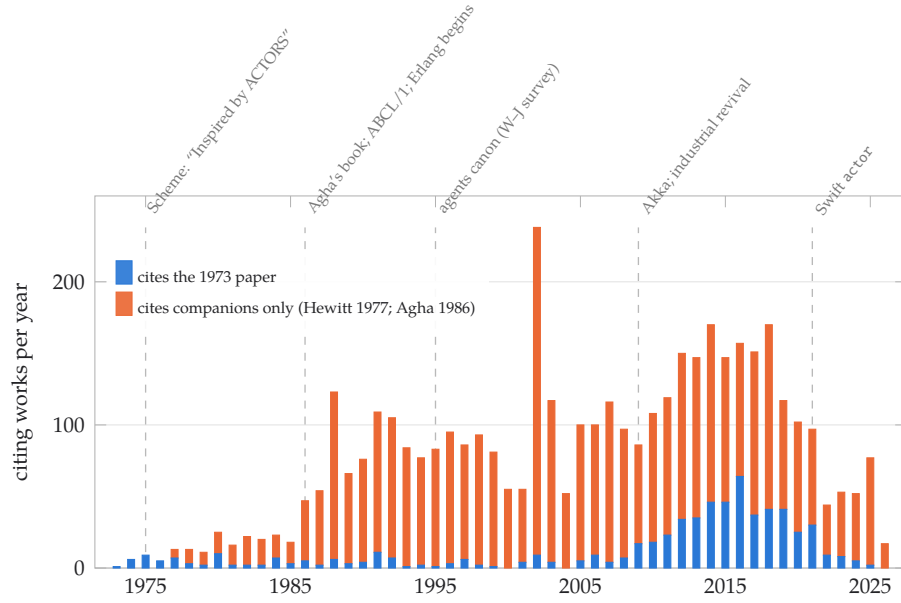


Figure 1: Citing works per year for the merged actor cluster (4,257 works, seven OpenAlex records), 1973–2026. Blue: works citing the 1973 IJCAI paper; orange: works citing only the companions (Hewitt 1977; Agha 1986 with its duplicate records). Markers are intellectual events from the genealogy’s timeline. The single-year spike at 2002 (238 works, against 55 in both 2001 and 2004) is flagged as a suspected database artifact — a batch of conference-proceedings records year-stamped 2002; decade totals are robust to it. 2026 is a partial year.

in *Artificial Intelligence*, “Viewing control structures as patterns of passing messages” (Hewitt 1977); and Gul Agha’s 1986 MIT Press book, *Actors: A Model of Concurrent Computation in Distributed Systems* (Agha 1986). The book alone required folding in four database duplicates — an ebook record, a *Science of Computer Programming* record, the 1985 thesis record, and a *SIAM Review* book review. The merge yields 4,257 unique citing works (Figure 1). One citing record was a ghost, with no title, no year, no authors, and 1,229 alleged citations of its own (OpenAlex W2963026732); we excluded it. Every genealogy in this series has met a pathology of this kind. Bibliographic databases are haunted in small ways.

Who read the paper first? Artificial intelligence did, and no one else. The 1974–77 reception is knowledge representation and cognitive science: Bobrow and Winograd’s KRL (Bobrow and Winograd 1977), the frames-versus-procedures debate, papers on memory schemata and learning in the Norman–Rumelhart line (Rumelhart and Norman 1976), Canadian AI’s 2.PAK. The concurrency reading existed at first only inside Hewitt’s own group — “Protection and Synchronization in Actor Systems” in 1974, Greif’s actor semantics in 1975, Baker and Hewitt’s “Laws for

Communicating Parallel Processes” in 1977 — and in early object systems such as Borning’s ThingLab (Borning 1977). One early citer went on to found a field: Smith’s contract net (Smith 1977), the founding protocol of distributed AI, cites the 1977 paper in the year it appeared. For its first years the paper was exactly what it said it was: an AI paper, read by AI.

3 The Branching

From there the corpus separates into nine trajectories we can tell apart — many directions for one conference paper, but the seed was a manifesto, and manifestos scatter. Four trajectories account for most of the mass (Table 1).

The theory line never detached. It runs from Greif (1975) through Baker-Hewitt (1977) to Clinger (1981), with its actor semantics of unbounded nondeterminism, then to Agha (1985/86), then to the Agha-Mason-Smith-Talcott semantics of 1997 (Agha et al. 1997). For each intermediary in this study we measure an *eclipse*: the fraction of its citers that never cite the seed cluster. The 1997 semantics paper has the lowest eclipse we measured anywhere, 41.7%. The theoreticians kept the family album.

The research-language line kept the cluster as working literature for five decades. Lieberman’s Act 1 (Lieberman 1987) and Yonezawa’s ABCL/1 (Yonezawa et al. 1986) cite Hewitt 1977; SALSA (Varela and Agha 2001) and AmbientTalk (Dedecker et al. 2006) cite all three cluster members; Scala Actors (Haller and Odersky 2009) cites the 1973 paper and the book. Eclipse in this community stays near 43–45%. This is the inner circle: for it, the papers remained things to read rather than things to point at.

The hardware line went and built the 1973 machine. Dally’s J-Machine at MIT titled its 1988 paper “The J-Machine: System Support for Actors” (Dally et al. 1988) and cites the Agha book; the message-driven processor line followed; and CHARM++ (Kalé and Krishnan 1993), which brought message-driven execution and migratable objects into production high-performance computing, cites all three cluster members. The swarm of bees got its silicon.

The agents line grew the largest and remembers the least. It began inside the reception itself, with the contract net in 1977, and became a field of its own. By the time of the field’s defining survey — Wooldridge and Jennings, 1995 (Wooldridge and Jennings 1995), at 6,722 citing works the largest single intermediary in this study — the actor model gets one sentence, filed as machinery: “The earliest concurrent object framework was Hewitt’s Actor model (Hewitt, 1977; Agha, 1986); another well-known example is the ABCL system (Yonezawa, 1990)”. The citers of the agents canon reach back to the cluster at a rate that implies 98.3% eclipse. One courtesy sentence, and a field moves on.

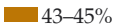
	emerged	relation	eclipse of the seed*
SOURCES OF THE SEED			
Simula-67 / Smalltalk-72 messages	1967–72	documented	
— via Kay			
ports (Krutar, Balzer, Mitchell);	1971–72	documented	
PLANNER-71			
capabilities — Dennis & Van Horn	1966	documented	
onward			
BRANCHES OF THE LINEAGE			
theory — Greif, Clinger, Agha, 1975→		documented	 42%
AMST 1997			
Scheme — “Inspired by ACTORS”; 1975→		documented	 97%
absorbed			
research languages — ABCL, 1986→		documented	 43–45%
SALSA, AmbientTalk			
agents / DAI — contract net to the	1977→	documented	 86–98%
MAS canon			
hardware & HPC — J-Machine, 1988→		documented	
CHARM++			
object capabilities — E, vats	2005→	strong	
industrial frameworks — Akka, Or-	2008→	documented [†]	 71–80%
leans, Swift			
embedded “actors” — Ptolemy; 2003→		strong	 80%
sense drift			
DORMANT OR DEAD			
the AI program — worlds, inten-	—1980	dormant	
tions, PLASMA			
schedulers, bankers, actor induction	—	dormant	
the actor machine — revived 1988,	—	dormant	
dormant again			
OUTSIDE THE LINEAGE			
Erlang — independent rediscovery,	1986	convergence	 80%
relabeled later			
process calculi — CSP, CCS, π ; com-	1978→	sibling	
mon soil			
BDI “intention” — homonym via	1987→	no descent claimed	
Bratman			

Table 1: The genealogy at a glance — a view of the evidence ledger. Relations use the ledger’s own vocabulary, not citation links. *Eclipse of the seed: the share of the branch canon’s citers that does not cite the seed cluster (bar drawn at the range’s upper bound). The gradient is the thesis: the research inner circle stays near 42–45%, industry near 80%, and the agents and education canons above 96%. [†]For the industrial frameworks the *attribution* is documented (Akka’s documentation names Hewitt, Bishop and Steiger), while the papers go uncited — the sources are hyperlinks to Wikipedia.

Two further branches matter enough to get their own treatment below: the Scheme absorption and the object-capability fusion. And one trajectory ended. The PLANNER-line languages are gone by about 1980; worlds, intentions and meta-evaluation have no successors under those names; the AI topics drop out of the corpus's top ranks after the early 1980s. Rival formalisms — frames first, then logic programming — took the territory. The paper's home discipline was the first to leave it.

4 Migration and Transformation

The decisive transformation of this genealogy is canonization by pruning. Agha's 1985 thesis (MIT AI-TR-844) and its 1986 MIT Press edition fixed what "the actor model" has meant ever since: actors identified by mail addresses; state change by behavior replacement, the *become* of the formalism; asynchronous communication with guaranteed delivery, expressed as fairness; an operational semantics given by transition relations; and openness, in the words of the thesis abstract: "Abstraction in actors is achieved by a model in which the only observable communications are those between actors within a system and actors outside it. Our model makes no closed-world assumption since communications may be received from the outside at any point in time". None of 1973's per-actor apparatus — the scheduler, the banker, the intention, the monitors, the binding procedure — remains as a primitive, and the AI side is gone wholesale. A doctoral student took a universal theory of computation and cut it down to a concurrency model; the cut gave the model edges sharp enough to prove theorems about. What the literature has cited ever since as "the actor model" is this pruned 1986 object.

The counts record the replacement without ceremony. Of the 4,257 citing works, 2,240 — 53% — cite only the Agha book and neither Hewitt paper. Another 825 cite only the 1977 article, and 638 only the 1973 paper. Nineteen works, 0.4%, cite all three. The populations also differ in kind: the book-only citers come from distributed systems, parallel computing and verification, while the 1977-only citers have multi-agent systems as their top topic. The concurrency community remembers the book; the agents community remembers the 1977 "society of experts" paper; almost no one reads the cluster whole.

Vocabulary migrated with the communities, and meaning did not always travel along. In the agents line, "message" turned into speech acts — KQML, FIPA-ACL — and "intention" reappeared with a different sense and a different pedigree: the BDI architectures take their "intention" from Bratman's philosophy of action. It is a homonym of Hewitt's contracts, not a descendant. Industry, for its part, inverted the canon's delivery axiom. Agha's semantics builds fairness on "the guarantee of delivery"; Akka's

documentation states its general rule as “at-most-once delivery, i.e. no guaranteed delivery”. The mailbox made the crossing; the guarantee did not.

5 The Lost Citation Chain

Citations are evidence of transmission, not its definition, and our method reserves a stage for the traffic that moves off the books. In this genealogy that stage recovers four episodes, and they are the spine of the story.

The first is dated December 1975, two years downstream of the seed. The first Scheme memo, MIT AIM-349 (Sussman and Jr. 1975), opens: “Inspired by ACTORS [Greif and Hewitt] [Smith and Hewitt], we have implemented an interpreter for a LISP-like language, SCHEME, based on the lambda calculus [Church], but extended for side effects, multiprocessing, and process synchronization”. Sussman and Steele had built the interpreter to understand PLASMA, and the memo already records what the exercise taught them: “A clink in a lambda calculus-based interpreter is in fact equivalent to a low-level default continuation as created by the PLASMA interpreter”. The R5RS rationale for proper tail recursion (Kelsey 1998) still tells the story: “Steele and Sussman later observed that in their interpreter the code for dealing with actors was identical to that for functions and thus there was no need to include both in the language”. By the implementers’ own account, the sequential half of the actor model collapsed into the lambda calculus and became anonymous infrastructure: closures, first-class continuations, tail calls. Scheme moved it into the mainstream, helped by the most-taught programming textbook of its era — SICP (Abelson et al. 1985) cites Hewitt 1977, and 96.8% of SICP’s 1,450 citers cite no cluster member. Infrastructure does not cite.

The second episode is the strongest independent rediscovery this series has recorded. Erlang, begun at Ericsson in 1986, is today the canonical industrial “actor language”. Armstrong’s definitive history of it — “A History of Erlang”, 26 pages written for HOPL-III in 2007 (Armstrong 2007) — contains zero occurrences of “actor”, “Hewitt” or “Agha”. The inheritance it declares is Ericsson’s own switching culture (“Erlang was heavily influenced by PLEX and the AXE design”), plus early experiments with Smalltalk and a Prolog meta-interpreter. And the design axiom Erlang added is the one the actor papers lacked: “the failure of a process or of hardware should only influence the immediate transaction involved and that all other operations in the machine should progress as if no failures had occurred”. That came from telephony practice, not from the literature; links and supervision trees followed from it. Co-designer Robert Virding put the matter on the record in 2014 (Virding 2014): “I think it is very lucky that we weren’t interested in, or worried about, the theoretical aspects,

or that we had heard about the actor model". The 1993 book *Concurrent Programming in Erlang* (Armstrong et al. 1993) does cite the Agha book, but that is association after the design, not influence before it. Erlang converged on isolated processes and asynchronous messages from its own constraints, and the world relabeled it an actor language afterwards. In our method an independent rediscovery is a positive finding, and this is the best one so far: two roads to the same design, only one of them holding the map.

The third episode, from 2008 to 2021, made the name mass-market while skipping the papers. Akka's documentation (Akka documentation 2026) writes: "The Actor Model as defined by Hewitt, Bishop and Steiger in 1973 is a computational model that expresses exactly what it means for computation to be distributed" — and links Wikipedia as its source. Swift Evolution proposal SE-0306 (Swift Evolution 2021), which put the actor keyword into a mass-market language in 2021, introduces the model with a Wikipedia link as well; its prior-art discussion cites Erlang/Elixir and Akka. The technical report on Orleans, the virtual-actor framework (Bernstein et al. 2014), has a reference list of 11 entries and no cluster member among them — a negative confirmed on the report's PDF: its references are the modern satellites, Akka's documentation, Armstrong's 2010 Erlang article in CACM, the E-language paper, with no founding paper in sight. Attribution has become hub-mediated, the same pattern *crdt.tech* and Wikipedia showed in Reports No. 0 and No. 2.

The fourth episode concerns the hub itself. The Wikipedia article that industry links to is one Carl Hewitt could not edit: Wikipedia's Arbitration Committee banned him in 2007, in a case centered on his editing around the actor-model and related articles. He spent part of his late career publishing his own histories of the model instead, the arXiv retrospective of Section 1 among them, and died in 2022. We report this as a fact about institutions, not about persons: the genealogy's main memory institution and its subject were at war, and the version industry uses for attribution is, by the encyclopedia's own rules, not the author's. In this genealogy, who writes the hubs decided who writes the history.

A quantitative footnote says how the founding papers are read when they are cited at all. Of 1,372 Semantic Scholar-indexed citers of Hewitt 1977, the intent classifier marks 406 citations as background, 169 as methodology, and 10 as result — and zero as "influential" by Semantic Scholar's measure. That flag is known to be sparse for older papers, and the zero should be discounted accordingly. It is still a zero.

6 Convergence, Fusion, and Reinterpretation

Convergence first. CSP and CCS grew beside actors, out of the same soil, with documented mutual awareness and separate mathematics. The contacts are already in the 1973 acknowledgements — Milner’s puzzlement over process equality, Hoare’s independent monitors — and there is return traffic: Hoare’s 1978 CSP paper (Hoare 1978) cites the actor line as “actors (Hewitt [1])”, the reference being Atkinson and Hewitt’s “Synchronisation in actor systems” (Atkinson and Hewitt 1977). The π -calculus paper (Milner et al. 1992) answers in kind: its introduction names “the Actors model of Hewitt” as “A well-known model of this kind”, its related-work section grants priority — of the formalisms allowing mobility, “The first was Hewitt’s Actor formalism” — and its citation, like Hoare’s, is a satellite rather than the cluster: Clinger’s 1981 thesis. Milner himself closed the remaining distance at the podium. His 1993 Turing lecture (Milner 1993) cites the 1973 paper and the Agha book — the only place in the process-calculi canon where the citation reaches the trunk — and credits the challenge by name: “Carl Hewitt, with his Actors model, responded to this challenge long ago; he declared that a value, an operator on values, and a process should all be the same kind of thing: an actor. This goal impressed me, because it implies the homogeneity and completeness of expression which we have discussed.” The lecture takes its first step “in the spirit of Hewitt” — all things should be processes — and lists among the calculus’s important tasks a comparison “with Hewitt’s Actors; there are definite points of agreement where we have followed the intuition of Actors and also some subtle differences, such as the treatment of names.” From there the two traditions ran their own semantics — synchronous channels against asynchronous mailboxes, bisimulation against event diagrams — with Clinger’s unbounded nondeterminism as the technical divide that never closed. Our verdict stays siblings for the lineage as a whole, with one documented borrowing on the record: the π -calculus’s one-kind-of-thing ambition answers, by Milner’s own account, a challenge Hewitt posed.

Fusion next. The 1973 paper had claimed actors as “a universal protection mechanism”, building on the capability literature it cites; Dennis–Van Horn (Dennis and Horn 1966) precedes the seed. Three decades later the combination returned. “Concurrency Among Strangers” (Miller et al. 2005), by Miller, Tribble and Shapiro — the defining paper of the E language, with its vats, promises and communicating event loops — cites the 1973 paper directly. The citation record ties the object-capability line back to the seed, and the descent is fusion-shaped: capabilities plus message passing, each older than their combination.

Reinterpretation last. Edward Lee’s “actor-oriented design” (Lee et al. 2003) — Ptolemy and embedded systems; the 2003 paper has 220 citers —

cites the Agha book, but its actors are dataflow blocks with static ports: partial descent, plus a real drift in what the word means. The community citing it sits at 80% eclipse. A word can be inherited like a house, then remodeled past recognition.

7 Decline, Survival, or Canonization

Counted by decade, the cluster's citations read 58, 414, 889, 1,016, 1,436, and 442 so far in the 2020s through 2026 — roughly 50 to 100 per year now, down from the 150–170 plateau of 2014–18. (A caution on the early numbers: OpenAlex undercounts citations from the 1970s and 1980s, so the shape of the curve deserves more trust than the early absolute values.) The shape has two humps: a first one from the late 1990s to the mid 2000s, at the height of the agents wave, and the long 2010s plateau, when multicore, cloud and the reactive movement made mailbox concurrency mainstream. (The per-year series also shows a single-year spike of 238 works at 2002, against 55 in both 2001 and 2004. We flag it as a suspected database artifact — a batch of conference-proceedings records year-stamped 2002 — and lean on the decade totals, which are robust to it. The ghosts of Section 2 come in more than one form.) No other seed in this series has its best decade fifty years out. CRDTs are still on their first rise; Lamport 1978 keeps to a plateau; Simula collapsed. The topics under the curve change in step: AI in 1974–83; logic, programming languages and parallelism in 1984–93; agents plus programming languages in 1996–2006; distributed systems, parallel computing, verification and cloud in 2010–20. Roughly once a decade, the model changed audiences.

Inside the counts, the canonical reference shifted. The Agha book owns the concurrency community's citations — the 53% book-only population of Section 4 — and Agha's 1990 CACM survey (Agha 1990) now serves as a second-order proxy, at 70.7% eclipse. The founding papers persist as monuments, cited as background and rarely as method.

The terminology audit is where this seed departs from its predecessors (Figure 2). "Actor" survived industrially — a rarity in this series, where concepts usually outlive their names. "Mailbox" and "message passing" are in daily use. Agha's *become* lives on inside Akka's API. "Mail address" is gone, displaced by PIDs and ActorRefs; so are "script", "intention", "banker", the per-actor "scheduler", "world", and "actor induction". "Open systems" persists as generic vocabulary, detached from Hewitt's specific usage. And "guaranteed delivery", as Section 4 showed, was inverted by industry. The name outlived nearly everything it once named.

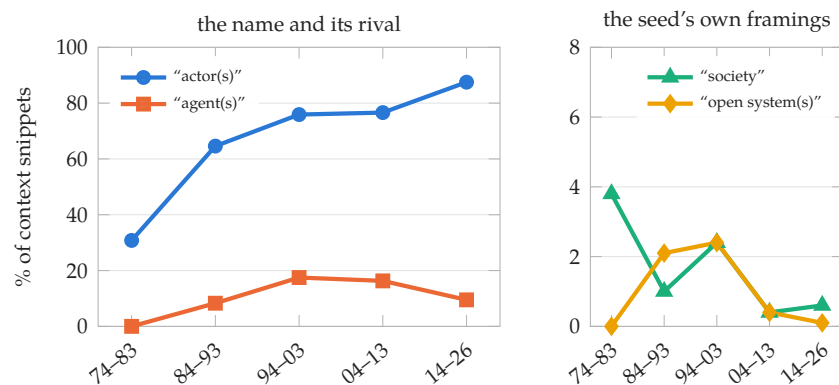


Figure 2: Term survival in the cluster's citation contexts, by era (share of context snippets; 3,239 context records across the three members, with the book's Semantic Scholar record only partially covered). Left: the share of contexts saying "actor" rises monotonically to 87.5% while the 1990s "agent" vocabulary passes through and recedes. Right: the seed's own framings — "society" and "open system" — fall to near zero. The name gains currency as the papers lose citations.

8 The Intellectual Legacy

What remains of the 1973 paper is its concurrency half, twice removed: pruned by the 1986 canonization, then industrialized mostly without the papers. What lasted best is the part no one attributes. Every closure and tail call carries a residue of the actors-to-Scheme collapse; every supervised, share-nothing, message-passing service embodies the design Erlang worked out again from telephone-exchange requirements without reading the actor literature. The unification thesis — everything is an actor — persists only as a style of slogan, in "everything is a process" and "everything is an object"; no system still running is actors all the way down. The AI program died. The protection claim came back as object capabilities. The machine prophecy had its decade, in the J-Machine and CHARM++, and then dissolved into the ordinary vocabulary of "message-driven".

The memory structure is the sharpest this series has mapped. One community, programming-language research, kept citing. Another, theory, kept proving. A third, agents, renamed the territory and left a courtesy citation. Industry kept the name, dropped the sources, and delegated attribution to an encyclopedia its author was banned from editing. And the most consequential implementation reached the same design by another road entirely. The actor model is at once the best-remembered and the least-read seed we have examined: its name is everywhere, its papers nearly nowhere.

The paper asked to be everything. The field kept one thing, and the

one thing is now everywhere. What made the actor model immortal is everything it lost.

Provenance

This report is built on 28 lineage claims recorded in the genealogy’s evidence ledger, all of which passed verification: 11 at documented strength, 17 at strong. The main hedges qualify the narrative as follows. Quotations from the 1977 article come from its MIT memo version (AIM-410), and quotations from Agha from the thesis version (AI-TR-844), not from the published journal and book texts. The two reference-list negatives first taken from OpenAlex indexing were both re-checked on the PDFs: the Orleans list indeed contains no founding paper (it cites the modern actor ecosystem instead), while the π -calculus check overturned the index — the paper cites the actor line through Clinger’s thesis and names Hewitt’s formalism as the first to allow mobility. Quotations from the π -calculus paper come from its technical-report text. The zero “influential” flags on Hewitt 1977 carry Semantic Scholar’s known sparsity for older papers. OpenAlex undercounts 1970s–80s citations, so the reception curve’s early absolute values are weaker than its shape. And the 2002 spike in the per-year series is treated as a database artifact, not a finding. Citation data from OpenAlex and Semantic Scholar as of 2026-09-07. Branch membership in Section 3 is established at survey depth, not by full-text reads of every member. The full research notes, data pulls, and evidence ledger accompany this document as research provenance. Margin ledger references can be rendered by compiling with the provenance option.

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